MANAGEMENT OF RISKS IN OIL AND GAS PROJECT

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MASTER OF SCIENCE
(PROJECT MANAGEMENT)

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A dissertation project submitted in partial fulfilment of the requirement for the degree of
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ABSTRACT

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Thien Kwok Nam

Risks in oil and gas construction project often cause time and cost overruns. The cost incurs in oil and gas industry is relatively large compare to others. This risk management research study on EPC project in Oil and Gas industry is very important to the EPC contractors and even the crude oil exploration and extraction company. The research includes identify, assesses and manage the risks.

The top five identified risks are incompetent of project team, design change, improper project feasibility study, economic and financial crisis, insufficient and poor performance of contractors. These risks are proposed with control and monitoring strategy which are control, avoidance, assumption or transfer. Apart from that, few control measures are proposed as guidance for risk management in EPC oil and gas project which are time consuming.

In summary, a risks control summary table is developed by doing the research of identification, assessment and evaluation of the top risks of the EPC projects. Project stakeholders are able to identify the preventive actions which need to be taken for managing the risks. This also can shorten the time for the project team in planning stage and able to focus on the project execution stage.

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APPROVAL SHEET

This dissertation entitled "MANAGEMENT OF RISKS IN OIL AND GAS PROJECT" was prepared by THIEN KWOK NAM and submitted as partial fulfilment of the requirements for the degree of Master in Science (Project Management) at Universiti Tunku Abdul Rahman.

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Date: 05/05/2016

SUBMISSION OF DISSERTATION

It is hereby certified that **THIEN KWOK NAM** (ID No: **11UEM05837**) has completed this dissertation entitled "MANAGEMENT OF RISKS IN OIL AND GAS PROJECT" under the supervision of Mr. Lim Chai Chai from Institute of Postgraduate Study and Research, Faculty of Engineering and Science.

I understand that the University will upload softcopy of my dissertation in pdf formant into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

_____

(Thien Kwok Nam)

DECLARATION

I THIEN KWOK NAM hereby declares that the dissertation is based on my original work except for quotations and citations which have been duly acknowledged. I also declared that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

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(THIEN KWOK NAM)

Date: 05/05/2016

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CHAPTER 1

INTRODUCTION

Due to country development and economic growth, the energy consumption is more than doubled compare to ten years back (IEA, 2010). The global crude oil utilisation is increasing by 1.5 million in year 2016, increasing of producing of crude oil are required to meet the demand. National Bureau of statistic stated that global gas consumption hit 88700 million m^3 and crude oil utilisation 380 million tonnes (True, 2012). The exploration and production of oil are necessary due to the high demand in the industry and society (Pasternak, 2007). Process equipments are largely used in the exploration and production of oil. Process equipments include pressure vessels, heat exchangers, storage tanks, filters, coalescers and skids package. Pressure vessel is a close tank which designed to containerise liquids or gases at different pressure value from the ambient pressure. The pressure can be up to 100-200 bar depend on the process requirement. They are used in a variety of applications in the O&G industry. Most of them are used in mining operations, oil refineries, petrochemical plant and hydraulic reservoirs. Constructions of process equipments are getting high demand due to the global Enhanced Oil Recovery Project and replacing/maintenance of existing oil plant.

Most of the constructions of process equipments are delivered in a general way which is Engineering, Procurement and Construction (EPC) project (Li, 2012). The processes of fabrication of the process equipments are included designing according to project specification, procurement of materials for construction and construction of the pressure vessels according to approved drawing (Davis & Choi, 2012). The

contractor will take responsibility of supervising cost, schedule, quality and safety of the project. The contractor normally will take more risk as getting more commitments.

Projects are exposed to both external and internal risks. Internal risks which include finance, construction, parties involved, contract, and operation risks. External risks are committee, law and environment, economic, social, political and logistic risks. Quality, schedule and cost of project will be influence by the risks negatively (Yeh & Charoenngam, 1999). Hence, risk management shall be well recognised and managed as an integrated function in project management.

The risk management must adopt in the early stage of project. However, risk management requires a logical and systematic process (Leung, 2008). There is a need of positive mind set, become not reactive and accept the great responsibility for continuous enhancement. Risk management is the process methodology of identify, analyse and react the risk accordingly. It is increase the occurrence and impacts of good events and decrease the occurrence and impacts of negative event which differ from project objectives (Ansell, 1992). Risk management can be categorized into three steps: (a) Identification of potential project risk. (b) Determination of the probability of risk occurrence as well as determination of the consequences. (c) Risk closure plan developed to bring all identified risks down to low levels, but not necessary eliminate them (Chapman, 2001).

1.1 Problem Statement

Risks in oil and gas construction project often cause time and cost overruns. Most of the project manager who could not manage risk efficiently, causes the delay of project or beyond their planned budgets. Due to emerging nature of economy, these problems used to happen more frequent these days. Projects today are more risk exposure and uncertain due to aspects such as design and engineering complication,

existence of different interest organisations, resources availability, climatic environment, social concerns as well as economical and political statutory requirement.

Malaysia produces 1.63million barrel of crude oil per day (Evans, 2011). Delays of the fabrication of the process equipments may cause delay of the commissioning to the plant, hence, tentatively cause the delay of the production of crude oil. One day delay of the production will cause million dollar lost to the crude oil producer. Hence, close monitoring of the EPC of the process equipments are necessary to prevent losses to the end user (William, 2004).

Most of the crude oil producer avoid the delay of oil production in their plant by introducing liquidate damage in the contract or purchase order agreement of the construction of process equipments (Shrank, 2009). This mean that the contractor or fabricators need to pay for the losses incur by the oil producer due to late delivery of the process equipments. Nowadays, many of the contractors are getting more concern on managing the project efficiently and effectively, by reduce the risk and increase profit (Li, 2012). Deliveries of process equipments on time by managing the schedule risk are necessary to avoid breach of contract in term of liquidate damage.

The risk with project cost and schedule is the possibility that a critical materials required in the project are not made available in the time-frame given, or the technical/engineering risk will cause a bad impact on the project. Depending upon the circumstances, risk can be merely an annoyance, or possibly have a catastrophic impact on the project.

Risk management on the cost and schedule performance is necessary at the early stage of the project to avoid impact of the project schedule and budget at the later stage. During planning stage, the risks that will impact project on different stages (Engineering, Procurement, and Construction) needed to be identified, assessed and managed properly (Baccarini & Arfcher, 2001; Williams, 1993).

Most of the risks might occur in different stage of the project such as: Contract stage, Engineering Stage, Procurement Stage and Construction stage (Zheng & Shuibo, 2011). EPC contractor would like to find out or identify the risks in each stage that need to be focus and avoid it during project execution. Besides that, they might need to know the probability and consequences of the each risk to the project performance. Finally, they would like to find out the way to manage the risks in the area more efficient and effective.

1.2 Aims and Objectives

The aim for this research study is to indicate risks factors that impact the O&G construction project and determine risks response. The objectives of the research study are:

1. Assess the identified major risks affecting the O&G construction project
2. Propose appropriate strategies and control measure to efficiently control and monitoring the top five risks.

1.3 Scope and Limitation of Research

The scope of this research study is to develop a risk control summary table in construction of process equipments for oil and gas industry in Malaysia. This includes identification of risks in the project which may impact the project delivery date and cost overrun. Besides that, the identified risks will be assessed the probability and consequences for the project health. The identified risks will be prioritized in the risk matrix form. Lastly, the risk control plan will be develop to manage all the risks according to their priority.

The limitation of the research is that there are limited journal and newsletter regarding risks in Malaysia Oil and Gas Project which available for reference. There are major variations on the Oil and Gas readings compare to those readings published

30 years back. Besides that, the research requires involvement of professional in the industry. It is anticipated that there will be some pull back from them to participant in the interview and questionnaire due to their tight schedule. They might not able to allocate too much time for the interview, hence in-depth or details thought from the respondents might be limited for the research.

1.4 Significant of Research

This risk management research study on EPC project in Oil and Gas industry is very important to the EPC contractors and even the crude oil exploration and extraction company. It tentatively benefits the crude oil consumer by ensuring the production continuity of crude oil availability at all time. As long as there is demand on the fuel oil, there will be continuous exploration of crude oil.

The research shall benefits to the industry by ensuring the project owner and contractor able to identify, assesses and manage the risk effectively and efficiently. The identification and assessment of the risks at project planning stage can alert the project owner and contractor on the major risks that may impact the success of project. By doing so, they can manage the risks successfully by applying the essential risk control method. Besides that, this research shall give a clear image to the project owner which risks area they need to pay more attention, such as procurement, manufacturing, logistic, design and etc. In this research outcome, project owner also may identify the risks that they never faced before in executing their project. The problem never happened in the past project does not mean it will not happen in future project. It is better to prevent than cure. By applying risk management in the project planning stage, project owner able to ensure the project success by deliver the project on-time and within budget. This can increase profit and improve reputation to the project owner as well.

