

# Risk Management in Petroleum Industry Construction Projects in Malaysia

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**Abstract**—The purpose of this research is recognizing the most occurring risk factors in construction projects of petroleum industry in Malaysia. Survey is conducted to attain necessary data for the study using questionnaires distributed to the upstream subsidiary company of Petronas and the contractor partners working in Petronas' downstream project in Malaysia. Picking out the major project risks occurring in the country and an analysis upon them are carried out based on the rank, followed by developing suggestions to mitigate the analyzed risks and its improvement measures.

The most often occurring risk factors have been identified based on the survey tests performed in the study, they are: 1) Bureaucratic government system & long project approval procedure; 2) Design changes; 3) Late internal approval process from the owner; 4) Delay in signing contract; 5) Inadequate coordination among contractors; 6) Inefficient & poor performance of constructors and lastly; 7) The increase of equipment cost.

**Keywords**—Risk Management, Petroleum Industry, Construction Projects, Malaysia.

## I. INTRODUCTION

Malaysia is an arising economy country in south-east Asia which has had one of the best economic records in the region with its adjusted Gross Domestic Product (GDP) in year 2010 is US\$ 230 billion (The World Bank). This number is believed to be significantly supported by the export trading of the country's one of most valuable natural resources, petroleum.

Mehden & Troner (2007) emphasize that the national oil company of Malaysia, Petrolia Nasional, or as it is renowned called Petronas, has been an essential supporter to the country national revenue by means of the tax system. It is approximated that 20% of the total Malaysia government revenue in recent years has occurred from petroleum, ultimately from the Petroleum Income Tax (PITA). Petroleum and its products (e.g. Liquefied Petroleum Gas or LPG, gasoline or petrol, fertilizers, plastics, asphalt and thousands of other products) also

became Malaysia's top receiver of foreign exchange and contributed to the government revenue, most notably in the year 1983 for as much as 28% (Mehden & Troner, 2007). Due to this fact, it can fairly be said that oil and gas industry has been one of the pillars of Malaysia's economy.

Petronas, who has wide range of operations from upstream to downstream at its home country and abroad is vested with the entire ownership and control of the petroleum resources in Malaysia and has numbers of construction project in doing their business operation. The projects of which may broadly vary from the fabrication of offshore platform and oil rig at the Malay Peninsula in the west part of Malaysia to the development of petrochemical plant at Sabah in the eastern part of the country.

Yanting & Liyun (2011) in their writing point out that in accordance with the theory of Risk Management, projects in petroleum operation generally are exhibited to risks of natural environment, engineering, management, and economic. These risks are unexceptionally also experienced by Petronas who shall manage them accordingly with their own actual situation, so that they may continue to govern the use of company's finance efficiently hence the industrial resource of natural oil and gas in Malaysia can be fully utilized for the benefits of both company and country.

There is a growing critical sense in term of managing the variation of important projects in oil and gas industry nowadays. Not only due to the facts that petroleum business requires huge investment, long period and high risk operations, but also following of the global economy and corporate revenue descending condition, stakeholders are calling for enhanced risk management, Return on Investment (ROI) and more considerable transparency (Ernst & Young, 2011).

In Malaysia, the participation of foreign partner companies in the country's petroleum industry is believed to make the related projects, including construction, suffer from risks such as differences in practices between domestic and foreign partners, policy and political risks, financial risks, legal and political risks. Furthermore, Petronas' progress to achieve their vision to be a Leading Oil and Gas Multinational of Choice may be decelerated by lack of effectiveness in the risk management system implemented particularly in their construction projects. Regarding the above issues, petroleum industry construction

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projects in Malaysia sit on lots of risk that may lead to counter-productive impacts on project implementation. Therefore, an improved risk management system is potentially needed by project management of Petronas group of companies.

The importance of risk management as described by Nielsen (2006) in his study, is it has the ability to identify risks and apply improved project management approaches which having a purpose of improving the company's achievement in the project's goals.

As petroleum and its derivatives are one of the country's main pillars industry, and Petronas as the highest authority of the business, Malaysia and Petronas have a bond that affecting one another. By conducting the project, it is hoped that the problems with respect to the risk management system presence in the body of Petronas and its company partners can be identified and discussed. The possible solutions are also provided for Petronas and its partner companies to take and implement in their business and consequently to improve their business performance with the ultimate goal is to actualize its vision as well as more positively contribute to Malaysia's economy.

