RISK ANALYSIS RELATED TO OPERATIONS IN OIL AND GAS PLANT: THE CHALLENGES FOR QUANTITATIVE AND QUALITATIVE ANALYSIS

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis/project and in my opinion, this thesis/project is adequate in terms of scope and quality for the award of the degree of Bachelor of Project Management with Honors.

Signature
Name of Supervisor:
Position:
Date:

STUDENT'S DECLARATION

I hereby declare that the work in this thesis/project is my own except for quotations and summaries which have been duly acknowledged. The thesis/project has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature
Name:
ID Number:
Date:

Dedicated to my beloved parents

Dedicated to my fiancé and his family

Dedicated to all persons who supported me

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ABSTRACT

This research is related to the circle of risk management in an oil and gas industry which only discussing the items with regards to risk analysis phase only instead of embedded up to whole of phases in the managing risk. In this industry, there are onshore and offshore sectors. Additionally, the scope of this research is only covering the plant in onshore sites. This research is conducted as there are several flaws or weaknesses in analyzing risks in the onshore plant. These weak points caused the risk analysis done previously seems relatively not effective since there is still accident happened in the plant. Therefore, this research was carried in order to search out what are the challenges that contribute to the existence of those flaws. This research was also done to determine the types of risks that have high possibilities to take place in undesirable future condition as well as investigating the types of risk analysis practiced by the personnel in analyzing these risks. The scope of this research is not over than the states of Pahang and Terengganu in the East Coast region of Malaysia. By referring to the previous academic sources, the term “risk” itself could brings either positive of negative definition. In the nature of risk, there are sequences of risk attitude when dealing with risk. The major types of risk attitude are risk averse, risk neutral and risk acceptance. The sources also discussed on the operations of the oil and gas plant as well as the types of risks identified that related to those operations. The most important parts of the information are the knowledge of the types of techniques used to analyze risk such as FMEA and HAZOP as well as the challenges that have been identified in conducting risk analysis in other industries generally. The type of sampling method used in this research was the simple random sampling which is the most suitable method to choose the targeted samples. By thorough discussions on the findings, there are five major types of risks exist in the onshore oil and gas plant which are fire, explosion, gas and equipment or machinery risks as well as maintenance risk. There are more than one type of risk analysis technique practiced in the plant such as the HAZID, HAZOP, FMEA, fault tree analysis and the HIRARC. Moreover, this research highlighted four specific challenges faced during the risk analysis process like limited of data, optimistic estimating, complex measurement and communication of risks and last but not least interpreting past data to predict or make decision of future risks.

ABSTRAK

Kajian ini adalah berkisar tentang sekitar pengurusan risiko dalam industri minyak dan gas di mana membincangkan perkara-perkara yang berkaitan dengan fasa analisis risiko sahaja dan bukan sehingga keseluruhan fasa dalam pengurusan risiko. Dalam industri ini, terdapat sektor dalam dan luar pesisir . Selain itu , skop kajian ini hanya meliputi loji atau kilang di tapak daratan. Kajian ini dijalankan kerana terdapat beberapa kelemahan atau kelemahan dalam menganalisis risiko dalam loji daratan. Hal ini disebabkan oleh analisis risiko yang dilakukan sebelum ini seolah-olah agak tidak berkesan kerana masih terdapat kemalangan yang berlaku di kilang atau loji. Oleh itu, kajian ini dijalankan untuk mencari apakah cabaran yang menyumbang kepada kewujudan kekurangan tersebut. Kajian ini juga dilakukan untuk menentukan jenis risiko yang mempunyai kemungkinan tinggi untuk mengambil tempat dalam keadaan yang tidak diingini pada masa depan selain menyiasat jenis analisis risiko yang diamalkan oleh kakitangan dalam menganalisis risiko-risiko ini . Skop kajian ini tidak lebih daripada negeri Pahang dan Terengganu di kawasan Pantai Timur Malaysia. Dengan merujuk kepada sumber-sumber akademik lepas, istilah " risiko " itu sendiri boleh membawa sama ada positif definisi negatif. Dalam sifat risiko , terdapat urutan sikap risiko apabila berurusan dengan risiko. Tiga jenis sikap risiko utama iaitu mengambil risiko , risiko neutral dan penerimaan risiko. Sumber-sumber tersebut juga memberi maklumat mengenai operasi kilang minyak dan gas dan juga jenis-jenis risiko yang dikenal pasti yang berkaitan dengan pengendalian itu . Bahagian maklumat yang paling penting adalah pengetahuan jenis teknik yang digunakan untuk menganalisis risiko seperti FMEA dan HAZOP serta cabaran-cabaran yang telah dikenal pasti dalam menjalankan analisis risiko dalam industri lain secara amnya. Jenis kaedah persampelan yang digunakan dalam kajian ini adalah pensampelan rawak mudah yang merupakan kaedah yang paling sesuai untuk memilih sampel sasaran. Dengan perbincangan yang menyeluruh ke atas hasil kajian, terdapat lima jenis utama risiko wujud dalam kilang minyak dan gas daratan iaitu kebakaran, letupan , gas dan peralatan atau risiko jentera dan risiko penyelenggaraan. Terdapat lebih daripada satu jenis teknik analisis risiko diamalkan di kilang seperti HAZID itu, HAZOP, FMEA , analisis pokok dan HIRARC. Selain itu , kajian ini mengetengahkan empat cabaran tertentu yang dihadapi semasa proses analisis risiko seperti data yang terhad, anggaran yakin, ukuran dan komunikasi risiko yang kompleks serta penggunaan data yang lepas.

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LIST OF ABBREVIATIONS

FMEA	Failure Modes and Effect Analysis
FTA	Fault Tree Analysis
HAZOP	Hazard and Operability Study
HAZID	Hazard Identification Study
HIRARC	Hazard Identification, Risk Assessment and Risk Control
HRA	Hazard and Risk Assessment
PETRONAS	Petroliam Nasional Berhad
PPE	Personal Protection Equipment
PPIC	PETRONAS Petroleum Industry Complex
PRA	Probabilistic Risk Assessment
SPSS	Statistical Packages for Social Sciences
SWIFT	Structured What-If Technique

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

An oil and gas industry is one of the industries which contribute to an economic of growth of a country. Globally, as the industry is giving huge money cash flows and defined as “gold field”, most of places specifically in the ocean region are explored and opened for oil and gas drilling activities. Significantly, the oil and gas industry is constituted of upstream, midstream and downstream activities which had been determined their respective hazards and risks. The operations in this industry for both offshore and onshore sites are in contact with dangerous circumstances including the presence of hazardous chemicals and the complex, critical equipments in the plant. By relying on this condition, it can be said that the oil and gas industry is non-zero risks and non-free hazard industry.

Malaysia is one of the places which is found as the precious area which having this industry in its coastal regions such as Terengganu and Pahang. In order to cope with the unsafe working situation, there are several legislations and acts that had been outlined by the government related agency with regards to occupational safety and health criteria. For industry in Malaysia, the Department of Occupational Safety and Health (DOSH) is the body assigned by the Malaysian Government to control the rights of the employees regarding to their safety and health. Particularly, the acts or regulations practiced in for the oil and gas industry are Occupational Safety and Health Act 1994 (OSHA), Control of Industrial Major Accident Hazard (CIMAH) law, Petroleum (Safety Measures) Act 1984 as well as Factory and Machinery Act (FMA) summarized the needs and procedures that crucial to be undertaken by industries including petroleum industry to have specific risk management in the plant, (Hafsham, 2007).

Complying with the stated regulations and legislations, it is compulsory for oil and gas companies to carry out risk analysis or assessment of the risk that presents in the onshore and offshore oil and gas plant. The rationale of conducting the risk analysis is so that the risk management process that a company should apply can be comprehensively prepared and followed by the plant personnel. In addition, the identified risk can be well analyzed its possibilities of occurrence along with its level of seriousness and give much closer of true picture on the real dangerous situation in plant especially to those which related with operations run in the particular plant. Besides that, the risk analysis can help in producing a detail document on the assessed risk and therefore can be reference if there is any accident happens in the plant or workshop in future time.

The onshore plant's projects are as dangerous as the projects carried out in offshore platform. The activities are highly contact with hazards and risks, hence, the risk analysis should be done as comprehensive as that is done for the operations of the offshore activities. The process of analyzing risk should be from the very first operation started in the plant until the last operation. This process is to ensure that the potential risk is assessed as much as possible without overlooking any operations in the plant and since the operations in the plant are unique and differ to each other, every single operation in the plant must be analyzed its possible risk and the results of the analysis must not be used for whole future time because the operations might have undergone either small or big changes in its procedures and the equipment may be also changed. For that reasons, the risk analysis must be carried out in the plant routinely and not stop for one time only.