1.5 Method of Research

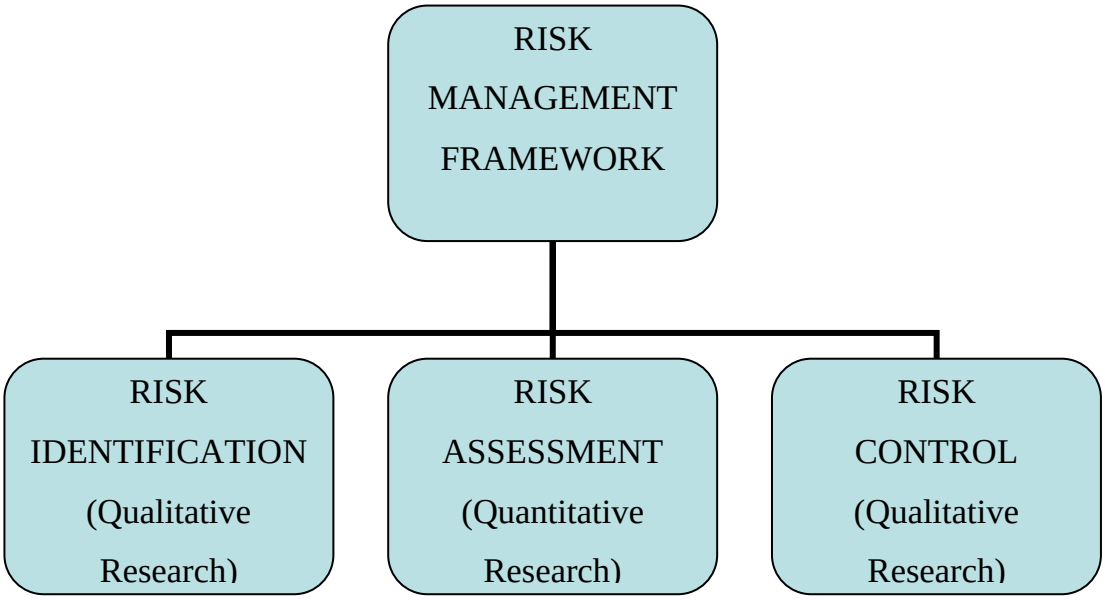


Figure 1.1: Risk Management Framework

1.6 Dissertation Structure

For this dissertation, chapter one will be the introduction. It will introduce the topic, the subject, problem statement, aim and objectives, and method of research.

Chapter two will be the literature review. This chapter reviews the literature and identifies the knowledge base that we have and gap between them.

Chapter three will be the research methodology. This chapter provides review of methodological dealing with data collection and data analysis.

Chapter four will be the finding and discussion. It analyses the subject under investigation referring to collected data. It also splashs all findings gain from the research. It discusses the findings in the context of the literature review and finding from the collected data.

Chapter five will be the conclusion. This chapter summarizes the objective and major finding, provide suggestion on the findings for both theoretical and practical, and acknowledge the limitation of the work and subjects need to be focus for advance research.

CHAPTER 2

LITERATURE REVIEW

2.1 Project Risk Management

Risk is thought as the mixture of the likelihood of an occurrence and its impacts (BSI, 2002). Under some circumstances, risk comes from the likelihood of deviation from the expected final results or occurrence but it is normally used only once there reaches least the likelihood of negative consequences. In quantitative engineering term, risks defined as the "(Likelihood of an incident) x (losses of incident)" (Agrawal, 2009)

Besides that, risks thought as the "aftereffect of doubt on objectives". An impact is a deviation from the expectation either positive or negative. Objectives can have distinct aspects (such as financial, safety and health, and environmental targets) and can apply at different levels (such as strategic, organization-wide, project, product and process) (Standards Australia/Standards New Zealand, 2009). Risk is usually defined by reference to potential events and consequences or a combination of these.

Risks is involved in the essence of all projects and zero risk projects tend not to generate attraction to follow because of the fact that facing with risk is a major factor to bring in desirable benefits in return for ventured resources. Undertaking

hazard may be thought as threat or opportunity (Chapman & Ward, 2003) which affects time, cost, quality, efficiency and productivity of the project (Kangari, 1995).

Project risk is an uncertain event or condition that, if happens, will impact on project objective. A risk may have one or more causes and, if it occurs, it may have one or more impacts. A cause can be regarded as an assumption, condition, constraint, or a demand that makes the likelihood of negative and positive outcomes, and project objectives consists of time, cost, quality, resource and scope (PMI, 2008).

Project Risk Management includes of the processes of conduct risk management plan, identify, analysis, response plan, and monitor and control on a project. The objectives of Project Risk Management are to improve the probability and consequences of beneficial occasions, and reduce the likelihood and impact of negative events in the project (PMI, 2008).

The objective of applying risk management is not to eliminate all of the risks from the project, but it is to ensure all risks are managed effectively (Thompson and Perry, 1992).

The main element purpose involving project risk management is to identify, assess and manage the risks towards a successful project. Time overrun is one of the success standards to measure the project achievement (Baccarini & Arfcher, 2001; Williams, 1993). Risk management generally refer to the procedure involving minimizing risks which considered endurable by society and to assure control, monitoring and public communication (Ortwin Renn, 1998). Risk management is also the process by which management decisions are made about controlling and minimizing danger and accepting residual risks (Briscoe, 1977). The main goal of risk management is to keep the risks at an acceptable level by maintaining the endurable risk and following a program to maneuver unsatisfactory risk to an acceptable level (Alena, 2004). Common risk management process is generally organized into three steps: risk identification, risk assessment and risk mitigation (Bode and Wagner, 2009; Kleindorfer and Saad, 2005; Tang, 2006).

According to PMBOK, risk management's purpose is to enhance the result and probability regarding good risks and decrease them for negative risks. It is not only eliminating failure, nevertheless to create concerning opportunities. Risk management includes four main processes in PMBOK theory. These are risk management planning, risk identification, risk assessment, and risk monitoring and control.

2.1.1 Risk Planning

Risk Management Planning is to choose the best way to execute the risk management activities of a project. The level of risk management is decided because it needs to be in line with the risk and significance about the actual undertaking all together. Most of these approaches can be properly allotted at this stage. Risk Planning is usually the last undertaking project management process to get finished during the planning phase as the overall plan and scope are needed to find out where risk management tasks can be allotted. The goal of risk planning is to determine the way of the overall risk management will be conducted for the project. The time required, the role & responsibilities, and template forms of the reports should be all established in this process. Once the preliminary work is done, identifying, analyzing, and adjusting for risks may be accomplished.

2.1.2 Risk Identification

There are numerous techniques and skills, such as Delphi techniques, brainstorming, questionnaires, case studies and interviews to develop risk identification and classification (Chapman, 2001). The objectives of risk identification are to identify the risk factors as well as the significant of those risk factors (Shen, 1997).

The objective of determining the source of risks is to steer clear of the events that can go wrong as well as result in project failing (Redmill, 2002). Risk identification is an iterative process because new risks may be known as the project progresses through the project life cycle. Therefore, it truly is beneficial to utilize extra approaches to risk identification. Combination of appropriate techniques for risk identification ought to be used (Hillson, 2002). Risk identification must stick to a holistic approach (Buhman, 2005), screening regularly to first signs regarding potential risks.

It is important to realize that just risks that recognized with the initial step could be assessed as well as managed in the subsequent process (Berg, 2008). Hence, these qualities of the risk identification activities are important for the overall risk management process. Only occasions which are identified as risk could be looked at for probable to harm the project.

There are few strategies or techniques when determining project risks. Among the strategies could be the scenario based tactic. The tactic requires utilizing imaginative brainstorming though to think of positive and negative risks inside the scope of the project. Besides that, technique to determine risks in a project would be the relative experiences strategy. Risks are determined by relating past projects, experiences and tweaking them to fit the scope of the current project. The third risk identification strategy is objective based scenario. This strategy follows the same ideas as the scenario tactic and the relating past experiences strategy, but instead of making up scenarios or using past experiences, risks are determined based on goals and wanted results for the project. Such tactic is ideal along with finding the positive risks in a project versus the negative risks.

2.1.3 Risk Assessment

Risk assessment is the methodical process of denoting the particular components of risk in precise, usually in quantitative or qualitative term. The goal of

risk assessment is to measure the consequence and impact of the identified risks in the project. There are a plenty of risk assessment skills such as Failure Mode and Effects Analysis, Monte Carlo Analysis, Program Evaluation and Review Technique and Fault Tree Technique. Risk assessment can be carried out quantitatively, qualitatively or semi-quantitatively as outlined by available data (Ebrahimnejad, 2007).

Qualitative risk assessment relies upon objective viewpoint in addition to experiences. New project managers should seek out lessons learned from the organization's knowledge management system or get input from experienced Project Managers. There are numbers of qualitative risk analysis techniques available such as brainstorming, structured interviews/questionnaires, evaluation applying multi-disciplinary group and specialist and expert objective viewpoint.

For a qualitative analysis, an example below using a five point scale for probability (1 to 5) and a five point scale for Impact (1 to 5). A particular risk's probability and impact is then combined via a five-by-five matrix to give an estimated level of risk of Extreme, High, Moderate or Low.

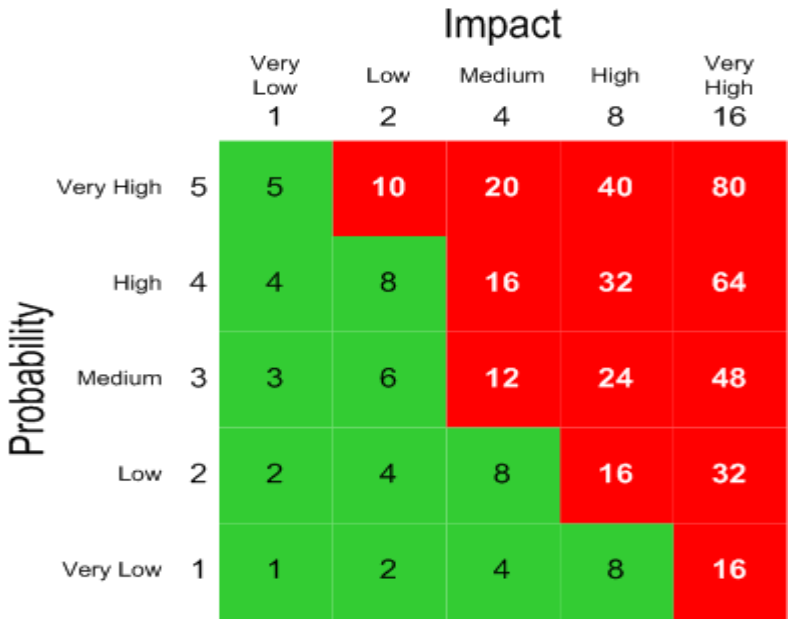


Figure 2.1: Risk Matrix

Red = Not acceptable. Time, money and effort must spend on a response. This is likely to be at the level of the individual risk.