Although there have been several risk-management-studies conducted on managing the project's risks prior to this research, risk factors are diverse depends on industry and countries. Therefore this research of "Risk Management in Petroleum Industry Construction Projects in Malaysia" is unmatched and in fact has huge importance for effective project management.

This research is mainly focused on two (2) objectives, including determining the foremost risk factors concerning construction projects in petroleum industry in country Malaysia and to recommend possibly applicable and beneficial strategies to effectively minimize, monitor, control and alleviate the likelihood or impact of undesired events in doing the business.

This study mainly focuses on risk management implemented in construction projects owned by Petronas in Malaysia. Inside the project contents are including risks identification followed by its frequency level of occurrence and ranks by distributing questionnaires to some respondents working on PETRONAS' projects in Malaysia to obtain the data needed.

## II. LITERATURE REVIEW

### A. RISK TYPES CLASSIFICATION

Yanting & Liyun (2011) state that risk management has a definition of a scientific approach in managing risks done by identifying measuring and analyzing them to effectively attain highest security at lowest cost. Globally, risk management has been utilized as a vital component in many petroleum companies nowadays due to the facts that the business enterprise management of the industry has been attempting to minimize more the occurrence of the risk factors. The development of risk management and analysis/evaluation

towards oil enterprises takes place up to present which developed from the fusion of its theory and practice.

Dissimilar with the risk in investment, petroleum operation risk is classified into several categories developed from the risk management theory and petroleum operation's characteristics (Yanting & Liyun, 2011). The brief analysis of which include:

#### 1) *Natural environment risk*

##### a) *Climatic risk:*

Different climates or weather have been found affecting the operations of petroleum industry. For instance during a snowing or raining season, borehole operation will have higher risk. Subsequently there is also higher risk of heat stroke faced in very hot weather.

##### b) *Geologic risk:*

The petroleum operation processes are also subjected risks related to geological conditions. Among them are the petroleum pool's structure and complexity, reserves and abundance, the nature, burial depth.

#### 2) *Engineering risk*

##### a) *Exploration risk:*

Within this type of risks are including improper use of exploration methods, inaccurate interpretation of seismic data and inaccurate positioning of the exploration wells in the exploration process.

##### b) *Development risk:*

In the process of project development, risks may due to inappropriate mining method, delay in progress, engineering design changes and technical problems. For example, due to incorrect understanding of the stratum, casing damage, formation pressure too high, lack of well control awareness the security will subject to high risks.

##### c) *Construction risk:*

Due to shortage of technical components, unmatched equipment and extended construction period during the process of construction a project may subject to construction risk.

#### 3) *Management risk*

##### a) *Human resource risk:*

Related to social relationship, the operational level, cultural level, age composition of employees and the overall quality, management ability, leadership and charisma of managers are among the factors that affect petroleum operations.

##### b) *Organization risk:*

This type of risk is occurring when there is presence of unreasonable organizational mechanisms, inappropriate staffing, and irrational allocation of responsibilities. Due to these, different understanding, attitudes and actions of the sectors of the petroleum operations may also occur and contribute to cause further disadvantages.

##### c) *Operating equipment risk:*

To enhance the products of running oil wells, management

of this operating equipment risk is necessary. This is because it immediately affects the progress of the petroleum operations in the process of oil and gas exploration and development.

*d) Dispute risk:*

In case of farmer's fields surround oil wells are presence, there are risks related to argument between the company and the farmers. This involves a number of compensation expenses, and may affect the progress of the well construction and further risk to economic losses.

*e) Environmental protection risk:*

Petroleum operations pollute the environment, so petroleum enterprise must comply with relevant environmental regulations and policies, and invest some money to treatment. If the petroleum enterprise creates environmental pollution because of its failure to take treating measures, it will be fined or even be ordered to suspend work, and petroleum operations will face the risk.

*4) Economic risk*

*a) Financial risk:*

The uncertainties such as financing, fund turnover, interest and exchange rate in the course of petroleum operations are among the factors classified into economic risks. This is due to its nature that petroleum business has a long cycle, wide geographical distribution, needs a large number of employees and a large amount of funds.