In analyzing risk, the methods that can be practiced to analyze the risks for each operation may vary due to the equipment used in the plant which also can differ to each other. Only one method of risk analysis used to analyzed equipment is sometimes not suitable to assess its risk because one method of analyzing the risk can be only up o certain aim or objective. For an example, the FMEA is used to analyze risk of the equipment failure while the HAZID is more to only identify risk in the plant. Consequently, more than one type of risk analysis should be used at one time so that the risk in the plant is analyzed extensively and well discovered. Lastly, in order to have good risk analysis, the method used must be both qualitative and quantitative methods so that the risk analysis document is not only about the description of the risk.

1.2 PROBLEM BACKGROUND

Risk analysis is the method or technique to assess identified risk and it is one of the chain of risk management process. According to Kouns and Minoli (2011), the term “risk analysis” can be also replaced by other similar term which is “risk assessment” whenever necessary. Thus, the usage of these two terms can be interchange throughout the discussions of this research. This research specifically related to oil and gas industry.

Based on previous record, many accidents or injuries happed in this industry. As pointed by Jamin (2012) in his column, there were nine workers injured and one killed in the case of a gas processing plant exploded in Kerteh, Terengganu. The accident may due to the incomplete or incomprehensive risk analysis done for the plant operations particularly.

Additionally, the accident also due to management fault or from the mistakes that had been done by the workers themselves. It is understood that there are some weakness during the process of analyzing risk in the plant. This study will be carried out to find out the challenges faced during analyzing the risk in onshore plant so that the flaws that weaken the risk analysis process can be resolved in future.

1.3 PROBLEM STATEMENT

An oil and gas industry consists of onshore and offshore sectors. In this industry, either onshore or offshore is described and observed as non zero-risk industry. In onshore oil and gas plant, there are risk analyses which used or carried out to cater its risky surrounding. Every single risk analysis done is hopefully able to minimize the number of accidents and to some extent could minimize the risks in plant. Nevertheless, these risk analyses have flaws and disadvantages to conduct, for instances, vast number of methods to use in an assessment of risks, involvement of people in the plant is not considered as a whole in doing risk analysis and problem to search out the factors contributing to undesirable operating condition.

The huge number of methods in theory is one of the issues in carrying out an assessment of risks. As outlined by Aven (2008), there are so many approaches that are used in assessing risks. In his book, the author had come out with several types of risk analyses like FMEA, HAZOP and SWIFT techniques. On the other hand, it had been discussed that there are several forms of risk assessment tools that can be used in

analyzing risks such as FTA, HRA and PRA and these three are used in its own traditional way, (Ostrom and Wilhelmsen, 2012). These two arguments prove that there numerous methods may present along the process of analyzing risk.

An involvement of specific people in conducting risk analysis also weakens the effectiveness of the analysis. According to Calixto (2013), the collection of data and the breakdown of the historical data assessment should be part of operations and its maintenance routines, plus it should be identified and supported by the managers. As illustrated by Lund et al. (2010), in the process of analyzing risks, the only the analysis team with the participation by major or domain roles such as the representatives of each department is required to involved along the process.

The last problem is searching out the factors that contribute to the undesirable conditions in the complex systems and operations in the plant. As pointed by Ayyub (2011), it is a challenge to recognize or discover the vulnerable reasons that lead to a disagreeable and an unacceptable operating state in the assessment and analysis of the risks regarding to the complex systems.

Collectively, these statement of problems with regards to the risk assessment are the weakening the effectiveness of the risk analysis itself. Therefore, this research will be going to increase the effectiveness of the process of analyzing risks as this research is intended to investigate the challenges of conducting risk analysis in the onshore oil and gas plant so that related direction will be obtained towards solving the problems mentioned earlier.

1.4 RESEARCH OBJECTIVES

1) To identify types of risk that are high probably present in onshore oil and gas plant.
2) To investigate types of risk analysis practiced for operations in onshore oil and gas plant.
3) To analyze the challenges in conducting risk analysis for operations in onshore oil and gas plant.

1.5 RESEARCH QUESTIONS

R.O 1:

1) What are the operations carried out in the oil and gas plant?
2) What are the risks that are high possibilities to take place in the plant?

R.O 2:
1) What are the types of risk analysis used specifically used for the operations in oil and gas plant?
2) Who prepare or carry out the risk analysis for the operations in oil and gas plant?

R.O 3:
1) What are the processes involve in conducting the risk analysis?
2) What are the elements in the risk analysis process?
3) What are the challenges faced by the risk analyst in developing the risk analysis for operations in oil and gas plant?

1.6 SCOPE AND LIMITATIONS OF RESEARCH

This research will cover the operations in onshore oil and gas plant in the East Coast region of Malaysia which are mainly in Kerteh and Telok Kalong in Terengganu as well as Gebeng in Pahang. The state of Kelantan will be not included.

The plant involve is either involve only PETRONAS plant or some other plant or workshop which belongs to other oil and gas company. In addition, the companies that are planned to be approached could be client, service provider or fabricator as long as the companies are doing business or service for oil and gas plant. There will be no companies that are doing business other than related to oil and gas filed such as companies in construction industry.

This research is involving those workers and management in the oil and gas plant who work for projects undertaken in onshore section. The population for the research will not be those who work at offshore oil and gas platforms.

The type of risk analyses for both qualitative and quantitative methods will be considered. However, the risk analyses used in the selected oil and gas plant are only listed with brief description and not on explaining how the risk analyses formulated from the beginning.

This research is conducted within limited time. The survey that will be carried out within 3 months time and the data collection are going to be done in the time as stated earlier. The results may not be easily collected if the targeted people are not in place during the data collection. It is expected to gain better results if the time given for this research is longer than existence one as more respondents can be approached for the survey.

1.7 SIGNIFICANCE OF STUDY

This research is conducted in order to clarify what are the problems with the existence risk analysis as there is accident happen in the plant by searching the challenges that need to be faced by the risk analyst during the development of the risk analysis which may cause the analysis to be less accurate or less effective.

Hence, by doing this research is hopefully able to assist the risk analyst to improve their methods in conducting the risk analysis. The challenges which will be outlined at the end of this research can be reduced in future by finding ways to mitigate them. Additionally, it is also expected to help those people who work at the operations section to realize their unrealized act or behavior which may lead to accident to occur.

1.8 EXPECTED RESULTS

There are three major risks will be determined through this research. They are fire and explosion risks as well as gas risk. The expectation is based on the nature of the oil and gas industry itself. At the end of this research, there might be more than these types of risk that are having high possibilities to occur in the onshore plant.

Next expected result will be related to second research objective. It is predicted that there are variety methods used in the process of analyzing risk in the plant. The popular technique such as HAZOP is expected to be one of the methods implemented during the process.

It is highly expected that the barriers or challenges in carrying out both qualitative and quantitative risk analysis for the operations in oil and gas plant will be identified. Part of the challenges expected is the time and cost constraints to update the risk analysis frequently. Moreover, the challenges will be due to the changes made in the operation procedures. Furthermore, major challenge will be from the practices of the management or the plant’s personnel itself.

Particularly, for the qualitative risk analysis, it is expected to obtain result that shows lack of expertise who experts in conducting the operations in oil and gas plant and lead to less accurate estimates used for expert judgment method.

For the quantitative risk analysis, it is expected to identify that there is some wrong calculation or mistakes in documenting the risk level documentation which then brings to less precise and less accurate quantitative risk analysis.

Nevertheless, these expected results may be different in future after this research is completely done. This is because other challenges may be identified or the expected challenges are not present in the real surrounding of the onshore oil and gas plant.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides the overview of previous researches related to the risk analysis conducted for the operation/s in oil and gas plant. The review of the literatures also includes the components such as overview of risk, risk attitude, operations in oil and gas plant, risks related to operations in oil and gas plant, risk analysis for operation/s in oil and gas plant and last but not least barriers for quantitative and qualitative risk analyses. The review of literatures in this chapter enables to provide some information and knowledge as firm source of reference for this research. A literature review permits a researcher to observe and study how the previous research efforts able to be beneficial to the existing degree of knowledge, (Cottrell and McKenzie, 2011).

2.2 OVERVIEW OF RISK

According to Fraser and Simkins (2010), risk is usually defined as the possibilities, opportunities or chances and uncertainty of either results or effect. Relying on this statement, risk is an event which is not yet occurs and has a potential to take place in upcoming time. As explained by Beck (2007), risk can be referred to as the prediction of future devastation and disaster. It is understood that risk involves an estimation of probability of specific condition that can cause harm later if a normal condition is not running as what had been planned in first place. Therefore, the nature of the risk itself is collectively about the possibilities and estimations on any undesirable occurrence due to certain unsafe and harmful situation in a place.