Green = Acceptable. Ignorance shall be avoided.

Quantitative risk assessment would be the handy formula to identify the rank of a risk. The formula needs two variables, one for the possibility of the risk to take place and one for the consequences of the risk if it did happen. There are four quantitative risk analysis techniques which are three point estimate, decision tree, Monte Carlo simulation and heuristics (rules of thumb). For decision tree analysis, there are in the form of a flow diagram where each node, represented by a rectangle, contains a description of the risk aspect and its cost. These rectangles are linked together via arrows. Each arrows lead to another box representing the percentage probability. These totals are calculated by multiplying the risk costs by the probability and adding that value to the initial cost. Monte Carlo analysis is determined by mean of computer by comprehending quite a few examples for the project and calculating the impact of particular the risk events and is helpful in identifying risks and the effect they have on the project schedule.

The outcome of the risk assessment activities needs to provide a classification of all identified risks and put them in prioritizing order. Graphical illustration can help to map risks in an appropriate way and show where, when, and with what likelihood and impact risks might occur (Hallikas, 2002; Harland, 2003; Manuj and Mentzer, 2008; Matook, 2009).

The specific understanding of any identified risk through an in-depth assessment process is thus requires to initiate the correct mitigation activities as prevention or once it occurs. For the mitigation to be effective and well suited for the particular risk, comprehensive knowledge of the sort of risk, its sources and possible impact is critical.

The identified risks are needed to be evaluated. There will be a list of risks throughout main concern rank. We should instead come to a decision if the risk is

actually satisfactory as well as not necessarily. Negligible risks will be recognised, intolerable risks will be treated. Between these extremes lies a band that requires cost-benefit evaluation. High in the band, risks will only be accepted in case the cost of treating them is too great, low in the band risks will only be treated in the event that the benefit is greater than the cost.

2.1.4 Risk Control and Monitoring

The identified and assessed risks need to be control as well as monitor. There are four essential strategies which work well in managing and control risks, which are control, avoidance, assumption and transfer (DOD, 2001).

Risk mitigation pursuits try and reduce the probability regarding risk occurrences as well as reduce the negative impact of an occurred risk (Tomlin, 2006).

The “Assumption” risks managing strategy is means for simply accepting the risk and proceeding. However, there can be a tendency within organisations to gradually let the assumption of a risk take on the aura of a controlled risk.

The “Avoidance” risks managing strategy is means for use an alternative approach that does not have the risk. The mode is not always an option. There are programmes that deliberately involve high risks in the expectation of high gains. However, this is the most effective risk management technique if it can be applied.

The “Control” risks managing strategy is controlling risks involves the development of a risk reduction plan and then tracking on the plan. The key aspect is the planning by experienced persons. The plan itself may involve parallel development programmes.

The “Transfer” risks managing strategy is means causing another party to accept the risk, typically by contract. Liability among projects is often transferred this way.

2.2 EPC contract

There are varieties of modes for international engineering construction. EPC (Engineering, Procurement, and Construction) is one of the project contracting modes which are widely used in recently. Under an EPC contract, the particular contractor will design and style the particular installation, purchase the materials and construct it, either through own labour or by subcontracting part of the work. The contractor carries the project risk as well as budget in return for a fixed price, called lump sum depending on the agreed scope of work.

EPC contract happen to be main stream model in the construction market; it also has become aside for about any domestic contract or to win contract in construction market. In EPC model, the application of supply and critical chains may heighten efficiency of engineering procurement.

The EPC contract starts from the bidding for engineering project procurement and ends in the signing of the main contract. Major function on this phase contains enquiry for equipments and materials to become essential in accordance with bidding documents, obtaining procurement quotes and participating in bidding, business negotiations and signing contract in the end (Zheng & Shuibo, 2011).

The leading motives that oil company utilize the EPC contract is because the contractor should get the entire accountability and responsibility for the delivery. It is time efficient due to Engineering and Construction is carried out throughout parallel. Besides that, the company desire a more compact project team in order to control the projects. There are disadvantages on EPC contract which is there are requirement that the contractor to acknowledge major risk. The high risk adverse behaviour leads

to high premiums being incorporated in tender prices. In addition, massive contractor makes the market segment vulnerable to capacity problems and insufficient competition.

EPC contracts tend to handle problems with greater sophistication. EPC contracts provide a sole level connected with responsibility which means that the contractor is responsible for all design, engineering, procurement, construction, commissioning and testing activities. Therefore, the project company only need to look for one party to fix the problem and provide compensation if any complications happen. Subsequently, when the contractor is a consortium comprising several entities the EPC contract must state that those entities are jointly and severally liable to the project company.

EPC contracts also provide a fixed contract price. Possibility involving cost overruns and also the benefit of any cost savings are classified as the contractor's account. The contractor usually has a limited ability to claim additional money which is limited to circumstances where the project company has delayed the contractor or had ordered variations to the works.

On top of that, EPC contracts provide a fixed completion date. EPC contracts include a guaranteed completion date that is either a fixed date or a fixed period after the commencement of the EPC long term contract. When this kind seriously is not fulfilled, the contractor is liable for delay liquidated damages. It is made to compensate the project company for lose and damage suffered as a result of late completion.

Besides that, EPC contracts provide minimal risk for client. It gives the maximum optimised risk to the client, because almost all of the EPC contracts are offered by the client based on performance bank guarantee by the EPC contractor, so there is itself the risk of the client will be reduced maximum and also the contract terms will be very specific with the contractor's scope of work, roles and responsibility of the contractor which is linked in to financial terms. In case of non-

performance or lack in performance will affect EPC contractor first and then only affect the client.

2.3 Schedule Risks in EPC project

Biding documents of EPC engineering project vary from one country to another, from project nature to project nature and from one design concept of consulting company to another. There are differences in standard for specified equipments and materials, such as British Standard, Japanese Standards, and etc. If the personnel lack sufficient experience with various standards while bidding, the construction tends to be rejected by supervising engineers in implementation process because of non-conforming standards. This gives a large impact on the project schedule during execution stage (Chen & Lu & Wei, 2008).

There is risk in purchasing sources in EPC project. There will be an Accepted Vendor List (AVL) attached to the bidding documents of common engineering EPC project. Contractor required to inquiry the materials within the scope of this checklist. With custom made materials, there will be require longer time for the delivery of the materials or equipments.

There may be variance between the understandings of the engineering personnel of contractors and the design concept of employer. This variation may extend the time for design document compiling, employer review and final approval. If the procurement design is the key period of the project, the variation may well drastically influence pursuing procurement also construction activities, and cause changes in time limit of the project (Lou, 2009).

Models and types of equipments and materials needed by EPC project are numerous. Supplier sources are complicated and numerous and the delivery cycle is usually lengthy. There is a high probability of risk in supply in this process and the risk may cause great damage and significant affect the time limit of project. Risk in

suppliers' supply includes out-of-time supply, quality defect, flaw not detected by outgoing inspection, inability to provide spare parts, imperfect field technical service, out-of-time after-sale service, failure of delivery documents to meet employer requirement and so on (Manavazhi & Adhikari , 2009).

Logistic and transport is a link which affected mostly by outside environment in EPC engineering project and a period in which risks simply happen. Contractor needs to pick unique shipping method to ensure the smooth arrival of materials in the fastest and economic way. Because of lack of strong exploration on local law and regulations, import and export procedures, selection of port, or forwarder lack experiences and strength, equipments and materials may stranded at port due to long custom clearance; equipments and materials are often damaged due to shipping method, transport route and transport life cycle (Manavazhi & Adhikari , 2009).

2.4 Risks element in oil and gas project

The oil and gas project is subject to risks in the function of finance, compliance, operational, strategic and etc.

2.4.1 Competency of project team

Most of the oil and gas projects are afraid of existence of incompetent team member works in the project. When there is existence of incompetent of member in the team, this will impact the success of the project in term on cost, schedule and quality. Apart from that, it will burden the other team members because the more competent player may have to take on additional work. When competency shortfalls are in the behavioural realm, emotion based interpersonal conflict and misunderstandings sap team energy which will eliminate the team work effort in the team. Incompetence of team member in influential positions can cause poor decisions which lead the team into misguided direction. Competence are hardly to

measure such as behavioural/ relationship competencies, emotional intelligence, thinking skills, concentration, mindfulness and self-awareness.

2.4.2 Internal approval process from the owner

In the life cycle of oil and gas project, there are bundles of procedures and documents need to be followed and approved by the owner before works can be carried out. There is a rare case where the owner will review and approve the documents within a week time. This is a common cause of delay because the owner usually have specific dates on which they convene, so the submission need to schedule accordingly in order to avoid delaying the process. Delays caused by the owner are difficult to control. Hence, proper planning and monitoring of project schedule requires ensuring the project run smoothly without obstruction from the owner in term of documents approval.