*b) Market risk:*

Uncertain market factors such as rising material and fuel prices leads to higher needed costs, and further causing a decreased effectiveness of the petroleum operations.

*c) Economic policy risk:*

Various taxes applied in different countries are important method for them to control petroleum production, supply and demand, and directly affect the profit gained by the companies related to it. Moreover, petroleum enterprise also undertakes implicit taxes including the coordination costs of workers and peasants, river maintenance costs, road bridge compensation, comprehensive management costs, security guard costs, build projects and direct losses of stolen oil, gas and water.

**B. RISK MITIGATION STRATEGIES AND MEASURE**

Risk management is a quickly improving knowledge and there are numbers of different view as well as description of what risk management involves, how it should be implemented and what it is for. According to (Yanting & Liyun, 2011), there are some strategies to manage the mentioned risks as a favour to oil company to achieve more efficiency in doing their construction projects, they are including:

*1) Risk awareness*

*a) Sense of crisis:*

With sense of crisis toward the risk awareness, employees may analyse the various risks faced, and take a proactive approach to resolve risk and control it at the early stages.

*b) Safety habits:*

Human error or illegal operation is the main cause of safety issue problems in any projects. Hence there is a need for petroleum enterprise to enhance the awareness of employees regarding this matter. To improve their safety habits, first petroleum enterprise should use various methods to improve their safety knowledge such as providing safety related posters, quiz contests, and technical competition.

*2) Fine management*

*a) Quality control system:*

To emphasize respective employees' responsibilities and strictly control all aspects, a firm quality assurance system and quality responsibility system are needed. Petroleum companies should strengthen their quality accident management, pay attention to the report, investigation and treatment of the accident and analyze the mass loss in time to minimize accidents to happen.

*b) Safety supervising and managing system:*

Besides supervisory and inspection of job site safety must be strengthened, petroleum enterprise should also improve the system of penalty for violation of safety regulation to make a clear definition of various types of acts in violation of regulations. In managing system, there must be clarity in term of organizational hierarchy to avoid clash of interest and authorization.

*3) Core technology*

The best indicator of core competitiveness between different companies in the same business may be differentiated in possession of technology used. Moreover by focusing on market needs, and continue to carry out technical innovation, petroleum companies may as well mitigate the impact of risk occur in their projects.

*4) Highly qualified personnel*

The development of a petroleum company is relevant to whether they own man power capable enough to control the commanding heights of the industry. In term of personnel mechanism, a petroleum company has to develop their human resources planning to use pioneering personnel. While at the same time they have to retain talented staff by focusing on staff training.

**C. THE IMPORTANCE OF RISK MANAGEMENT**

Oil and gas construction projects stretches from the development of pipelines and oil refinery in upstream activity, until the construction of petroleum retail station in downstream activity. Not only has large investment, but also petroleum operation has long period and high risk, which determine risk management is required for to be implemented in this industry. The significance of risk management both globally and in Malaysia's national industry are discussed in this section.

### *1) In Global Pipelines Project*

Nielsen (2006) indicates that all the parties related to the project execution want to be ensured achieving its commercial and professional goals. Due to that, there is a growing need of risk management techniques to be applied globally in today's project management bodies of knowledge to minimize negative consequences in pipeline constructions. The risk management application is so important mainly because of its ability to identify risks and apply enhanced project management methods for the purpose of improving the company's achievement in the project's goals.

Nielsen (2006) conducts study in 6 continents around the world, and shows that risk management is a fundamental practice to identify and create input to fulfil all the needs throughout the stages of a pipeline project's life. The stages are described as from the early stage of concept and feasibility study, to execution and operations stages, until its sustainable recycling process. Although risk management is equally important to be applied in any stages of the project, the difference of its nature make specific risk management must be developed for each stage.

Despite more and more project management standards are being generated and applied, yet engagement of risk management in pipeline projects is not concentrated on the wide range of its risk factors (Nielsen, 2006). Therefore there is a lot of room to be improved in term of specification of region or company in developing risk management standards.

### *2) In Malaysia's Petroleum Operation*

Yusuwan, Adnan & Omar (2008) specifies that construction industry in Malaysia is one of the country's significant contributors to its economy growth with activities are including specific civil engineering projects of petroleum industry such as pipelines and oil refinery. This sole fact is representative enough to show how important the efficiency is in performing the construction projects in Malaysia's oil and gas industry.