Definition of risk could be either long or short where the long definition of risk is likelihood and level of disaster or an unwanted event and a magnitude of losses whereas risk in short is defined as sort of bad things that could occur in future (Hubbard, 2009). The word risk is labeled and identified as the chance of suffering harm from a danger exposure, (Cohrssen and Covello, 1999). Based on these two definitions of risk, the word risk is determined as the potential of an event to be harmed and related to dangerous and hazardous influence and impact.

In contrast, risk is not restricted to probability of an event only but also determines and refers to values and estimated losses, (Hardy, 2005). Therefore, risk is not only a story about predicting its occurrence but also considering the impact or consequences in monetary aspect. This is because when the risks take place in real circumstances, the related parties or companies need to bear either big or small losses due to the failures or the unwanted things happened. As a result, either much or less, the companies or the parties have to spend some amount of money to fix or control the problem or failure that arises. The cash flows out is considered as the predicted losses and values as mentioned before.

Risk definition and understanding about risk is also depending on the opinion and perspective towards risk. The perceptions towards risk may vary in different ways of interpretation. In most cases, risk is expected to be always a terrible and unwanted event. According to Renn and Rohrmann (2000), risk in most contexts is understood as a danger of undesirable occurrence rather than a chance for obtaining desired results.

Meanwhile, Ramroth and Jr. (2007) pointed that risk usually refers to probability of threats, dangers or unwanted conditions to take place. For that reason, risk is believed to be something which is not planned to get and has potential to occur and will threaten and harm particular item if it occurs. These arguments and viewpoints are actually illustrate that risk is a condition or event which will gives negative and bad impact and effect to one state and is usually shunned and is unpleasant as its possibilities of occurrence can results deterioration consequences.

On the other hand, the term risk is not limited to the negative things only. When a risk could open opportunity and producing good results, the risk can be classified as

positive risk. As pointed by Stoker (2006), risk is not a chance or an opportunity that is to be escaped but in other way round, risk is an opportunity or chance that is cannot be avoided. Based on this statement, one should not keep away from risk as it will always exists in any state or circumstances and when it seems to be beneficial in upcoming time. Furthermore, it is also mentioned that a fresh new opportunity can be created if the right risk is chosen and it is faced in right way. In other words, a particular risk can be a good thing instead of giving bad effect in future if the risk is taken and confronted with right ways.

Risk also can be a fine and positive consequence and future event and necessarily only affect a condition negatively. Risk can be defined in many other ways and the term itself can brings either upside and downside in certain occurrence. Likewise, risk can give advantage when it is considering about the profit or return by which one can gain by taking up the risk, (Leitch, 2008). Thus, risk is can be assumed as a good thing whenever its outcomes associate with prospect benefits and profits.

By referring to the definitions of risks generally, the term is mainly about negative effect and about harms. Nevertheless, risk also can be defined as a good thing and a potential of obtaining positive feedback or outputs when the risk is accepted instead of stay away from it. Hence, there is no exact and finite definition of risk but the definition still about the likelihood and severity of the risk and the way how the word risk is defined depending on the interpretation of the risk itself either optimistic or pessimistic point of view.

2.3 RISK ATTITUDE

Risk attitude is the constitution of risk averse, risk neutral and risk tolerant and risk seeking. Some ideas do include also the risk seeking as one of the risk attitude and some are not. The risk attitudes demonstrate the action and response of a group or of an individual towards risk. In addition, risk attitude is depending on how is the group or the person think and have an idea about risk. The terms averse, neutral, tolerant and seeking are the representative of one’s response to an uncertainty which is considered and is catalyzed by perception towards risk, (Webster and Hillson, 2012).

Generally, risk attitude is about how a person or a group that involves to react and shows their intuitive feeling about the risk they need to face as well as how they are doing in experiencing the risk. As explained by Drummond et al. (2005), if a person keeps away from risky approach and choice, the person is identified as risk averse, if he or she is unresponsive to the risk hence the person is risk neutral while the person is called as risk seeking if risky conditions and states are his or her preference.

Furthermore, Geweke (1992) stated that hypothesis of attitude to risk refers to one's preference to do risky choice and selection method is incorporation of strength of a feeling to the risk and also how his/her response or react to the risk. Based on the hypothesis, one of examples that can be referred to is if the stronger the unpleasant feeling to the risk identified, the stronger the reluctance and the aversion to the risk. This will be similar for other three types of risk attitudes.

Risk reluctance or risk aversion is being noticeable in a situation with less risk, Vertzberger (1998). The reason is it is easier to resist or to keep away from taking up the risk as in low-risk situation, this action towards risk does not giving high impact if the risk is refused or rejected rather than if in a high-risk states or circumstance.

According to Aven and Vinnem (2007), the idea of risk aversion is used to describe an attitude or behavior to risk and uncertainties and it is believed that risk aversion is about disliking and unpleasant feeling towards effects and consequences. Thus, the risk averse can be pointed to a person who has disagreeable feeling and tend to disregard a risk. According to the arguments and statements before, it can be deduced that risk aversion is all about risk avoidance and risk resistance.

Conversely, risk neutral is about a state where a person or a group is indifferent towards risk identified in surrounding. The level of risk aversion and risk acceptance or risk seeking is at same level and not bias to any of these risk attitudes. The risk neutral is definitely about an individual or team which is or are neither avoid nor accept the risk and to an extent, they thinks it is better to draw and formulate strategies that will give profit and advantage in future, (Hillson, 2009).

Nonetheless, as explained by Hillson and Simon (2012), term risk neutral shows a combination of temporary risk aversion and also durable risk seeking. Describing this point

of view, it is understood that risk neutral is a combination of risk aversion and risk acceptance or risk seeking. Unlike the definition of risk neutral before which is stated that risk neutral is about balance level of risk averse and risk acceptance, risk neutral here is perceived as people refuse to take risk for short-term time duration only and after they aware the upside of taking up the risk, their attitude change into looking for the risk.

According to Webb (2000), risk acceptance is referring to an action and to a response of concerning the presence of risk in which the people with this type of attitude have a tendency to acknowledge risk when the risk impact and its possibility to occur are inaccessible and small. Therefore, it is believed that risk can be accepted or can be tolerate if the situation is under control and has very low risk level.

Moreover, as pointed by Hillson (2009), the people with an attitude of risk tolerant will not see a risk as harm thing and accept the risk as a typical and normal thing which has no implication to them. They are either really aware about the risk and try to treat the risk as a thing which is not dangerous or they are actually do not has an exact estimation on the degree of the risk capable to cause destruction in one particular time in future and that is why they are just accepting the risk.

Risk seeking is different with the other behaviors to risk. Risk seeking is all about aiming for high return on investment. Risk seeking is explained as a risky condition and state is faced in order to gain equal or higher expected value in time onward (Kahneman and Tversky, 2000). Once ones have trust and are very confirm that their investment will produce positive outcomes and revenue, they will be willingly to take up and bear the risk as long as they can get what they wish for in prospect.

Hillson (2009) determined that risk seeking as an attitude towards risk by which those who are with this attitude will either misjudge the threats or overestimate the uncertain payoffs and they are not scared to take action. This type of people can be labeled as risk seekers. They are craving for risk or in other words they are always looking for chance and opportunity to gain benefits from some situation although they know the risk that they will and should bear with.

The risk attitudes are important to be determined and understood in order to see people's responses and culture towards risk. By understanding these several types of risk

attitudes, how the risk is faced which is corresponds to the risk perception about risk is identified as well as the ways risk management processes are carried out can be also found out. By having only a general overview about risk, it is insufficiently for ones to understand what are other dimensions of risk can be and how the term risk itself can be diverged in many other specific things.

2.4 OPERATION/S IN OIL AND GAS PLANT

According to Devold (2009), the oil and gas combining networks can be very huge and wide together with thousands well as a source of production from very far distance via a gathering channels into a processing plant. The onshore oil and gas plant is obviously about project of processing and production of products from the crude oil and raw gases extracted from drilling activities at offshore area.

As pointed by Inkpen and Moffett (2011), oil and gas industry is an industry which using very large amount of investment of money and also involve in decision-making of an upstream exploration and development project as well as during a post-development after the upstream development activity complete which is specifically during process of production together with in midstream and downstream sections such as transporting like shipping, pipelines, refining and last but not least range of chemicals. As referring to this statement, oil and gas plants can be classed or consisted of plants of different operations such as for refining and production of chemicals. Besides, the operations in the oil and gas plants for onshore project are not restricted or limited to only production activity.