2.4.3 Inadequate project organisation structure

There are three different types of organisational structures which are functional organisational structure, matrix organisational structure and projectised organisational structure. Inadequate implication of organisation structure provides major impact to the success of the project.

In a functional organisation, projects that exist within a single functional division generate no organisational issues, but projects that cut across functional divisions can be a challenge to the project. The project manager has no direct authority and must obtain continual cooperation and support from functional managers of other division in order to meet project objectives and this can be complicated.

In matrix organisational structure, it gives authority to both the project managers and functional managers. The outcome is to provide more seamless division of labour and ultimately to build a stronger team culture. However, the potential of conflict between project manager and functional manager still exists because there is still resource conflict which everyone has two bosses (Project manager and functional manager).

In projectised organisational structure, the authority is centralised. Lines of communication are shortened because the projects remove the resources from functional divisions. These factors enhance the ability to make swift decisions. Project teams able to develop a strong sense of identity which in turn creates a high level of commitment from team members. Due to their involvement in consecutive projects of similar nature projectised organisations can develop and maintain a long-term body of experience and skills in specific areas. It is clear that projectised organizations make it easier to run projects because the entire structure is set up for that purpose. Communication, conflict resolution and team building will be key to project success.

2.4.4 Project planning and budgeting

At the initial stages of project planning, budgeting is the determination of costs associated with the defined activities. Statistics tell that over 85% of projects go over budget. There are several reasons for the project cost overruns. It shall understand that cost overruns do not just suddenly happen. In fact, it happens all the time, every day in every phase, mostly in small incremental chunks. Accurate estimation of project budget is probably the most obvious culprit for causing project cost overruns. Project estimators might perform the budgeting in hurry and overly optimistic. They might miss out some important elements which involve huge amount in the budget. Some of them are relies a little too much on gut-feel without documenting and qualifying their numbers can also cause estimating snags.

2.4.5 Project feasibility study

Feasibility study is an analysis of the ability to complete a project successfully, taking into account legal, economics, and technological, scheduling and other factors. Rather than just diving into project and hoping for the best, a feasibility study allows project managers to investigate the possible negative and positive outcomes of a project before investing too much time and money. A feasibility study needs to be completed as early in the Project Life Cycle as possible. It evaluates the project's potential for success; therefore, perceived objectivity is an important factor in the credibility of the study for potential investors.

In oil and gas project, feasibility studies are important risk assessment tools, influencing company decisions regarding if and how to pursue the project. They also serve as a stepping stone toward optimizing a project once it's started. Accurate and timely feasibility studies become increasingly important in oil and gas industry as market instability begins to have a great effect on long term exploration, production, distribution and maintenance costs. It involves the appraisal of several alternatives processes and designs and end with the most promising selection for business consideration and potential development. In these initial phases, profitable concepts are identified, and screening or process design studies are performed.

2.4.6 Government Interference and change in law & Regulations

Political factors refer to issues at the national level and regional level including inconsistency in policies, laws and regulations, and political instability. These factors contribute to an environment of uncertainty on return of capital investment. In most of the instances, the probability of occurrence of political factor is small but its impact is relatively large. Political instability coupled with underdeveloped institutions and lack of awareness in the people may result in frequent change of governments or stimulate abrupt change of policies adversely affecting the successful achievement of project objectives.

Legal factors refer to unexpected changes in government policies pertinent to laws and regulations and currency conversion; absence of appropriate regulatory systems; rate and methods of taxation including customs, royalties, and convertibility of currency. Researchers attributes the legal challenge to the change in any legislation or agreement set by the government related to issues such as taxation, pricing, royalties, ownership, fund remittances, process regulation and environment issue.

2.4.7 Economic and financial crisis

The global economic crisis was triggered by the financial crisis, took a dramatic turn for the year. Financial difficulties caused by plugging asset values have curtailed sharply the ability and willingness of banks to lend money, which is impeding investment, undermining consumption and paralysing economic activity. There has been a steady stream of announcements of cutbacks in capital spending and project delays and cancellations, mainly as a result of low prices and cash flow. Most of the bankers/lenders take long time to evaluate the potential of the project before they approve the loan. Most of the lender will question and request additional documentation throughout the loan application process.

The economic and financial crisis will impact the oil and gas project in relative to the increase of the materials, equipments and consumables price. With the absence of capital and support from financing sector due to bad economic, supplier faces difficulty in securing materials from manufacturer; hence cause delay in material delivery. Apart from that, manufacturer might slow down their production line for cost cutting purpose which causes lack or shortage of materials in the market.

2.4.8 Contractor management

Contractor management is the managing of outsources work performed for an individual company. Contractor management implements a system that manages contractor's health and safety information, insurance information, training programs and specific documents that pertain to the contractor and the owner client. Risk increases with the loss of control from outsourcing work. Outsourcing the works reduces the amount of control held over these aspects. While contracts and agreements can be set in place to control the end product, the Owner client cannot have complete assurance that their requirements are being met. Companies need to have full visibility into the quality of work their hired contractors have performed in the past and are performing now, and this often proves difficult.

There is negative impact on the project when having poor contractor management system to monitor contractor performance. Inadequate coordination among contractors will also impact the successful of project. There should be prequalification process for the selection of qualified contractor in the job. Successful contracts awarded not only look into the lowest price, but also look onto other aspects such as the knowledge and experience of the contractor in the project. It will be an added advantages if the contractor focus on continuous improvement to simplify and fasten their work by implementing new technologies.

There are two major considerations when managing contractors. First is deciding on the criteria for evaluation and second is developing an effective management process to evaluate these criteria. There are number of criteria on which a contractor's can be evaluated, such as historical and future trend information.

2.5 Qualitative Research

Qualitative research is primarily exploratory research. It is used to gain an understanding of underlying reasons, opinions, and motivations. It provides insights

into the problem or helps to develop ideas or hypotheses for potential quantitative research.

The data collection approaches for qualitative research usually involves either direct interaction with individuals on a one to one basis or direct interaction with individuals in a group setting. Qualitative research data collection methods are time consuming, therefore data is usually collected from a smaller sample compare to quantitative approaches. The benefit of the qualitative approach is that the information is richer and has a deeper insight into the phenomenon under study. The main methods for collecting qualitative data are individual interviews, focus groups, observations and action research.

Interviews can be unstructured interview, semi-structured interviews or structured interview. Unstructured interviews can be referred as ‘depth’ or ‘in-depth’ interviews. The interviewer may just go with the aim of discussing a limited number of topics, sometimes as few as just one or two. The interviewer may frame the interview questions based on the interviewee and his previous response. This allows the discussion to cover areas in great details. They involve the researcher wanting to know or find out more about a specific topic without there being a structure or a preconceived plan or expectation as to how they will deal with the topic.

Semi-structured interviews are sometimes also called focused interviews. A series of open ended questions based on the topic areas the researcher wants to cover. A series of broad questions to ask and may have some prompts to help the interviewee. The open ended nature of the question defines the topic under investigation but provides opportunities for both interviewer and interviewee to discuss some topics in more detail. Semi structured interviews allow the researcher to prompt or encourage the interviewee if they are looking for more information or find what they are saying interesting. This method gives the researcher the freedom to probe the interviewee to elaborate or to follow a new line of inquiry introduced by what the interviewee is saying.

For structured interview, the interviewer asks the respondent the same questions in the same way. A tightly structured schedule is used. The questions may be phrased in order that a limited range of responses may be given.

Qualitative interviews should be fairly informal and participants feel they are taking part in a conversation or discussion rather than in a formal question and answer situation. A good quality qualitative research involves thought, preparation, development of interview schedule, and conducting and analysing the interview data with care and consideration. Once data collected, the information has to be organise and though about.

Identifying and refining important concepts is a key part of the iterative process of qualitative research. Sometimes, conceptualizing begins with a simple observation that is interpreted directly and then put back together into more meaningful term. The focus in the conceptualization is to provide a detailed description of what was observed and a sense of why that was important. The data was categorised by looking into details its properties and how they relate to each other.

2.6 Quantitative Research

Quantitative research is the systematic empirical investigation of observable phenomena via statistical, mathematical or computational techniques. The objective of quantitative research is to develop and employ mathematical models, theories and/or hypotheses pertaining to phenomena. The process of measurement is central to quantitative research because it provides the fundamental connection between empirical observation and mathematical expression of quantitative relationships. Quantitative data is any data that is in numerical form such as statistics, percentages, etc.

Quantitative research is more reliable and objective. It can use statistics to generalise a finding. It is often reduces and restructures a complex problem to a limited number of variables. Quantitative research looks at relationships between

variables and can establish cause and effect in highly controlled circumstances. It allows testing theories and hypotheses.

Questionnaires are a method used to collect standardised data from large numbers of people. They are used to collect data in a statistical form. Researchers usually use questionnaires or surveys in order that they can make generalisations; therefore, the questionnaires are usually based on carefully selected samples. Questionnaires consist of the same set of questions that are asked in the same order and in the same way in order that the same information can be gathered.