Moreover, there are numbers of journal and research showing high level of awareness among organizations toward the risk management and believe that risks can affect productivity, performance, quality and the project budget. The construction industry in Malaysia is among those industries with the most subjected to diverse risks (Yusuwan, Adnan & Omar, 2008). These risks may affect negatively on the productivity, performance, quality and the budget of the project. As a result, for the sake of certifying the successful of the project, it is desired to have an accurate and well-ordered risk management strategy in place. Subsequently, a risk management is also hoped to be performed with certain characteristics in order to manage the risk factors in the most efficient manner.

## *D. PETRONAS AS MAIN STAKEHOLDER IN MALAYSIA*

### *1) Company Overview*

Malaysian National Oil Company, Petronas (stands for Petroliam Nasional in Bahasa Melayu), is the wholly owned by Malaysian government given the highest authority for the entire of petroleum resources in Malaysia through the Petroleum Development Act 1974. The company is the controlling body in performing exploration, development, refining, marketing and distribution of petroleum and its products in the country. (Chua & Oh, 2010)

Mehden & Troner (2007) mentions in their study that within only about 30 years plus since it was founded in 1974, Petronas has entered into overseas operations in some 35 countries, became a powerful player in global oil and gas shipping business, and financially helped a set of mega projects in Malaysia.

Although it is 100% state owned, Petronas is considered as a well-run company and free from corruption. Petronas is a business entity with orientation of profit as their prime objective. The company has been free from Malaysia's government interference in its daily business but has significantly supported government-sponsored mega projects outside its interest such as Twin Towers and Putrajaya (Mehden & Troner, 2007).

### *2) The Relation of Petronas to the Malaysian Economy*

Started as the huge exporter of tin and manufacturing products, Malaysia has now become a country which its petroleum resources have continued to bring healthy income to its economy since the era of late 1970s and 1980s. Not only that, study conducted by Mehden & Troner (2007) indicates that Petronas as the main stakeholder petroleum resource in the country is also contributing through the income tax payment system until 20% of all total of the government's revenue.

Petronas is doing both exploration and production business inside the country and overseas. With its corporate strategy being to maximize returns for the Malaysia's government as shareholders, Petronas has a willingness to become an overseas investor both in upstream and downstream sectors and also promoting the foreign investments to come to Malaysia. Besides that, Petronas is also trying to give advantage to local demand by providing a long-term activity involving Malaysia, the host countries and other firms (Mehden & Troner, 2007).

### *3) Petronas and Risk Management*

As one of the key players in the country's energy development, Petronas' actions in managing risks exposed to their business have been becoming really essential not only to its own business performance, but also Malaysia's economy growth.

Mehden & Troner (2007) also draw attention to the time

during Asian Energy Forum in 2005, when the Vice President of Petronas insisted that it is vital for Petronas to have good partners for several reasons including risk mitigation. According to him, although risks cannot be totally eliminated, mitigating risks still requires highly credible partners to spread financial risk and attract other financial institutions.

### III. METHODOLOGY

#### A. PROJECT ACTIVITIES

Main activities in performing this project are including 1) Background study; 2) Analyze previous related journals; 3) Develop questionnaires for respondents; 4) Collect primary and secondary data; 5) Analyze the data obtained from the respondents; 6) Write recommendation and project report towards the data finding; 7) Final Year Project report writing.

#### B. TOOLS & DATA ANALYSIS METHOD

In performing this study, the tools needed to acquire data are questionnaire form (print-out), online survey and interview questions based on survey results.

Data used for this study is classified into primary and secondary data. While the primary data is acquired by questionnaires, online survey and possible casual interviews with certain people in management level, secondary data is collected from resources such as journals, previous paperwork and thesis.

In order to determine the main risks in construction projects in the company, a qualitative measurement or ranking system is used in the analysis of this study. From the reasoning answers obtained from the respondents, a value of Average Index will be obtained by using the rating for the questionnaire, as follow:

- 1 – Never; 2 – Rarely; 3 – Sometimes;
- 4 – Often; 5 – Very Often.