Likewise, downstream activities are about refining, marketing, processing and also distributing functions, (Wright and Gallun, 2008). As mentioned before, onshore oil and gas plants are not only focusing on operation of production only but also functioning and operating for some other purposes such as refining and processing of crude oil and raw natural gases drilled from offshore sites.

There are several major components of a plant which consist of different sections of processes. The sections are wellheads, manifolds, separation, gas compression as well as some sections for metering, storage and export, (Devold, 2009). These various divisions differ to each other and have dissimilar processes and outcomes. This is to actually differentiate the products and to prevent the operations and procedures to be

mixed up. Yet, with the crucial components that have their respective roles and purpose, this is how downstream operations are functioning.

Last but not least, the operations in oil and gas plant are not narrowed to only production purpose but also can be other type of operations or they also can be a constitution of several types of operations which are specifically categorized and grouped according to the intended principles and outcomes.

2.5 RISK RELATED TO OPERATION/S IN OIL AND GAS PLANT

Before a risk analysis can be carried out, any types of risks in the plant should be identified. By doing this, the risk analysis will be more specific and correlated to the risks. Hence, person or people who responsible in doing the risk analysis as well as all workers in related oil and gas plant should aware all those risks so that no one of the risks are misjudged and misplaced during the analysis and interpretation of the risks.

According to Ayyub (2011), any accident happen in a complex system like offshore and onshore oil and gas processing plant, it will cause large monetary expenses or losses as the accident occur in that kind of risky places can cause the plant to stop its operations and to one extent it also can also hurt people, damage property as well as an environment. The accidents happen as a consequence of some factors which consist of specific risk events and the occurrence of the accidents shows that risks in oil and gas plant are relatively important to beware and identified.

Likewise, as explained by Nolan (1996), oil and gas operations are mostly a type of nonstop operations and yes the industry is upgrading economics but this condition will cause an increasing amount of fuel inventories which then inbuilt risk in that particular operations. Thus, it is believed that operations in the oil and gas plant specifically come along with their respective allied risks and the exposure to the risks is high and risky condition in the plant is always there.

One of risks that can take place in an oil and gas plant is a fire risk. As pointed by Hardy (2005), this type of fire is a risk that has possibility of fire to ignite. Based on the definition, fire risk is also one of the risks in oil and gas plant as it is understood that the plant which operating with the oil and gas materials where most of them are flammable and can be source of fire ignition.

According to Stellman (1998), fire is an expression of uncontrolled burning which involves combustible materials such as in the presence of large amount of gases, liquids and solids that are found in industry. Hence, fire risk is considered as one of risks identified in oil and gas plant as there are wide range of flammable materials which associate with fuels as a product from oil and gas operations.

Other risk that has probability to occur and does exist in onshore oil and gas plants is inspection risk. The Interior's onshore and offshore guidelines for tracking and supporting where oil and gas are measured are not reliable by which Interior tracking offshore measurement points offshore but not for onshore operations and thus creating challenges for onshore staff assigned for inspection job to validate accuracy of the related measurements, (Rusco, 2010). Based on this statement, it is illustrated that an inspection risk is also exist in onshore oil and gas plant. This type of risk associates with the errors made by the staff during conducting inspection procedures. The errors of the measurement outcomes are results from inspection inaccuracy which can be caused by lack of guidelines and appropriate policies.

According to Roberge (2007), the constraint that has to be faced by a corrosion engineer is to have plant inspection workforce with a sound technical understanding of potential deterioration mechanisms for use in developing effective strategy to limit risk of potential equipment failures. Any fault inspection can be one of the risks although inspection is used to find out and determine the possibilities of failures occurrence. This condition can be described as if there are any failures that are miscalculated during the inspection and there are some crucial failures that are given less attention and only few are concerned and well observed. Hence, the inspection itself can be a risk to the operations in oil and gas plant.

Braunschweig and Gani (2002) stated that the most vital issues concerning the operations of revolving machinery such as power generator of gas turbine and compressors and the efficiencies of both of these types of machines are vividly fall at operations which are significantly divert from the design point. This shows that the machinery faulty and deterioration is one of the risks related to the operations in oil and gas plant as the machines are important parts or components in the plant and those machines are considered failed when they are not functioning as planned earlier.

In onshore oil and gas plant, there is also of gas risk. As explained by Doukas et al. (2011), gas risk probability is referring to natural gas supply where the likelihood of this risk to take place is low in most categories but its impact should be seriously considered. The occurrence of gas leakage is relatively low probability to take place in oil and gas plant. However, when it occurs in real condition in future time, it has a capability to result wide range of consequences such as explosion and fire. Thus, that is a reason why the impact of gas risk should be place under severe or serious considerations.

2.6 RISK ANALYSIS FOR OPERATION/S IN OIL AND GAS PLANT

Risk analysis is the method where risks are evaluated based on particular elements and criteria. The risk analysis has two types which are a qualitative risk analysis and also a quantitative risk analysis. However, why do risk analysis needed to be carried out? Aven (2008) stated that the main purpose in conducting the risk analysis is to backup the decision making as the risk analysis able to give crucial basis in order to balance different concerns for instance in terms of safety and costs. In oil and gas plant, it is important for the risk manager or the plant manager to have some ideas on the probable risks before he/she can make a decision on something that is close to or with regards to the operations in plant to avoid other bigger potential risk events and dangerous incidents to take place in the plant.

According to the Aven (2008), the risk analysis is beneficial in all phases of a system; however the approaches applied must be matched to the need. Here, it provides initial guide to conduct a risk analysis. By obeying the rule, the risk analysis which is going to be done should comply with the specific condition and requirements of the phases either phases of system or phases in the life cycle of a project. It will be no use of doing risk analysis if the methods use are not appropriate and prevents the risk analysis to be effective whenever needed.

Risk analysis can be divided into two categories. They are, a qualitative and a quantitative risk analyses. As explained by Bartlett (2004), there are several realities in practice with regards to qualitative risk analysis and project stakeholders will use this risk analysis or risk assessment as a basis to predict risks and for sustaining decision making along with quantitative risk analysis. Moreover, quantitative risk analysis and evaluation commonly follows qualitative risk analysis activities, (Gunn, 2009). In nutshell, both of

these risk analyses are interrelated to each other as quantitative risk analysis only can be carried out when there is a fundamental assessment of the risks which is through qualitative risk analysis.

A qualitative risk analysis is defined as a method used in practice that forecast probability and severity of unfavorable events in prospect and the risks identified are ranked based on their priority to influence project goals and objectives, (Heldman, 2005). As stated by Dobson et al. (2012), the risks are rated according to their significance which are rated in terms of impact and probability. Therefore, qualitative risk analysis are a general assumptions of risks and commonly about placing suitable rank or in other words about rating the identified risks based on their capability to affect an event in future.

On the contrary, quantitative risk analysis is a risk assessment that gives more accurate and defined risk measurements in terms of such as cost and reputation, (Nardone, 2009). As explained by Garrick (2008), when performing quantitative risk analysis, specific attention and considerations are given on calculating the probabilities and organizing circumstances and conditions and the calculation involves mathematics and mathematical physics approaches. Hence, it can be deduced that this type of risk analysis is using mathematical ways to further quantify the probability of the risk occurrence the methods are systematic but complex rather than doing assumptions during performing qualitative risk analysis.

Risk analyses can be conducted at different phases in the life cycle of a particular system which are from the beginning concept phase towards the operation and closing phases, (Aven, 2008). Hence, it is understood that all phases in a project especially for the various operations of in the oil and gas plant that differ to each other requires risk analysis respectively. Here, the risk analysis for the operations in a plant will be vary to the risk analysis in other plant and should not be used commonly for several different plants.

One of the risk analyses is failure modes and effect analysis (FMEA). As pointed by Lock (2007), FMEA begins with considering potential risk events or specifically about the possible modes of failures. Here, the probability of the risk events are actually refers to probability of the risk of failures state or condition if it happens. Furthermore, according to Aven (2008), one of the types of risk analysis is failure modes and effect analysis (FMEA). The purpose of FMEA method is to expose the possible failures and to expect the failure

effects on the system entirely. However, this method only considers one single component and the other components are assumed as to function with no flaws.

In addition, this FMEA method could be used to analyse the risks in oil and gas plant and yet, the method can be used for the risk analysis related to the operations involve in the plant. By having the risk analysis for the operations where the failures and the effects of those failures will help the plant risk manager for example to determine the risk events and help to rise up the suggestions to mitigate the risks with regards to the operations integrated.