There are various ways to analyse the data in quantitative research. Statistical Package for the Social Sciences (SPSS) is a widely used program for statistical analysis in social science. Cronbach's alpha in SPSS is the most common measure of internal consistency or reliability of sets of data. A commonly accepted rule for describing internal consistency using Cronbach alpha is as follows, though a greater number of items in the test can artificially inflate the value of alpha and a sample with a narrow range can deflate it. A commonly accepted rule of thumb for describing internal consistency as follows:

Table 2-1: Internal Consistency

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Apart from that, Pearson's chi square test in SPSS is used to discover if there is a relationship between two categorical variables. It is suitable for unpaired data from large samples. It tests a null hypothesis stating that the frequency distribution of certain events observed in a sample is consistent with a particular theoretical

distribution. A desired level of confidence (significant level) of 5% is commonly selected. Accept or reject of null hypothesis is based on whether the test statistic exceeds the critical value X^2. If the test statistic exceeds the critical value of X^2, the null hypothesis (H_0 = there is no difference between the distributions) can be rejected with the selected level of confidence and the alternative hypothesis (H1 = there is a difference between the distributions) can be accepted with the selected level of confidence.

CHAPTER 3

Research Methodology

3.1 Survey Design

In the first stage of the research, it was designed in such a way to gather the opinions of the professional and non-professional in Malaysia Oil and Gas Company in regards to the risks that may affect the successful of the project in term of cost, time and quality. The information was first collected through direct personal investigations from literature review and unstructured interviews were adopted to identify the risks which will impact the oil and gas construction project. A total of 30 risks identified from the literature were tested with targets of 50 professional and non-professional through unstructured interview.

3.2 Risks Assessment (Quantitative Research)

3.2.1 Introduction

In the second stage of the research, survey design which defined as a quantitative research is adopted to assess the acknowledged risks. The questionnaire for data collection was designed based on the research objectives. This study was targeted on the personnel who worked or involved in O&G constructions projects in Malaysia. These kind of closed-ended questions were several option sorts. A survey format was

utilized due to the large number of Oil and Gas Company, along with problems of professionally job interview.

3.2.2 Population and population size

The population of the survey was made of all professional and non-professional who working in Malaysia Oil and Gas Company. The respondents may have 1 to 40 years of experiences in the oil and gas industry. The respondents working company is not limited to joint-venture nor state-own company. The respondent's may hold a managerial roles or executive roles in the company/ organisation and can be from various functions such as Operation & Maintenance, Finance & Accounting, Commercial & Retail & Trading, Logistics, Health Safety Environment & Security, Project Engineering and others, etc.

Total 150 pieces of questionnaires are planned to be distributed to professional and non-professional in Malaysia oil and gas company to obtain their feedbacks. The population size was limited because it is time consuming which discourages participants to take part on the survey. Questionnaires return rate of 50% is required to ensure sufficient data for analysing toward success of research.

3.2.3 Data collection

The respondents are given the questionnaire to evaluate the probability of 30 identified risks to happen and degree of risk impact using the 5 level judgements scale of very high, high, medium, low and very low. Besides that, the respondents are required to provide suggestion on the method to manage the identified risks which is control, avoidance, assumption or transfer. They are allowed to provide additional comments regarding the risks managing methods.

The probability of risk to happen, represented by Pr; while the level of risk consequences, represented by Ir. The risk matrix, represented by R, is the function of

these 2 attributes. The risk is actually added up to the multiplication of probability of risk occurrence and degree of risk impact.

$$R = Pr \text{ X } Ir$$

The opinion judgement scale need to be change into numerical scales which the "very high" takes the value of 0.9, and the "high", "medium", "low" and "very low" take values of 0.7, 0.5, 0.3 and 0.1 respectively. The risk value is calculated from the model:

$$R_{ij} = Pr_{ij} \text{ X } Ir_{ij}$$

Where, Pr_{ij} is the probability of risk, *I* occurrence assessed by respondent j ; Ir_{ij} is the level of risk I assessed by respondant j.

By simply averaging the risk value for every risk from every one of the respondents, the average score is named risk index score and utilized to rank the risks.

$RI_i = Sum\ T$

Where, RI is the risk index score for risk i, T is the number of respondents, R_{ij} is the risk matrix value of risk i by respondent j.

Only the top five high ranking identified risks with higher risk index score are analysis in details in next stage of the research.

3.2.4 Data Analysis

Data analysis was completed by utilizing Statistical Package for Social Science (SPSS). Cronbach's alpha is applied to measure the internal reliability of the collected data (risks value) from the questionnaire. The Cronbach alpha value of more than 0.7 is considered acceptance of the collected data is reliable.

Table 3-1: Internal Consistency

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Pearson's Chi-Square Test is also applied in this study to discover if there is a relationship among a pair of variables, where to verify the judgements of the respondents on the risks whether there are any differences. The test gives attention on 3 grouping: working experience, job position as well as type of company. The null hypotheses with significant level of 5% for hypothesis test usually are:

1. H_0: There are no different within the judgement concerning the risk between respondents with experience of greater than fifteen years and respondents with working experience below fifteen years.
2. H_0: There are no different within the judgement concerning the risk between respondents in the management workforce and the respondents as an employee.
3. H_0: There are no different within the judgement concerning the risk between respondents work in stated-owned company and respondents working in Joint Venture Company.

We are accepting that the null hypothesis if the P-value is more than or equal to 0.05 and rejecting the null hypothesis if the P-value is less than 0.05.

3.3 Risks Management Strategy / Control Measure (Qualitative Research)

In the final stage of research, the top five identified risks with higher risk index score which identified in second stage are further analyse to identify the best strategies to manage the top five risks. In the questionnaires, the respondents are questions on the method to manage the identified risks which is either control, avoidance, assumption or transfer. The feedback from the respondents on the risks managing methods are utilised to identified the best strategy to manage the top five identified risks. The highest selection rate is considered as the best managing strategy. Certain control measures proposed and recommended by the respondents on the questionnaires are further analyse using content analysis. The words and phrases which most mentioned are those reflecting important control techniques for risks in the questionnaires. The routine words can be analysed in their specific context to be disambiguated. Synonyms and homonyms can be isolated in accordance to linguistic properties of a language. A further literature can be done to support the findings.

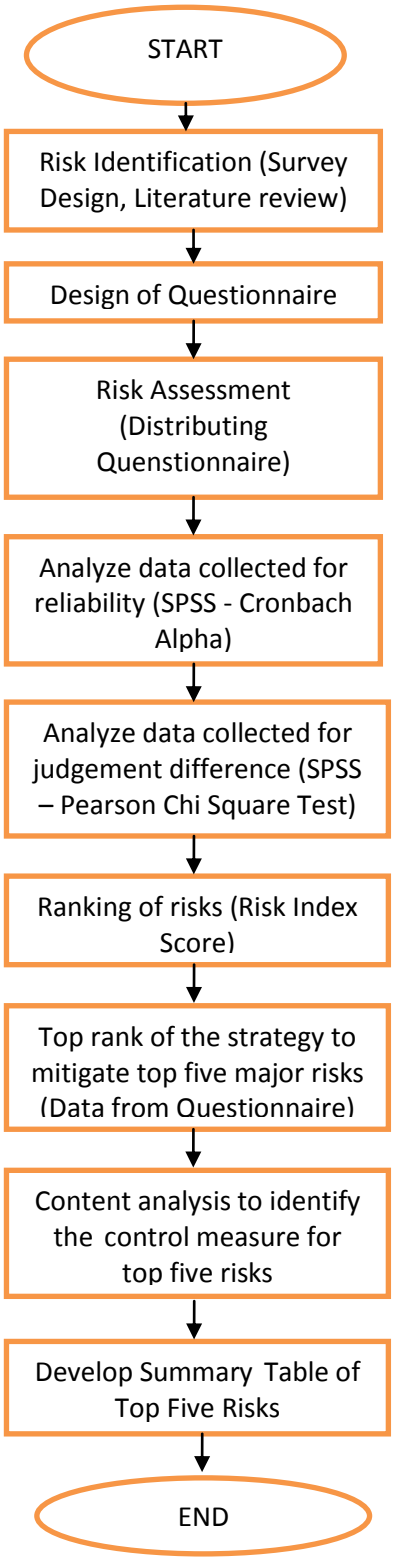


Figure 3.1: Research Methodology Process Flow

CHAPTER 4

Finding and Discussion

4.1 Risk Identification

In the first stage of research, 30 risks factor that will affect the success of Malaysia Oil and Gas project was identified through literature review. The 30 identified risks were tested on 50 professional and non-professional through informal conversation or interview and 100% respondents agreed upon that these 30 risks are potentially impact the success of their project. A questionnaire was designed for continuality of research in second stage in order to meet research objectives. The questionnaires consists of thirty identify risks for the respondents to evaluate on the probability of risks occurrence, severity of risks impacts, strategy to handle the risks and proposal of controlling the risks. The 30 identified risks as below:

Table 4-1: Thirty Identified Risks

1	Incompetence of project team
2	Late internal approval process from the owner
3	Inadequate project organisation structure
4	Improper project planning and budgeting
5	Inadequate tendering price
6	Improper project feasibility study
7	Government interference
8	Exchange rate changes
9	Change of policies/ law / regulations

10	Economic and financial crisis
11	Low credibility of lenders
12	Late approval by lenders
13	Poor design
14	Design change
15	Insufficient and poor performance of contractors
16	Inadequate coordination among contractors
17	Lack of knowledge and experience on construction
18	Improper selection of project location
19	Increase of material cost
20	Increase of equipment cost
21	Work condition differing from contract
22	Poor quality of procured materials
23	Ineffectiveness and lack of supervision of consultants
24	Poor relation and dispute with partners
25	Equipment failure
26	Increase of labour cost
27	Late material delivery
28	Material shortage
29	Shortage of new technologies
30	Damage to work by third party

4.2 Statistical Packages for Social Science (SPSS)

In the second stage of research, a total of one hundred and fifty questionnaires (Appendix 1) were distributed to all level of professional and non-professional in Malaysia's Oil and Gas companies such as Petronas, Shell, Exxon, Murphy oil, Halliburton, Schlumberger and etc. Out of 150 questionnaires delivered, just 82 questionnaires have been feed backed from respondents. The return rate of 55% was sufficient for our research data analysis. 85 questionnaires were delivered to 85 managers and only 40 questionnaires were feed backed with the return rate of 47%;

while out of 65 distribution, 42 employees returned the questionnaires with return rate of 65%. Table 4.1 showed the distribution and feedback of questionnaire responses.