The Average Index Formula:

$$\text{Average Index (AI)} = \sum (\beta \times n) / N$$

Where,  $\beta$  is weighing given to each risk factor by respondents

- n is the frequency of the respondents
- N is the total number of respondents

With the rating scales by Majid & McCaffer (1997) are:

- 1 = Never (1.00 < Average Index < 1.50)
- 2 = Rarely (1.50 < Average Index < 2.50)
- 3 = Sometimes (2.50 < Average Index < 3.50)
- 4 = Often (3.50 < Average Index < 4.50)
- 5 = Very often (4.50 < Average Index < 5.00)

The risk factor with highest Average Index score means that risk is the most often to occur in Petronas' construction projects. Subsequently, the lower Average Index score

indicates that the risk factors are less often to happen.

#### C. TARGET RESPONDENT

The questionnaires are prepared to gather data from about 21 survey respondents voluntarily who are willing to contribute in this study. The target population is people involved in Petronas' construction projects in Malaysia in the upstream and downstream businesses. Target respondent in the upstream business is Petronas Carigali Sdn Bhd, whereas target respondent in downstream business are contractors APEX Energy Sdn Bhd and PT Rekayasa Industri (Rekind). APEX from Malaysia and Rekind from Indonesia are part of the consortium contractor for Sabah Ammonia Urea (SAMUR) project which was awarded by Petronas Chemicals Group Berhad's (PCG) to perform basic & detail Engineering, Procurement, Construction and Commissioning contract (EPCC).

Accordance with the objectives, the literature and the research hypotheses, two types of questions are developed in the questionnaire. They are multiple choice questions and open-essay questions which were distributed to project managers, functional managers and also project team members. In addition, interviews to certain level of managements were conducted for further analysis.

#### D. REPORTING

The report is to include the analysis on data obtained by classifying the risk factors into group of the "top five" from the rank resulted from the survey performed. Further discussion towards these top five risk factors with the possible strategies to manage them are also comprised in this report.

### IV. ANALYSIS OF THE TOP-FIVE RISKS

Total number of respondents is twenty one people comprises of thirteen from Petronas Carigali Sdn Bhd and eight from APEX Energy Sdn Bhd and PT. Rekayasa Industri. From the result of the combined survey data, top-five of most often occurring risks on the projects in Malaysia are found according to the respondents' feedback towards the study (Table 1). Analysis is performed with the aim of formulating proper and useful strategies to lessen the occurrence and effectively minimize the impact of each risk factor. Another analysis is also done to discover the causes based on characteristics in relation to the project situation in Malaysia.

#### A. BUREAUCRATIC GOVERNMENT SYSTEM AND LONG PROJECT APPROVAL PROCEDURE (RISK FACTOR, RF-9)

With the average index score of 3.571, the risk which is most likely to occur in construction projects in petroleum industry in Malaysia is "Bureaucratic government system and long project approval procedure". Long bureaucracy in performing any project could invite bribes and corruptions to come from any individuals or groups who desire to speed up the procedures or their applications. Not only can this reduce the effectiveness of a company in term of budget (because they

TABLE I  
TOP-FIVE RISK FACTORS

Rank	Risk Factor	Average Index
1.	Bureaucratic government system and long project approval procedure (Risk Factor, RF-9)	3.571
2.	Design changes (RF-18)	
	Late internal approval process from the owner (RF-25)	3.524
3.	Delay in signing contract (RF-15)	3.333
4.	Inadequate coordination among contractors (RF-24)	
	Inadequate coordination among contractors (RF-24)	3.286
5.	Increase of equipment cost (RF-34)	3.238

have to provide extra money in order to achieve their target within time frame), this also can be vital for the country Malaysia itself if they are to build good image of the country which is “corruption free” in attracting the infestation.

According to the interviewed engineer, who is working on SAMUR project from PT. Rekayasa Industri (Rekind), some possible mitigating strategies are suggested to be applied by his company and also Petronas. From the perspective of Petronas’ partner, the probable approaches are including demanding the Malaysian government for reformation in administration procedure, to develop good relationship with the government as well as environment authority and lastly to be familiar with the system by understanding the laws and regulations.

Whereas for the Malaysian government, the possible strategies that can be applied are including to form a working team which is aimed at cutting down bureaucracy and enhancing the quality of the delivery of public services to attract investments. This team has jobs to identify measures of improving procedures, rules and current laws and formulate an easier way for the companies to conduct their businesses in Malaysia according to the statement.