Like the FMEA method, the hazard and operability study (HAZOP) is one of the types of risk analyses that can be used to study risks in an industry. As explained by Wells (1996), a HAZOP is about illustrating endeavor to upgrade safety in plant. Based on this statement, this type of risk analysis is suitable for oil and gas plant as it is rationally used with regards to aim for assessing risks in plant. According to Aven (2008), HAZOP is used in determining hazards and weaknesses in a processing equipments and it is commonly used during the designing phase in the stage of planning. This risk analysis technique was initially constructed for chemical processing facilities. However, it still can be used for other type of systems and facilities. For instance, HAZOP is used in oil and gas industry in Norway.

By comparison, unlike the FMEA technique, the HAZOP analysis method is not paying attention on the failures of the operations but it intensively also focus on other critical parts or characteristics of the operations such as the complexity of one single operation. As argued by Aven (2008), HAZOP can ease the process of obtaining and carrying out further quantitative consistent risk analysis for onshore oil and gas plant's operations as it provides early qualitative information and descriptions of the related potential risks and hazards.

Besides the FMEA and the HAZOP risk analysis methods, there is another example of risk analysis technique which is structured what-if technique (SWIFT). SWIFT is a risk analysis technique where head question-what-if is used systematically with the purpose of identifying variations or changes of the normal conditions (Aven, 2008). SWIFT is defined as a method to analyse and interpret as well as to evaluate the risks by raising

the conditional issue such as what if or what will happen if the conditions are not as what it were planned or conducted in their normal situations.

Through SWIFT, the risk manager will be able to determine earlier the risk event of technical risk that can take place in the onshore plant. Question such as what if the plant's operations are not conducted as they were designed before and what if the facilities in the plant breakdown will direct the attention of the risk manager or the plant manager to make related preparations if the circumstances mentioned of identified via SWIFT take place in the plant.

As pointed by (Moulik, 2012), the hazard identification study (HAZID) is a type of risk analysis which needs drawings such as plant layout and process flow diagram, Therefore, HAZID is believed to be used for operations in oil and gas plant. With the drawing like plant arrangement plan, hazards and risks can be identified in terms of arrangement and design of the plant itself together with the operations that are operated at particular places in the plant.

HAZID is also can be used to analyse risks in onshore oil and gas plant as it considers the risks of components in the plant will be identified and assessed. HAZID process helps to identify risks as it acts as a checklist for each single component of a sub-system as well as pointing out related assets and their respective deviations from the normal conditions or in other words their damages, (James,1996).

Risk analysis also can be conducted through fault tree analysis. Fault tree analysis (FTA) is one type of quantitative risk analysis that can be conducted during the project and operational stages and then is supported by life cycle analysis which correspond to safety considerations for oil and gas industry, (Calixto, 2013). The fault tree analysis is shown and understandable that it suits the needs for risk analysis for the operations in oil and gas plant.

As explained by Ruan et al. (2010), the fault tree analysis calculating and evaluating the probability of the failures which integrates two independent events by using connectors such as OR and AND gates and generally the probability can be calculated using numbers to facilitate judgment of the experts. Therefore, this type of risk analysis can assists to quantify the justifications made by the experts of the oil and gas plant as the

probabilities of the risks identified are well computed and not only based on the experts' judgment and estimates.

As discussed by Lee et al. (2010), the hazard identification, risk assessment and risk control which also known as HIRARC is covering the process of Strategic planning, identification of hazard, assessing risk, preparing a plan for risk control action as well as step of reviewing the plan timely. This statement indicates that this type of risk analysis tool is not only stop at evaluating the risk but continues until providing the control measures that can be implemented onto the identified possible risk in the workplace. Therefore, if there is an industry or particularly oil and gas company is conducting the risk analysis along with its control procedures plan, it can be said that the company is doing or practicing the HIRARC risk analysis method.

Moreover, as pointed by Saidin (2013), the HIRARC is used to help company in planning, introducing and monitoring the protection measures to make sure that the risks are sufficiently controlled. Additionally, the author further discussed that the personal protection equipment (PPE) such as safety helmet and safety shoes is one of the risk control techniques. Here, it is understandable that when the protection equipment is provided to the personnel, the company had undertaken part of steps in controlling the identified risks in the workplace. In the specific contact in oil and gas industry, generally the workers are provided with as much as protection equipment while working in the industry and directly it is illustrating that the HIRARC technique is also implemented similarly with the technique to control risk used in the construction industry.

There are various types of risk analyses that can suit and match the operations in the onshore oil and gas plant. There perhaps a sequence of different ranges of risk analyses conducted and practiced in the plant. Thus, the specific and common risk analyses used in the plant will be identified in this research as one of the research objectives is to investigate types of risk analyses used for the operations in oil and gas plant.

2.7 CHALLENGES FOR QUANTITATIVE AND QUALITATIVE RISK ANALYSES

As explained by Bedford and Gelder (2003), there is insufficient guidance and principles that can be referred to for conducting risk management in most industries. By referring to this statement, one of the barriers during performing risk analysis for operations in oil and gas plant is the analysis and the interpretation of the related risks is not along with enough basis and information to refer with. This is because, risk analysis or risk assessment are one of the risk management process and when the risk management process are having shortage of guidance, the risk analysis will also share and bear the similar problem.

According to Aven (2008), it is simpler to make some alterations and modifications during planning stage rather than to implement any changes to the existing systems in the operating stage. It is not easy for the person in charge for the risk analysis to make changes on analysis when there are some amendments in the operations of oil and gas plant. This is because, the risk identified before may or may not be the same as the risks identified of the designed and existing operations and it is not an easy task to do all over again for such complex and tremendous operations in the plant and to update the new risk analysis for those operations as it has a potential to disturb or has capability to cease some or all of plant's operations.

There are limited challenges and issues about performing risk analysis in the onshore oil and gas plant discussed in the previous researches. Some of the researches focused on the downsides of certain risk analysis. Nevertheless, this research will interpret and find more the barriers in conducting risk analysis in onshore oil and gas plant with respects to the operations as well as with regards to the people who involve in operating the particular plant.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter will describe in detail about the research methodology used in the research. The explanation will include about the location where the research approach and the design of this research, the location where the research is carried out, the population and the sample description and the aspects of data collection. This chapter will also describe the reliability and validity of the questionnaires as well as the pilot test for pretesting those questionnaires, the ethical issues considered for data collection and last but not least description on the data analysis method. The research methodology for this research is based on the research objectives as listed below:

1) To identify types of risk that are high probably present in onshore oil and gas plant.
2) To investigate types of risk analysis practiced for operations in onshore oil and gas plant.
3) To analyze the challenges in conducting risk analysis for operations in onshore oil and gas plant.

3.2 RESEARCH APPROACH AND DESIGN

This research is a type of descriptive research as the research is paramount intended to determine the challenges faced during the risk analysis in the oil and gas plants. As illustrated by Gravetter and Forzano (2012), the descriptive-type research is focusing on the explanation or description of the individual variables respectively instead paying attention on the relationships between those variables and involving the process of measuring group of variables as in their natural state of presence. By referring to this statement, this research is once again stressed as the descriptive research since all of the variables will be analyzed respectively without considering the relationships among them.

Next discussion will be on the research design. As pointed by Kothari (2004), research design is defined as the condition's arrangement for both data collection and data analysis with an intention to integrate relevance to the research objectives. The research design used in this research is survey design. This survey is a primary data collection where the data and information are obtained directly by the selected respondents. The survey is defined as a no experimental design which uses sequences of written and verbal items that enable the respondents' opinions, thoughts and beliefs to be quantified, (Abbott and McKinney, 2013). According to Creswell (2003), survey design is allows a numeric description which is also known as quantitative description of trends, opinions or behavior of a population by studying its sample.

Kothari (2004) pointed that the research design is dominant in specifying the types of information and sources that related to the research problems and particularizing the approach to be used in collecting and analyzing the data. Other than that, research design is the plan that is implemented by the researcher to answer questions objectively, accurately, validly and economically, (Kumar, 2011). Therefore, the research design is included in this chapter as one of the crucial section of this research.

3.3 RESEARCH SETTING

This research will be conducted in the East Coast region of Malaysia. The areas that will be involved are Kerteh and Telok Kalong in Terengganu as well as Gebeng in Pahang. All of the selected areas are those in main industrial area only. These areas are chosen because there is several oil and gas plants present in that areas. The plants that are located in the selected areas are not solely participated by the main oil and gas company in Malaysia like PETRONAS but also have participation by other oil and gas support service companies for both local and international ones.