Table 4-2: Number of Questionnaire Responses

Job Position	Distribution	Feedback	Percentage %
Manager	85	40	47%
Employee	65	42	65%
Total	150	82	55%

Of the 82 respondents, 23 respondents are from state-own company while 59 respondents are from joint-venture companies. Besides that, there are 45 respondents had greater than fifteen years of working experience, while 37 respondents with working experience below fifteen years. Table 2 show the distribution of respondents with different company and different years of working experience. Table 4.2 showed the percentage respondents from different function

Table 4-3: Respondents from Different Functions

Variables	**Number of respondents**	**Percentage %**
State-owned Company	23	28%
Joint Venture Company	59	72%
>= fifteen years working experience	45	55%
< fifteen years working experience	37	45%

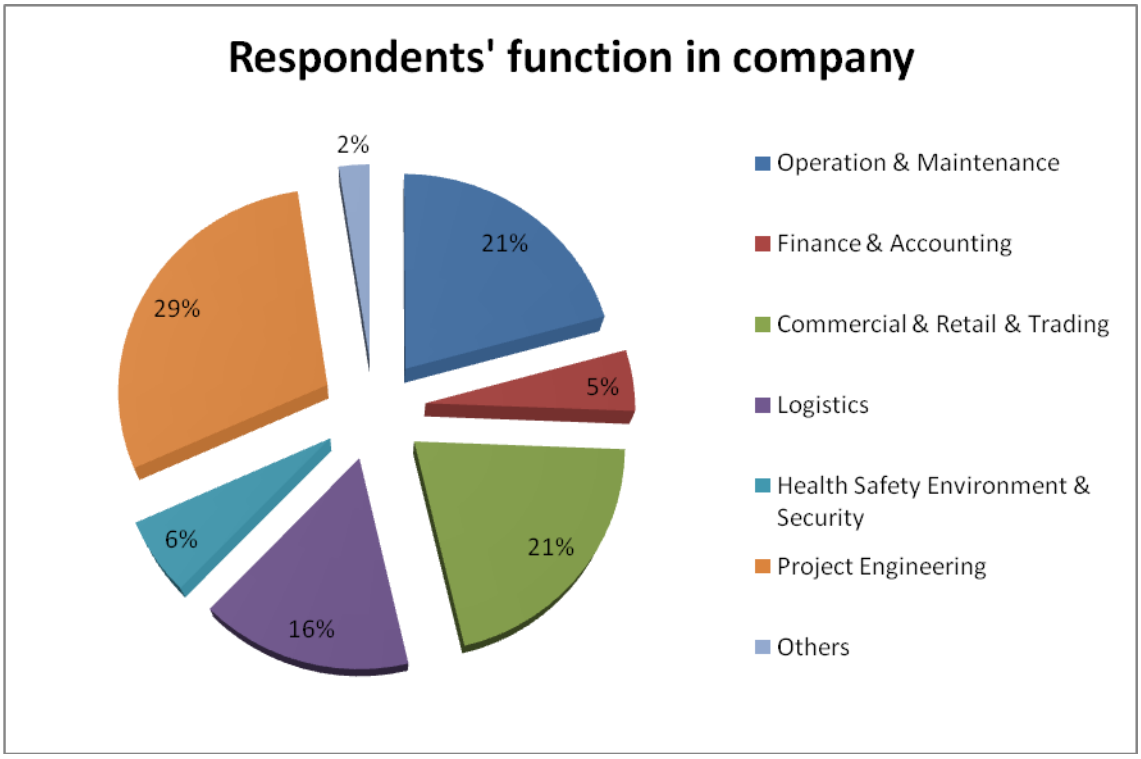


Figure 4.1: Respondents from Different Functions

Management workforces and employees are generally inquired to set impartial values of the probability of risks will come about as well as the degree of risks influence toward the project. The probability of risk to happen, represented by Pr; while the level of risk consequences, represented by Ir. The risk matrix, represented by R, is the function of these 2 attributes. The risk is actually added up to the multiplication of probability of risk occurrence and degree of risk impact.

$$R = Pr \text{ X } Ir$$

The risk value is calculated from the model:

$$R_{ij} = Pr_{ij} \text{ X } Ir_{ij}$$

Where, Pr_{ij} is the probability of risk, *I* occurrence assessed by respondent j ; Ir_{ij} is the level of risk I assessed by respondant j.

By simply averaging the risk value for every risk from every one of the respondents, the average score is named risk index score and utilized to rank the risks.

RI_i = Sum T

Where, RI is the risk index score for risk i, T is the number of respondents, R_{ij} is the risk matrix value of risk i by respondent j.

Table 4-4: Risk Index Score and Ranking

No.	Risks	Risk Index Score (RI)	Ranking
1	Incompetence of project team	0.49	1
2	Late internal approval process from the owner	0.056	24
3	Inadequate project organisation structure	0.051	29
4	Improper project planning and budgeting	0.057	23
5	Inadequate tendering price	0.048	30
6	Improper project feasibility study	0.377	3
7	Government interference	0.067	17
8	Exchange rate changes	0.062	20
9	Change of policies/ law / regulations	0.052	26
10	Economic and financial crisis	0.295	4
11	Low credibility of lenders	0.051	28
12	Late approval by lenders	0.057	22
13	Poor design	0.052	27
14	Design change	0.427	2
15	Insufficient and poor performance of contractors	0.248	5
16	Inadequate coordination among contractors	0.088	12

17	**Lack of knowledge and experience on construction**	**0.112**	**6**
18	**Improper selection of project location**	**0.089**	**11**
19	**Increase of material cost**	**0.087**	**13**
20	**Increase of equipment cost**	**0.055**	**25**
21	**Work condition differing from contract**	**0.095**	**10**
22	**Poor quality of procured materials**	**0.100**	**8**
23	**Ineffectiveness and lack of supervision of consultants**	**0.097**	**9**
24	**Poor relation and dispute with partners**	**0.101**	**7**
25	**Equipment failure**	**0.058**	**21**
26	**Increase of labour cost**	**0.064**	**18**
27	**Late material delivery**	**0.076**	**15**
28	**Material shortage**	**0.078**	**14**
29	**Shortage of new technologies**	**0.073**	**16**
30	**Damage to work by third party**	**0.063**	**19**

Cronbach's alpha is applied to determine the internal reliability of the gathered data (risks value) from the questionnaire. The reliability figures showed Cronbach's Alpha value of 0.717 which translated that the compilation of gathered data are reliable and have absolutely sufficient internal consistency.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.717	.720	30

Figure 4.2: Reliability Statistics

Pearson's Chi-Square Test is performed to evaluate the variations in the judgement of the respondents on the risks with significance level of 5 percent. Below are the results of the test:

Table 4-5: Results of Pearson's Chi-Square Test

Risk Factor	RI according to job position		P Value	Significance at 5%
	Management	Employee		
Government interference	0.0420	0.09	0.000	Significant
Exchange rate changes	0.0490	0.075	0.03	Significant
	RI according to working experience			
	>= 15 years	< 15 years		
Government interference	0.052	0.085	0.009	Significant
Late approval by lenders	0.048	0.067	0.041	Significant
Poor design	0.041	0.065	0.02	Significant
Inadequate coordination among contractors	0.064	0.116	0.048	Significant

It was noticed that there is almost no judgements differences from the respondents for the 3 groupings. In the job position groupings, there are two risks (2 out of 30 risks) having significant difference which are government interference and exchange rates changes. There are substantial distinctions of judgement between management workforce and employee because management views the project as a whole while employee only concentrate on their own discipline which might lessen their view on risks that may influence the project. Besides that, most management are generally communicating as well as interacting among the managers from different division which supply them more information and updates that may wider their view and make better judgement. Besides that, there are four risks (4 out of 30 risks) have significance difference which are government interference, late approval by lenders, poor design, inadequate coordination among contractors in the grouping of working experience more and less than 15 years. There is different judgement on the opinion about "Inadequate coordination among contractors" risks between respondents having less than 15 year working experience and those having less than 15 year

working experience. The less experience respondents judged with (Risk Index Score of 0.116) that the risk is excessive compares to those respondents have more than 15 years experience (Risk Index Score of 0.064). Based on the statistical research, there are no significant risks for the grouping of different type of company.

Risks with Top Five Risk Index Score

Incompetence of project team is the top risks with Risk Index Score (0.49). This indicates that the oil and gas construction project can be prone to fail as a consequence of incompetence of task group. Other team members will be burden and jeopardizes by less competenet team member in the team. The task needs to have completed and also performed effectively. That often means that the more competent players need to undertake extra job that they might not have had to take on had the full team been very capable. This may causes the team members not satisfy, particularly the higher performer. This can result in expense and schedule impact as errors and omissions occur, rework becomes necessary and performers are generally over worked. When skill shortfalls have been in the behavioural realm, emotion based interpersonal conflict and misunderstandings sap group energy.