#### B. DESIGN CHANGES (RF-18)

With average index score 3.524, “Design changes” risk factor is ranked 2 in term of likeliness of occurrence. Change or modification is always an expected component of any project’s design and construction. There is no assurance for a project will be free from experiencing significance changes, not even the best well-designed plans or most detailed contract agreement. This risk of design changes is badly affecting the project to an extent of delay in schedule and over budget cost. Moreover huge complex projects such as the construction projects in petroleum industry, are subjected to more risk of

design changes due to different policies from the involvement of multi-national companies.

One of the ways that could reduce the impact as mentioned above is by implying the function of a Configuration Management (CM) methodology at the project stages of planning, designing, constructing, maintenance and operating (Steinberg & Otero, 2008). In their writing, Steinberg & Otero (2008) mentions that according to the American National Standards Institute, Configuration Management is “A process of organization for setting up and preserving steadiness of a product’s performance, functional, and physical characteristics with its necessities, design, and functioning information during its life span”. By applying so, it is expected that the partner company (e.g. contractor, consultant, etc) may generate more profit from the works and at the same time satisfying their client, thus can have a more successful project.

#### C. LATE INTERNAL APPROVAL PROCESS FROM THE OWNER (RF-25)

Together with “Design changes”, the risk factor of “Late internal approval process from the owner” share the average index score of 3.524 and place rank 2 in the most often risk factor to occur in the industry. This risk is coming from the problems within the organization itself, thus it is considered an internal risk. It occurs either when the people who are drawn in the project are not giving enough dedication or when the manager of the project is structurally powerless in solving the problem or in other words he/she doesn’t have the authority to do so but has to report to higher manager instead (Thuyet, Ogunlana, & Dey, 2007).

In their writing also, Thuyet, Ogunlana & Dey (2007) suggest possible mitigation strategies which include enhancing the manager’s of the project empowerment. According to Egeland (2011) in his article, empowered teams are better than the ones which disempowered in term of effectiveness. An empowered team is more united in which the process of conclusion creation is moved downwards to the personnel, staff, or any division which management level is ranked lower, to allow them to employ more efficiently and openly their talent. A team which has been empowered will take more responsibility for the produced outcomes. Furthermore, in empowerment the team may distribute the weight of the project’s responsibility with the project leader as well (Egeland, 2011).

In the implementation of empowerment strategy, the project managers of Petronas’ projects are advised to be aligned with the company’s management objective and believe. Based on understanding, management’s confidence and managers’ reliability decisions can be more quickly decided thus any delay or late in approval process can be minimized.

#### D. DELAY IN SIGNING CONTRACT (RF-15)

In rank 3 with average index score 3.333 there is risk of “Delay in signing contract”. This delay happens if the operator companies (client) change their mind and are late in ordering

the instruction or approving drawings. The fact that this risk is due to the client, does not make the contractor is unable to prevent it to happen. Coordination with client is necessary to at least try preventing this risk to take place. Furthermore there is always a possibility to reduce the impact affected by the risk upon occurring.

As mentioned, one of the reasons that this risk may occur is due to the design changes by client. A way to possibly prevent this to happen is by setting "Freeze Time" of design changes at a certain point to allow for procurement lead times, approvals. This fixed deadline allows the contractor to catch the target on-time. For instance, contractor of an oil rig fabrication has to finish their works on a certain date, and then there is a "Point of No More Changes" when upon the reaching of this point of time, client (e.g. Petronas) has to obey the agreement and not allowed or not advisable to issue more changes.

Besides, in most cases of which this risk is already happened, there are potential methods could be applied to reduce the negative impact of the risk. No matter what the root of the delay is, company must try and recover their position. One method is by accelerating the company work upon the risk to happen. It shall be faster than it should be as previously planned. If an essential timeline is missed, it may not matter whose fault it is. The most important thing is still how to reach the goal of the project in term of quality, budget and time frame. Secondly, Petronas is to supervise the jobs performed by the contractors carefully. To ensure recognising and documenting the delays are also advised, to control and further study the cause of the delays and try not to repeat the same mistake in the future.