3.4 POPULATION AND SAMPLE

It is explained Vaus (2002) that population is the group of units and will be represented by the particular sample. Moreover, the full collection of measurement outputs, individual or object in a study is called as population, (Satari et al., 2011). For this research, the population defined is the companies in the three areas mentioned before which are doing business related to the oil and gas industry. Therefore, the population will be consisted of various types of oil and gas companies. Thus, the population is selected as

it correlates to the objectives of this research since the subjects for this research are related to the industry studied which is oil and gas industry.

Sampling is defined as the process whereby selecting a few items from larger group to be the foundation of forecasting the prevalence of unknown information with regards to the bigger group, (Kumar,2011). Relying on this statement, there is a type of sampling process that is chosen to be undertaken to extract samples from the population. For this research, the type of sampling selected is simple random sampling.

As pointed by Diamantopoulos and Schlegelmilch (2000), a simple random sampling is one type of probability methods by which samples are randomly selected and the potential of the population's subjects to be chosen is equal for each subject respectively. Therefore, the samples for this research are going to be selected randomly as long as the companies are doing business which related to oil and gas industry. Choosing this type of sampling has its own reason. According to Congalton and Green (1999), the core benefit of using simple random sampling process is obtaining the good and quality statistical properties. This is because there will be no bias in selecting the samples from the population since every single item in that population has equal probability of chances to be chosen for this research.

To make sure that sampling process to succeed, the targeted samples should be determined first. Satari et al. (2011) stated that a sample is a part of a population which consists of objects that are exactly observed in the study. As stated by Kumar (2011), a sample is a subset of the desired population. Thus, it is understood that the samples which are going to be selected must be those from the population that had been chosen earlier. In this research, the subjects will be constituted of oil and gas companies and for that reason, only one personnel will be needed to represent his or her company. If there are 40 companies, the numbers of participated respondents or samples will be also 40.

In collecting data, the numbers of respondents that are going to be invited as research samples are the main question. The sample size of the targeted samples will be identified by referring to the Morgan table. According to Sekaran and Bougie (2010), there is table that had been provided by Krejcie and Morgan in the year 1970 which summarized and simplified the sample size for particular population size. Based on the table, if the population size is 30, the number of samples required will be 24 samples.

For this research, the statistical information were obtained from PETRONAS Petroleum Industry Complex (PPIC)'s administration complex and lists of industry's directory by which highlighted that there are about 26 companies that have been registered to involve in the oil and gas business in the selected research areas. Hence, the sizes of samples that are needed to be randomly approached are approximately 24 companies are needed to be selected to participate in this research.

3.5 DATA COLLECTION

3.5.1 DATA COLLECTION INSTRUMENT

In this research, a questionnaire is chosen to be a tool to gather data. Respondents are selected from a specific population to answer the questionnaire. As stated by (Abbott and McKinney, 2013), questionnaire is the written questions which needed to be completed by respondents. The data collected will be interpreted statistically by using the Statistical Package for Social Sciences (SPSS) illustrates the part of statistical research design. IBM SPSS Statistics is software that takes raw data and integrates them into a new statistics which can be used as predictors, (Griffith, 2010).

According to Gillham (2000), questionnaire is only one of the methods to gain information from people and tool that provides answer to the research question. Each section will be respectively related to each research objective. These different sections will help in achieving the research objectives listed in Chapter 1 previously. For detail, questions in Part A related to the details of the respondents as well as three questions in Part B which also to gain the information of the respondents' background. Another remaining of questions in Part B complies the first and second research objectives while and the questions in the last part which is Part C will be able give direction on providing answers for the last research objective.

The questionnaire of the survey consists of three sections; Part A, Part B and Part C. The questions present in Part A are multiple choice questions. The questions in Part B are consisted of dichotomous, checklist and Likert scale questions while Part C consists of only Likert scale type of questions. As pointed by Peterson (2000), there are two root types of questions in a research which are open-end questions and close-end questions. Moreover, the close-end questions are the questions that include class of responses and answers which are identified earlier by the researcher. Based on this statement, it can be

concluded that the questions in Part A, Part B and Part C are close-end questions. Other than that, some of the questions in Part B and those in Part C are defined as Likert scale type of question. By using the Likert scale, the respondents rate their degree of agreement, (Hardy and Bryman, 2009).

3.5.2 PROCEDURE OF DATA COLLECTION

There are two methods used in order to collect data via the questionnaire. First method is by distributing the questionnaire personally to the workers in some of selected oil and gas plants. The workers are approached and will be asked to complete the questionnaire within the time allocated. The questionnaire will be immediately collected during the site visit itself. This method will help to avoid from the questionnaire from being lost or answered in longer time period.

Second data collection procedure will be by sending or distributing the questionnaire through e-mail. The questionnaire will be sent via e-mail either to the representative of particular plants or through the e-mail of the companies. This method is quicker and cost-saving as well as not time-consuming in approaching the workers who work in the oil and gas plants in the selected two states in the East Coast region of Malaysia.

3.6 RELIABILITY AND VALIDITY

3.6.1 RELIABILITY

As pointed by Hardy and Bryman (2009), reliability is aware with the variable's consistency. Furthermore, Vaus (2002) stated that the reliable results are ones by which same result are gained on the similar and repetitive conditions or events. The reliability of the measurements in this research is determined by concerning the consistency of the respondents in answering the questions during the survey. The questionnaire is distributed and will be answered by different people in the plants in order to measure the level of this reliability. As stated by Kumar (2011), the higher the level of consistency and stability in the instrument, the higher the level of reliability of the instrument. Therefore, it can be said that the degree of reliability of the questionnaire is depending on the degree of its stability and consistency in providing answers to the questions asked.

3.6.2 VALIDITY

A valid measure is when the measurement obtained is same as what one is desired to be measured, (Vaus, 2002). According to Kothari (2004), the measurement is said to meet validity where the level is confirmed towards the estimated correlations with those in theory part. Other than that is the content validity. Content validity refers to the data collection instrument able to provide sufficient coverage to the research topic, (Kothari, 2004). In this research, the questions in the questionnaire are ensured to be related and have the ability to correspond to the topic of this research as well as correlating with the research objectives.

3.7 PILOT TEST OF THE QUESTIONNAIRE

A pilot test has been conducted to test the questionnaire's reliability and its validity. The pilot test was conducted by distributing the questionnaire and took ten respondents' responses. The results obtained will then analysed by using the SPSS method.

For the first pilot test, the questionnaire was answered by the workers who work in the plants that owned by PETRONAS only. This shows that the pilot test or the pilot study involved the convenient respondents which are also have all criteria of the sample as stated previously. As pointed by Martinez (2007), a pilot study is to test the instrument which is a survey that was conducted in a New Mexico school district and the pilot study gave the researcher the chance to solve some decision-making problems with reference to the implementation of survey approach.

A pilot study is a phase by which gathering a small amount of data to test the procedures of a particular project, identifying the problems for the collection of data protocols and to prepare the stage for an actual and real study, (Teddlie and Tashakkori, 2009). Hence, by using the results from the pilot test carried out, the instrument for this research which is the questionnaire will be known its readiness and its precision as well as its accuracy level to be used for data collection in an actual research.

Besides that, the pilot test able to convince the researcher about the stability of the instrument. As stated by Painter et al. (2006) that the pilot studies' outputs can assists to convince the reader that the study has been planned carefully and can give good

perspective where the study gives results that shows the study is a scientifically sound study.

The pilot test was carried out and was analysed by using SPSS system. The pilot test or in other words the reliability test of the instrument was conducted in two different sessions. For the first time, the pilot test was conducted by using only ten respondents who are only the PETRONAS's workers. Based on the results, the obtained value of Cronbach's Alpha for the questionnaire is 0.479. The value shows that the questionnaire is unreliable. As explained by Bryman and Cramer (2005), the principle of the output should be 0.8 or above and this rule is used to examine retest reliability. Hence, there will be some items in the questionnaire should be deleted to achieve the suggested Cronbach's Alpha value.

According to Leech et al. (2005), the value of Cronbach's Alpha will increase by removing or deleting poor items. By referring to the table of SPSS results attached in the appendices, there are some items to be deleted in order to gain higher Cronbach's Alpha reading. The items or also known as variables with high Cronbach's Alpha values are chosen to be selected for this action. Based on judgment and justification, variables noted with V3, V20, V22, V26 and V30 will be deleted from the questionnaire. The reason is, all of these ranges of items have values of 0.504, 0.522, 0.534, 0.537 and 0.540 respectively and they carry and give high value of Cronbach's Alpha value if they are erased.