The second highest risks are the design change with Risk Index Score of 0.427. Oil and gas have unique features which will give rise to design and style change. The design change could differ according to the type, size and complexity of project, project organisation design, contract type along with supply process. Project management practice is one of the factors which usually bring about design changes throughout oil and gas project. The tools and techniques perform an essential role in controlling design changes and style improvement and the effect involving improvements about project effectiveness. It is include pre-project planning, scope classification, project management techniques, tools, and methods, design data freezing, degree of stakeholder's engagement through project execution and design interdisciplinary coordination. With regard to scope classification, it concentrates on the completeness of project scope definition as well as the integrity of the design

scope ahead of performance phase. Human-related components usually are an additional team affecting project changes and their impacts in turn on project overall performance. The attributes consists of project team work experience, education and learning degree, abilities, personality and background, management support along with staff transformation.

Improper project feasibility study takes the third place of greatest risks with Risk Index Score of 0.377. Project feasibility studies are restricted in range which may possibly be strictly engineering, fiscal, legal, and functional, schedules, resources, as well as cultural aspects. The reason for doing a feasibility study is to find a specialist viewpoint in if it seems sensible to move forward with a project. It is to reduce risk as well as distinguish prospective issues, threat which could only turn out to be distinct after deeper research and evaluation. However in the event that a feasibility study is performed too quickly, there exists high possibility that critical factors will be underestimating or may be losing out. The vast majority of the high management would like to rush through the feasibility process so they can get on their project and this also commonly results in failure.

Economic and financial crisis is the fourth highest risk to oil and gas construction project with Risk Index Score of 0.295. Economic consequences takes place to be a direct consequence associated with public or private business decisions, or perhaps public policies and programs. When the fiscal is usually lower, stakeholder can decrease the activity in view of the benefit against the cost. This will likely impact the planned schedule along with eventually holds up the whole project. The financial meltdown had a negative effect on oil and gas project as it led to a large decline of oil selling price. The financial crisis also likewise concluded in limited credit conditions that resulted in many project owners paying substantial rates of interest due to reduce of oil production.

The fifth highest risk with Risk Index Score of 0.248 is insufficient and poor performance of contractors. Contractor associated aspects consists of site management, improper planning, limited contractor experience, as well as mistakes. Limited contractor experience had been the main element which related to the contract awarding procedure where almost all initiatives usually are honoured towards the cheapest bidder. Additionally, local contractors, entirely or through joint ventures, are being honoured significant and complex projects in which they have tiny experience because such projects were virtually limited to international contactors in the past. Inappropriate planning is also cause problem to contractors. Local contractors are reluctant to utilise scheduling tools and to update schedules on a regular basis. Fluctuation in the oil and gas construction market as well as seasonal nature of the industry has forced a lot contractor in direction of diversity. Therefore, they do not concentrate on one line-of-work and seek to undertake advanced method and techniques.

4.3 Content Analysis

In the final stage of research to identify the top five risks managing strategy and control measure, the results or outcomes from the questionnaires was derived and calculated as below:

Table 4-6: Respondents on Risks Managing Strategy

No	Risks	Number of Respondents			
		Control	**Avoidance**	**Assumption**	**Transfer**
1	Incompetence of project team	**67**	15	0	0
2	Design change	15	12	**50**	5
3	Improper project feasibility study	1	5	7	**69**
4	Economic and financial crisis	0	**75**	2	5
5	Insufficient and	**40**	10	7	25

	poor performance of contractors				

Based on the respond of questionnaire from the respondents, it is proposed to use the strategy of "control" to minimise the possibility of incompetence of team member in the project. The comments in the returned questionnaire was analysed and it is found that there are wording such as "Hiring", "Assessment", "Performance management" frequently used by the respondents. Hence, it is suggested that the existences of incompetence team members are more likely due to the failure of hiring process. Sufficient of a good obligation primarily based performance management process will prevent not competent team members in the project. In some project, there are structured examinations or assessment programs to course the actual proficiency associated with individual practitioners, nevertheless even there is incompetent performer slip through. Competency assessment and improvement through training, coaching, mentoring and on the job performance reviews are generally methods for managing proficiency and ensuring that the project team is consists of competent team member and the not competent team members are identified, remediated and removed if necessary.

While based on the respond of questionnaire from the respondents, it is proposed to use the strategy of "assumption" to minimise the possibility and risks of design change in the project. The comments in the returned questionnaire was analysed and it is found that there are words such as "Revision", "Documentation", "Change management" frequently used by the respondents. Hence, it is suggested that control of design process and documentation is incredibly crucial throughout professional practice. There are strong negative implications of poor managing of the design procedure. Engineering documents are always marked with revision numbers and dates. For example, if the document ended up being adjusted, it is given a new dated revision number to prevent probable confusion. In order to mitigate project risk in term of design change, any participating organisation within the collaborative

culture of the project that determine the actual transform in the contracted scope of work is expected to report which transform and provide evidence to support it. The change order should be submitted toward appropriate consultant or owner for project impact assessment. Project documents in which happen to be registered and issued to the team should not be updated and circulated until the change order has been accepted by the owner. Invalid document revisions and distributions could substance undertaking risk, leading to schedule delays and cost overruns. All registered documents should reflect approved change resulting from change orders. Details of the approved changes should be noted within the appropriate documents, and updated document should be transmitted toward appropriate project team members.

Based on the respond of questionnaire from the respondents, it is proposed to use the strategy of “transfer” to deal with the risk of improper project feasibility study before initiate a project. The comments in the returned questionnaire was analysed and it is found that there are wordings such as “Involvement of all parties in different function”, “Hire consultant”, “Tender and selection” frequently used by the respondents. It is summarised that there is always doubt in making decision whether or not to conduct a feasibility study. Generally the larger the advance investment, the greater intricate the project, or the greater the potential outcome involving failure, the more important is to execute a feasibility study. When with hesitation, the particular best course of action would be to complete the feasibility review. In natural, Investors, engineers, designers and CEOs commonly get attached to their unique suggestions. They discount problems, would like to aside concerns, and also trust independently. Consequently, the feasibility must be performed by simply an independent expert. An effective feasibility study should be limited in scope in term of engineering, economic, legal, operational, cultural, financing, resources, etc. In most cases a big mistake to restrict the feasibility study to purely technical issues. Aside from which, a much better approach is always to employ a new group along with mix of the specified skills – from economic and market analysis to engineering and sustainability. However, it is really a great idea to have a several expense quotations and proposals, yet keep clear associated with looking for the best expense.

It often means the lowest quality. We need to harmony getting a cut-throat cost with sourcing experts who have the total choice of ability was required to genuinely check the feasibility of project. It is better to never speed in doing a project feasibility study. If a feasibility study is conducted too quickly, the percentage of lacking, or perhaps underestimating one or more critical factors is usually high.

Refer to the respond of questionnaire from the respondents; it is proposed to use the strategy of "avoidance" to reduce the risks of economic and financial crisis in the project. The comments in the returned questionnaire was analysed and it is found that there are words such as "Feasibility study", "Contract", frequently used by the respondents. Hence, it is suggested that economic and financial crisis on project can be reduced by performing a proper project feasibility analysis prior to the execution of project. The majority of instances exactly where there are contractual issues and contest with the contractor/subcontractor which produce monetary issues. The conflict could causes by time pressure due to a far too ambitious time schedule for the project, which does not leave virtually any space with regard to unpredicted conditions or perhaps troubles. A good contract drafting specifically with respect to procedural guidelines (eg Change requests, extra works, scope of work or technical specification) may avoid occurrence of contractual conflicts. Co-operation as well as effort among contractual parties is vital to prevent contractual arguments which can result in financial disaster to the project. Awareness of expenses mixed up in the project and the economic situation during the project execution phase may slow up the risks of project failure.

Referring to the respond of questionnaire from the respondents, it is proposed to use the strategy of "control" to minimise the possibility of insufficient and poor performance of contractor which will impact the project. The comments in the returned questionnaire was analysed and it is found that there are words such as "Monitoring", "Progress Report", "Company Site Representative" frequently used by the respondents. Hence, it is suggested that the risks of Insufficient and poor performance of contractor can be managed by close monitoring of contractors'

performance. Experience project coordinators should be allocated to monitor the contractors regularly. There needs to be a plan to attempt an assessment of all the works at least at weekly intervals during the works. Contractor Progress Report shall be submit to the client weekly basis during project critical stage for close monitoring. Apart from that, project coordinators may perhaps assist the contractor in decision making because many contractors do not have a well-defined process for producing go/no-go choices. Besides that, the project coordinator should connect closely along with contractors make sure they have adequate strategy planning in executing the project.

Table 4-7: Risk Control Summary Table

	Identified Risks	**Strategy**	**Control Measure**
1	Incompetent of project team	Control	- Efficient hiring process. - Good obligation primarily based performance of management process. - Structured examinations or assessment programs to course the actual proficiency of team members. - Provide training, coaching, mentoring and on the job performance reviews
2	Design change	Assumption	- Project team to report change provide evidence to support. - Implementation of structured document revision process to capture changes. - Only approved changes should be noted within the appropriate documents, and updated document shall be distributed toward appropriate project team members
3	Improper project feasibility	Transfer	- Must be performed by simply an independent expert - have a several expense quotations and

	study		proposals, yet keep clear associated with looking for the best expense - never speed in doing a project feasibility study
4	Economic and financial crisis	Avoidance	- performing a proper project feasibility analysis prior to the execution of project - Ensure no time pressure due to a far too ambitious time schedule for the project. - Good contract drafting specifically with respect to procedural guidelines - Awareness of expenses mixed up in the project and the economic situation during the project execution phase
5	Insufficient & poor performance of contractor	Control	- Close monitoring of contractors' performance by allocate experience project coordinators. - Submission of Progress Report to the client on weekly basis

CHAPTER 5

Conclusion

5.1 Conclusion

Nowadays, all of the projects are fast track in order to compete with others in such a competitive environment. The process of identification and assessment of the risks in EPC project required a long period of time and effort.