#### *E. INADEQUATE COORDINATION AMONG CONTRACTORS (RF-24)*

The risk factor number 4 in the rank is "Inadequate coordination among contractors". With average index score 3.286, this risk factor is also prone to exist in the construction projects in petroleum industry in Malaysia. When there is lack of coordination, there will always be a communication problem behind it. Steps-forward actions necessary to be taken by big companies like Petronas to improve coordination between their partner contractor companies in hopes of resulting more economical and effective project development

One of the actions to minimize the risk is by carrying out a series of constructors meetings to share ideas on what's being bought and what issues are running between them that decelerate the progress of the development project. It could be done also by delivering precise input from all the division involved to escalate probability of happening. Problems such as lack of mobility, relation to client/government and others that occur along the time of performing the project are to be discussed here in the meeting. Petronas as client can also attend the events and network with the contractor's program managers and contracting officers. An enhanced effective

communication between the contractors and also between the contractor and the client is hopefully achieved, and thus by strengthening project team relation and performing more comprehensive forecast, coordination among them can also be more sufficient and more satisfactorily in doing the project.

#### *F. INEFFICIENT AND POOR PERFORMANCE OF CONSTRUCTORS (RF-28)*

With the same average index score of 3.286, risk factor "Inefficient and poor performance of constructors" is also ranked 4 in the survey. Poor performance of the constructor may be due to lack of capabilities of the leader in the contractor partner companies who are directly managing the project. This problem can possibly be solved by registering the root causes to some mitigation approach performed by the client towards the organization partners.

A scheme or an initiative that possibly has ability to boost constructor performance in technical and management throughout the project development is by putting some reinforcement in Petronas to sanction outperforming contractors and reward the ones which are doing excellent works. Petronas is advised to have an authority that is able to perform take away a contract manager from constructor partner who is not performing well. It also includes an annual review by the Petronas to put some considerations whether to keep the same contractors for the next projects.

#### *G. INCREASE OF EQUIPMENT COST (RF-34)*

Lastly, in number 5 of the rank and with average index score of 3.238 is the risk factor of "Increase of equipment". The price of equipment in Malaysia is considered prone to raise might not only due to world economic growth but also to higher demand of the equipments for the same project of petroleum industry in this country than any neighbouring countries. The necessary equipment's price has direct effects on the budget of project development and rehabilitation. Petronas as the project's owner, the equipment manufacturers, consulting engineers and related partner companies share strategies to diminish the risks affect created by this increasing cost of equipment. One of the strategies is including "risk-sharing techniques".

According to Odd Ystgaard vice president of Norconsult AS in Norway, the crucial objective of implementing "risk-sharing" system is to distribute risk to the group of owner/developer, contractor and supplier so that it can be easier and better measured and minimized (World, 2008). The means of mitigating this risk is by allocating the proper risk. For example if there is an increasing equipment cost allocated to the supplier, then the project owner must also subjected to the risk by paying a premium to help the supplier cover this risk.

Besides the method as mentioned above, according to one of the respondents from the survey performed, other strategies that are advised to be implemented in the body of Petronas are by performing big procurement contracts of the equipment near the beginning of the project which subject to international

competition and also by estimating budgets which are able to accommodate even the most unpredictable increases. This means it is advisable for Petronas to source for better contractor, not only limited to local contractor to improve the efficiency in doing construction projects, as well as to be most cautious in providing approximate financial fees.

### V. CONCLUSION AND SUMMARY

From the results of surveys as presented above, it can be concluded that the most occurring risk factors in the oil & gas construction projects owned by Petronas in Malaysia from rank 1 to 5 respectively are “Bureaucratic in government system and long project approval procedure”. Besides that, risks such as “Design changes”, “Late internal approval process from the owner”, “Delay in signing contract”, “Inadequate coordination among contractors”, “Inefficient and poor performance of constructors” and “Increase of equipment cost” are also occurring to be some of the highest top factors.

Besides risk types of “governmental and policy” and “economic” risks, the fact that three out of top-five risk factors are categorized under “project management and engineering risks”, show that there is sense of importance to improve these sectors in construction project activities in Malaysia petroleum industry.

Some mitigation strategies have been developed to possibly be implemented by Petronas and its partner companies in the project. The strategies are built not to diminish the risk 100%, but instead it is developed to minimize the chance of its occurrence and reduce the impact resulted if problems due to such risks are experienced by Petronas and its partner companies. In summary the strategies for addressing the major project risks in petroleum industry in Malaysia, are as shown in table 2 beside.