As for assumption, by deleting those items will results higher Cronbach's Alpha value which represents and demonstrates that the questionnaire is more reliable after deleting the items. However, the deleted variables will be then replaced with new ones and the others will be reviewed. The reviews of questionnaire are as follow:

- Include the demographic types of question. The demographic question is about the workers' background and their working experiences. The reason of this question is included because the working experiences can ease the respondents to answer the questions during the survey.
- The arrangement of the questions is changed. The alignment of the answers is considered.
- The questions to determine the types of risk analyses are not directly refer to those analysis method but some descriptions or statements are outlined in the

questionnaire since the personnel might not be really sure or familiar with the name of the methods and yet, they are actually practicing these kinds of methods to analyze risks in the plant.

After the questionnaire had been reviewed and adjusted, second pilot test was run. The pilot test involved twelve respondents which consisted of various companies' workers. Furthermore, the pilot test was conducted for two different parts. For the first part, the variables 1 to 23 were tested. From the generated results for these variables, the Cronbach Alpha value was achieving up to 0.732. Additionally, the results for another remaining variables shows that the reliability of the answers was relatively high. This is because the Cronbach Alpha value was achieving up to 0.773. Since the valid reliability value is more than 0.700, therefore it can be concluded that the answers collected were relatively reliable and can be trusted since they have high reliability values.

3.8 ETHICAL ISSUES

In conducting the survey for this research, some ethical issues are considered. The very first issue is concerning about the respondents' benefits and advantages. As pointed by (Abbott and McKinney, 2013), the main directive in conducting research is to protect the participants and the others are including scientific and social responsibilities, integrity and also the discipline-specific professional standards.

Vaus (2002), wrote in his book that most of the professional codes of ethics emphasis on the five responsibilities towards those who participate in the survey. The five ethical responsibilities are informed consent, no harm, issue of privacy, voluntary involvement and confidentiality anonymity.

3.9 DATA ANALYSIS METHOD

After the data have been gathered, the researcher then will shift to the task of analyzing the data collected. The data analysis requires related operations such as establishment of categories, the application translating of those categories to raw data by using coding, tabulation and last but not least come out with sort of statistical inferences, (Kothari, 2004).

For the data analysis and detail interpretation of the survey outcomes purposes, the data collected will be gathered in Microsoft Excel for backup database. Furthermore, the data analysis will be conducted in specific time given for this research. The analysis will involve tremendous data that need to be analyzed.

In this research, the data that have been collected from the survey will be analyzed or interpreted by using software named SPSS. Abbott & McKinney (2013) argued that some statistical software packages are present to manage and analyze data but the SPSS is most flexible and responsive program. Thus, it is believe that SPSS is the most suitable and outstanding method to be used to analyze the data collected for this research.

As a conclusion, the research methodology in this chapter provides and shows the strategy for this research to be conducted and guidelines to gather and analyze data obtained through selected respondents' answers. Last but not least, the research methodology provides a specific direction in achieving the research objectives.

CHAPTER 4

DATA ANALYSIS (FINDINGS & DISCUSSIONS)

4.1 INTRODUCTION

This chapter focuses on the discussions of all findings regarding to the research. All of the results were obtained through data collection process and were analyzed by using SPSS software. Through further discussions on the analyses, the objectives of this research are directly achieved.

4.2 METHOD AND PROCEDURE

During the distribution of questionnaires, there were two methods used to collect needed data. As this research concern is on onshore oil and gas industry, the respondents approached were those who are working in this industry. Some of the questionnaires were given out through emails and some of them were distributed by hands. The rationale of distributing by hands was to ensure that the respondents answered the questions thoroughly and honestly besides of decreasing the time of waiting replies from emails.

Additionally, the questionnaires collected from both methods were analyzed by using the SPSS software. The variables in the question papers were evaluated through frequency statistics. There were no regression and correlation analyses due to this research are not involving any hypothesis and the variables are independent and were not affected by each other. All variables that represented each questions in the questionnaires were typed in the SPSS and saved. Next, the variables were transferred one by one in the dialogue box appeared. The" statistics" and "charts" toolbars were adjusted as needed.

For the demographic questions, the presentation of pie charts was used. However, the presentation of data by using bar charts were chosen since it suits better to illustrate the values of the percentage of the frequencies so that the differences among the variables.

In the summary table as shown in Appendix A, there is standard deviation values included which was used to see and consider the goodness of the data in the database of the SPSS. After all, when the variables were analyzed, there were several output sheets that contain summary table, frequency tables for each variables and bar charts presentation. Every frequency tables and bar charts of each questions or variables are useful in assisting the explanation in additional discussions in next section of this chapter.

4.3 RESPONDENT PARTICULARS

As stated earlier, the respondents approached were personnel in the onshore oil and gas industry. The personnel were those who worked in plant or workshop and were chosen from any companies that are doing business with regards to this industry. The details of the respondents were obtained through the data gained in Part A which consists of few demographic questions and questions numbered 5 to 7 in Part B. The outputs of these sections are as followed. Each variable represent the questions in the questionnaires in sequence respectively.

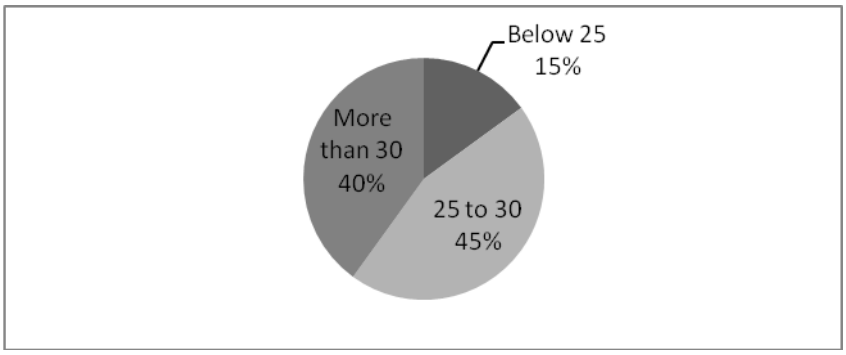

Figure 4.1 Age

As shown in the above Figure 4.1, most of the respondents are from the range of 25 to 30 years old with score of 45%, followed by those who are more than 30 years old where the percentage is 40% and the respondents whose age are below than 25 are having the least percentage which is only 15% out 100%. This statistics show that most of the respondents who participated in this research are those who are 25 to 30 years old.

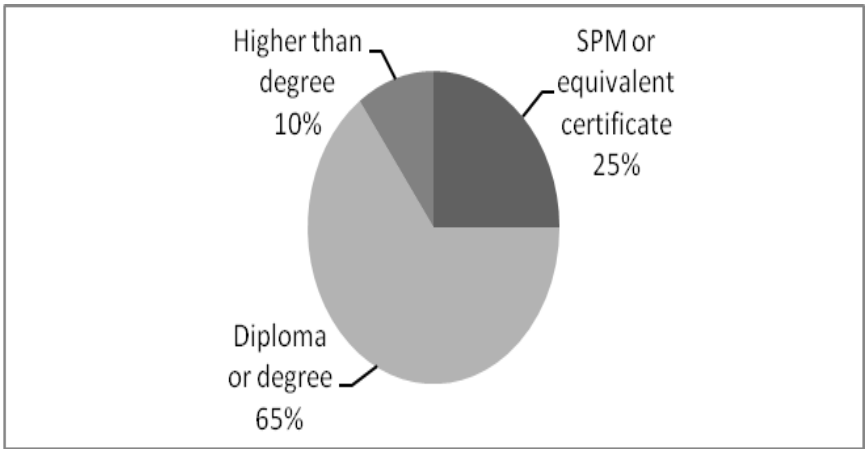

Figure 4.2 Education Level

The second pie chart illustrated in Figure 4.2 shows that 65% of the respondents are Diploma or Degree holders while 25% are holders of SPM or equivalent certificates. Besides that, there is only 10% of respondents participated in this research has education level of higher than degree level. These numbers indicate that this research are joined by different and various levels of education.

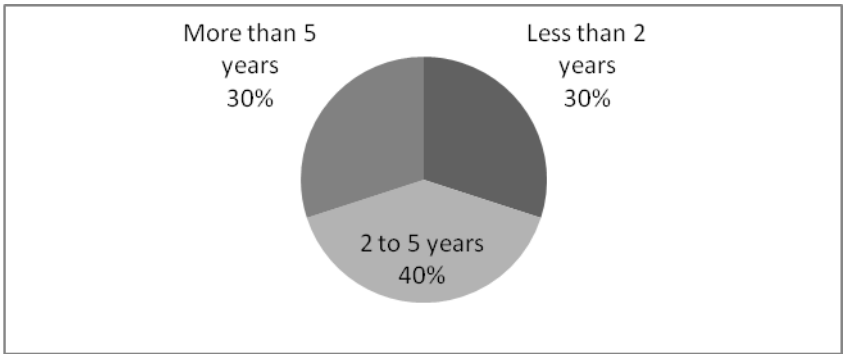

Figure 4.3 Working Experience

The value of 40% illustrated in above Figure 4.3 represent that most of the participants or respondents of this research have worked for their companies for two to five years whereas the half of remaining 60% have been worked for more than five years and the other half signify those who have worked only for less than two years which are still

new to the companies' surrounding and have less experiences. The 40% respondents are having moderate level of working experiences in the companies that had been chosen to be the samples or subjects in this research.