By doing the research of identification, assessment and evaluation of the risks of the EPC projects, a risks control summary table is developed. The top five identified risks are incompetent of project team, design change, improper project feasibility study, economic and financial crisis, insufficient and poor performance of contractors. These risks are proposed with control and monitoring strategy which are control, avoidance, assumption or transfer. Apart from that, few control measures are proposed as guidance for risk management in EPC O&G project which are time consuming.

A risks control summary table is developed by doing the research of identification, assessment and evaluation of the top risks of the EPC projects. All of the stakeholders can follow the risk control summary table by focus on the identified risks in certain stage. Through the summary table, stakeholders able to identify the preventive action need to be taken to manage the risks. This also can

shorten the time for the project team in planning stage and able to focus on the project execution stage. Hence, the objectives are achieved.

5.2 Limitation

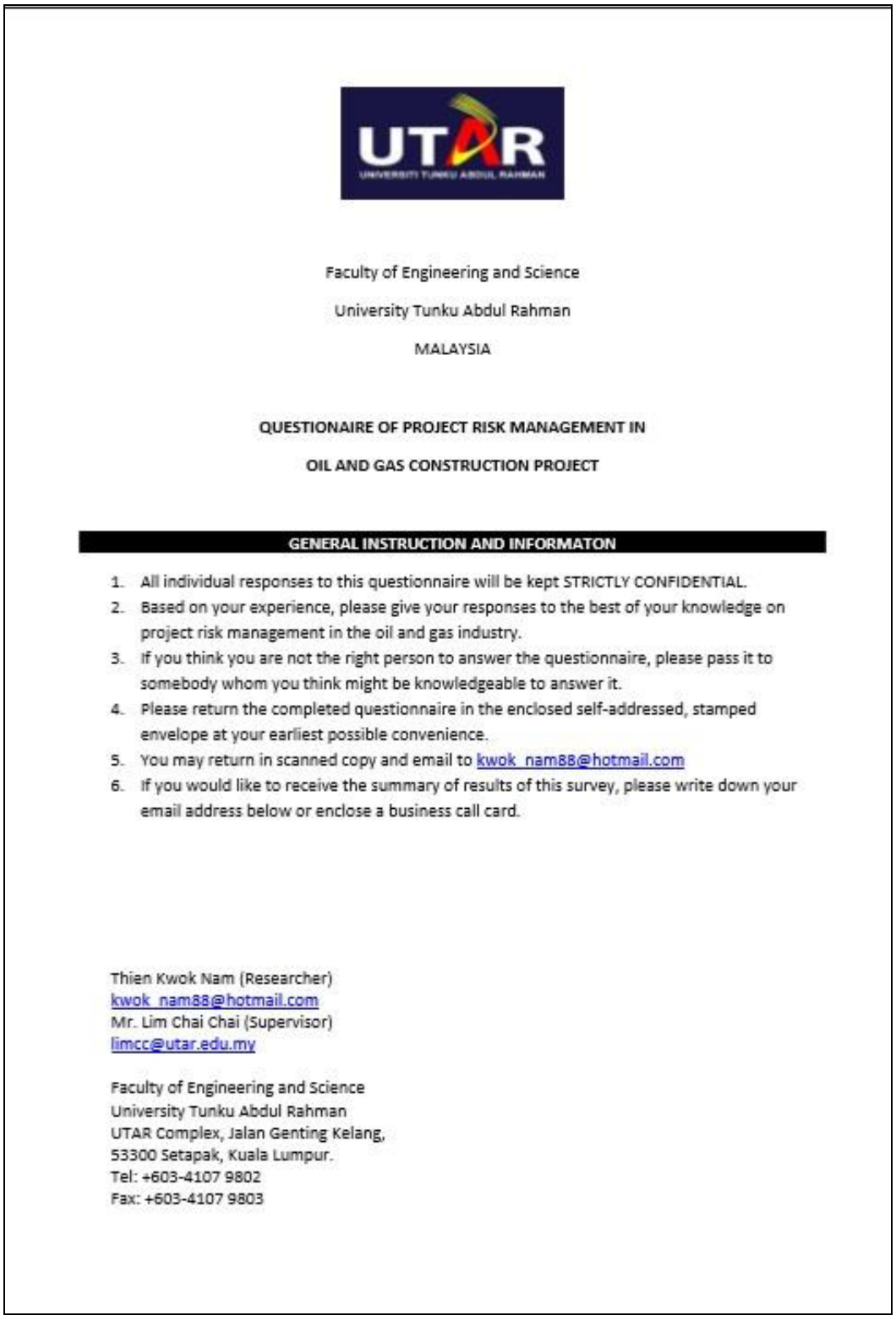
Although the research has reached its objectives, there were some unavoidable limitations. First, the interview sessions on the first stage of research has limited participants because of their tight schedule. Apart from that, there are lesser respondents for the questionnaires are from state-owned company which they might not able to see and provide their feedback on the risks factor compare to the respondents who working in a joint-venture company. Besides that, the research was conducted only on a small size of population who working in Kuala Lumpur, Sabah, and Labuan. Therefore, to generalize and generate more accurate findings and results, the study should have involved more participant at all different state in Malaysia.

5.3 Recommendation / Further Research

It is recommended that the further research can be done in covering the oil and gas company for all states in Malaysia and also overseas. The reason for this is because Oil and Gas Company are scattered all over the world which any major problem/ crisis occur will impact the industry globally. Apart from that, Oil and Gas Industry is governed by the market oil price. There always fluctuation of oil price in 8 to 10 years. During low oil price period, companies are looking for alternative ways to explore and produce crude oil with low cost but effective. They also buy in a lot of new ideas from the professionals and graduate to reduce the cost as low as possible without compromising quality. Hence, further research on the topic shall be conducted in next 8 to 10 years. This is because the identified risks and risks managing strategy which identified now might change in next 8 to 10 years. New technology and management system might already in place to mitigate or eliminate the risks during that time.

APPENDICES

Appendix 1: Questionnaire



Faculty of Engineering and Science

University Tunku Abdul Rahman

MALAYSIA

QUESTIONAIRE OF PROJECT RISK MANAGEMENT IN

OIL AND GAS CONSTRUCTION PROJECT

GENERAL INSTRUCTION AND INFORMATON

1. All individual responses to this questionnaire will be kept STRICTLY CONFIDENTIAL.
2. Based on your experience, please give your responses to the best of your knowledge on project risk management in the oil and gas industry.
3. If you think you are not the right person to answer the questionnaire, please pass it to somebody whom you think might be knowledgeable to answer it.
4. Please return the completed questionnaire in the enclosed self-addressed, stamped envelope at your earliest possible convenience.
5. You may return in scanned copy and email to kwok_nam88@hotmail.com
6. If you would like to receive the summary of results of this survey, please write down your email address below or enclose a business call card.

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SECTION A: ORGANISATION / COMPANY PROFILE

This section is about your organisation / company and your personal information. Please insert / where appropriate.

1. Organization / Company type.

	State-owned Company
	Joint-Venture Company

2. Current position in the organisation / company.

	Management
	Employee

3. Working experience in the organisation / company.

	< 15 years
	>= 15 years

4. Functions in the organisation / company.

	Operation & Maintenance
	Finance & Accounting
	Commercial & Retail & Trading
	Logistics
	Health Safety Environment & Security
	Project Engineering
	Others (Please Specify) _____

SECTION B: RISK MANAGEMENT

This section is about assessing the pre-identified risk based on your best knowledge and experience. The probability of occurrence and the severity of impact of the identified risks to be assess with value from 1 to 5. You may suggest the strategy of managing the risk based on four strategies (control, avoidance, assumption, transfer). You may add in additional thought on the remarks column.

Probability of Occurrence	Severity of Impact
Very Low (1)	Very Low (1)
Low (2)	Low (2)
Medium (3)	Medium (3)
High (4)	High (4)
Very high (5)	Very high (5)

No	Risks	Probability of occurrence	Severity of impact	Managing Strategy	Remark
Eg	RISK	2	4	Control	
1	Incompetence of project team				
2	Late internal approval process from the owner				
3	Inadequate project organization structure				
4	Improper project planning and budgeting				
5	Inadequate tendering price				
6	Improper project feasibility study				
7	Government interference				
8	Exchange rate changes				
9	Change of policies/ law / regulations				
10	Economic and financial crisis				
11	Low credibility of lenders				
12	Late approval by lenders				
13	Poor design				
14	Design change				
15	Insufficient and poor performance of contractors				
16	Inadequate coordination among contractors				
17	Lack of knowledge and experience on construction				
18	Improper selection of project location				
19	Increase of material cost				
20	Increase of equipment cost				
21	Work condition differing from contract				
22	Poor quality of procured materials				
23	Ineffectiveness and lack of supervision of consultants				
24	Poor relation and dispute with partners				
25	Equipment failure				
26	Increase of labour cost				
27	Late material delivery				
28	Material shortage				
29	Shortage of new technologies				
30	Damage to work by third party				

THANK YOU FOR YOUR PARTICIPATION

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