TABLE 2  
ANALYSIS SUMMARY OF THE MAIN RISKS

Rank	Risk Factor	Mitigation Strategies
1.	Bureaucratic government system and long project approval procedure (Risk Factor, RF-9)	<ul style="list-style-type: none"> <li>• Reformation in the government’s administration procedure;</li> <li>• For Petronas and its partners to develop good relationship with the government authorities; and</li> <li>• To be familiar with the system by understanding the laws and regulations.</li> </ul>
2.	Design changes (RF-18)	<ul style="list-style-type: none"> <li>• Utilizing a method of Configuration. Management (CM) for various project stages.</li> </ul>
	Late internal approval process from the owner (RF-25)	<ul style="list-style-type: none"> <li>• Enhancing the empowerment of Petronas’ manager in its projects.</li> </ul>
3.	Delay in signing contract (RF-15)	<ul style="list-style-type: none"> <li>• Coordination with client; and</li> <li>• Setting “Freeze Time” of design changes at a certain point</li> </ul>
4.	Inadequate coordination among contractors (RF-24)	<ul style="list-style-type: none"> <li>• Carrying out constructors meetings to share ideas, what issues are running between them and how to overcome those problems.</li> </ul>
	Inefficient and Poor Performance of Constructors (RF-28)	<ul style="list-style-type: none"> <li>• Petronas to give sanction the underperformed contractors and prize to the excellent.</li> </ul>
5.	Increase of equipment cost (RF-34)	<ul style="list-style-type: none"> <li>• Implementing the “risk-sharing techniques”.</li> </ul>



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## REFERENCES

- Aven, T., Vinnem, J. E., & Wiencke, H. S. (2007). A Decision Framework for Risk Management, with Application to The Offshore Oil and Gas Industry. *Reliability Engineering and System Safety* 92 , 433-448.
- Chua, S. C., & Oh, T. H. (2010). Review on Malaysia's national energy developments: Key policies, agencies, programmes and international involvements. *Renewable and Sustainable Energy Reviews* , 2917-2925.
- Egeland, B. (24 June, 2011). Creating an Empowered Project Team. Retrieved 10 July, 2012, from Project Management Tips: <http://pmtips.net/creating-empowered-project-team/>
- Ernst & Young. (2011). Capital Project Life Cycle Management for Oil and Gas. Retrieved 13 February, 2012, from Ernst & Young: <http://www.ey.com/GL/en/Industries/Oil---Gas/Capital-projects-life-cycle>
- Majid, M. Z., & McCaffer, R. (1997). Discussion of Assessment of Work Performance of Maintenance Contractors in Saudi Arabia. 91.
- Mehden, D. F., & Troner, A. (2007). Petronas: A National Oil Company With an International Vision. *An Energy Study* , 29.

- Nielsen, K. R. (2006). Risk Management: Lessons from Six Continents. 61-67.
- Sitorus, J. (2011). General Information SAMUR Project. Jakarta: PT. Rekayasa Industri.
- Steinberg, M., & Otero, F. (2008). Using Configuration Management to Mitigate the Impact of. PACO Group, Inc.
- The World Bank. (n.d.). Data Country Malaysia. Retrieved February 11, 2012, from The World Bank: <http://data.worldbank.org/country/malaysia>
- Thuyet, N. V., Ogunlana, S. O., & Dey, P. K. (2007). Risk Management in Oil and Gas Construction Projects in Vietnam. *International Journal of Energy Sector Management* Vol: 1 No: 2 , 175-183.
- World, H. (9 January, 2008). Metal Price Increases: Strategies for Mitigating the Risk. Retrieved 8 July, 2012, from HydroWorld.com: <http://www.hydroworld.com/index/display/article-display/357753/articles/hydro-review-worldwide/volume-16/issue-4/articles/cover-story/metal-price-increases-strategies-for-mitigating-the-risk.html>
- Yanting, Z., & Liyun, X. (2011). Research on Risk Management of Petroleum Operations. *Energy Procedia* Volume: 5 , 2331-2332.
- Yusuwan, N. M., Adnan, H., & Omar, A. F. (2008). Clients' Perspectives of Risk Management Practice in Malaysian Construction Industry. *Journal of Politics and Law* Vol.1, No.3 , 121-130.