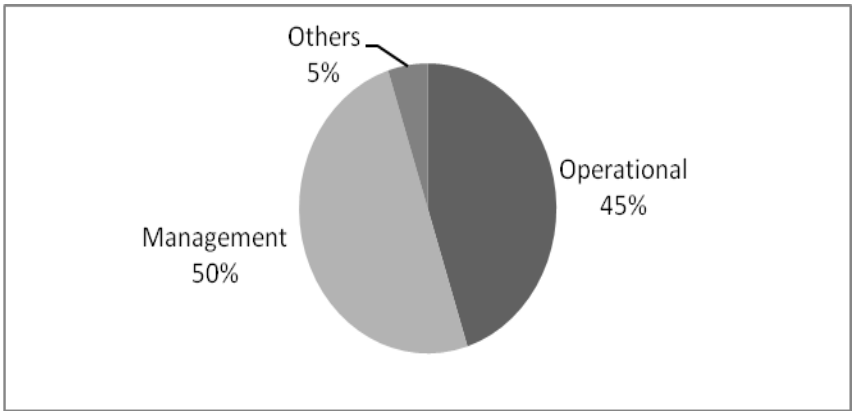

Figure 4.4 Working Section

The Figure 4.4 represents the working background of the personnel. The question in this part outlines the department or section which they are working in. Based on the chart for this variable, 50% of the respondents answered second option which is "management", 45% chose "operational" and only 5% answered "others". Here, it can be summarized that mostly of the respondents in this research survey are those who worked in management and operational departments. The 5% of the total respondents refer to those who are not working in other those two departments. Thus, it is defined that this research are engaging all units of the industry despite of only involving the personnel who work at certain unit only.

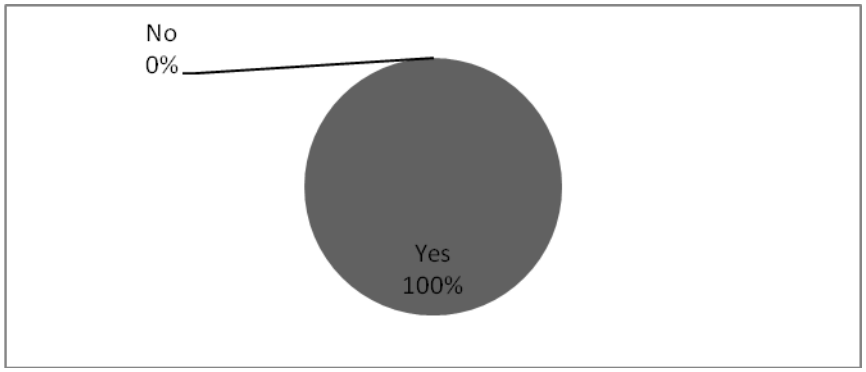

Figure 4.5 Safety Training Given

According to the pie chart shown in Figure 4.5, it is stated that 100% of the respondents approached to answer the questionnaire were given some sort of safety training. It is understood that every employee in the oil and gas industry is compulsory to attend particular training program without limiting the needs of the training to only those who work in a plant or workshop.

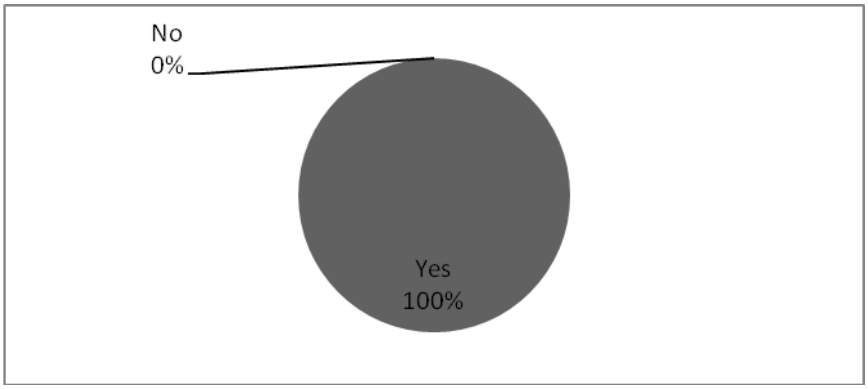

Figure 4.6 Presence of Safety Policies

The Figure 4.6 which demostrates the pie chart that corresponds to the question which to identify whether the respondents are aware and have knowledge on the safety policies provided by the companies. As a result from the analysis, 100% of the respondents answered “yes” which directly proves that all oil and gas companies are having their respective policies regarding to safety issue and the employees are well concern on the policies that they need to follow. These policies are the guidelines for the personnel to work without neglecting the safety procedures.

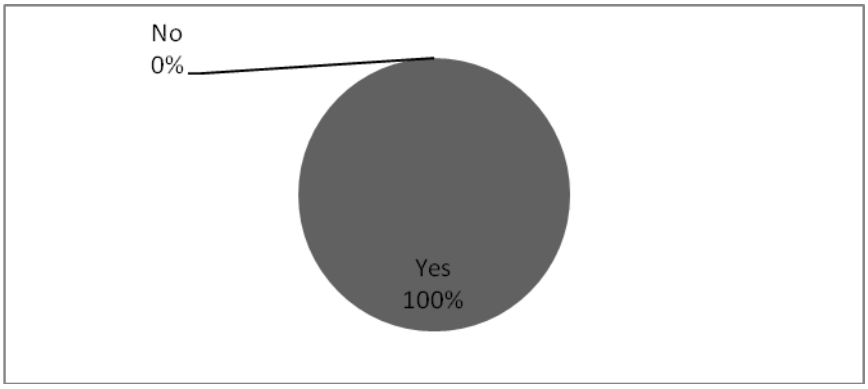

Figure 4.7 Hazard Signages Displayed

By referring to the pie chart as shown in Figure 4.7 above, it is demonstrated that none of the respondents anwered “no” for the question of whether there are hazard signages displayed in the plant they work in. The signifiance value of 100% verifies that there are hazard symbols pinned up in the plant or workshop they work in where these symbols act as a reminder to the oil and gas personnel so that they are always alert towards the hazards at their circumstances. Hence, all of the respondents in this research are sensitive to the signages provided in the workplace as well as the presence of hazards itself. In a nutshell, through the analysis of the questions 1 to 7, it is confirmed that the respondents invited to response to the questionnaires are suitable and appropriately approached to be the samples in this research.

4.4 GOODNESS OF DATA

The goodness of data collected in this research is not measured by using the Chi-square test. The reason of not using the test is because this research does not involve any relationships, interdependent variables or drawing out a hypothesis. The goodness of the data was only analyzed through observations on the values of standard deviation and variance for each variable. In the descriptive statistics table shown in the Appendix A, there is summarization of standard deviation together with its respective variance for all variables. Moreover, there are also mean values, median as well as skewness for each variable are only for additional information of the data that had been analyzed.

The values of standard deviation and their variances signify the dispersion of data. In other words, these values are useful to see the spread of the data. The larger the values, the higher the degree of the dispersion. This statement shows that the data are more dispersed. The high value of standard deviation and variance verifies that data of a particular variable for a respondent is highly differs to the others. For an instance, the first respondent was selecting different answer for 24^{th} variable in the questionnaire (standard deviation value of 1.119) compared to the second respondent which means their answers were not very likely or similar to each other.

Conversely, the standard deviations for the first three variables in Part B are 0.000. These values defines that there is no difference of answer chosen by the respondent as 100% of the respondents chose to answer “yes” for the variables number 5, number 6 and number 7. However, the standard deviations for these three questions do not affect the

goodness of the data in this research because the questions are only for determining the particulars of the respondents. When refers to the standard deviations for other questions in Part B and all questions in Part C, it can be seen that the values are relatively high which means there are more dispersion among the data. Therefore, the more the data disperse, the higher the degree of data goodness. As a conclusion, the data collected in this research are useful and trustworthy towards achieving the research objectives.

4.5 FINDINGS AND DISCUSSIONS

- *Research objective 1: Risks that are high possible to occur in plant.*

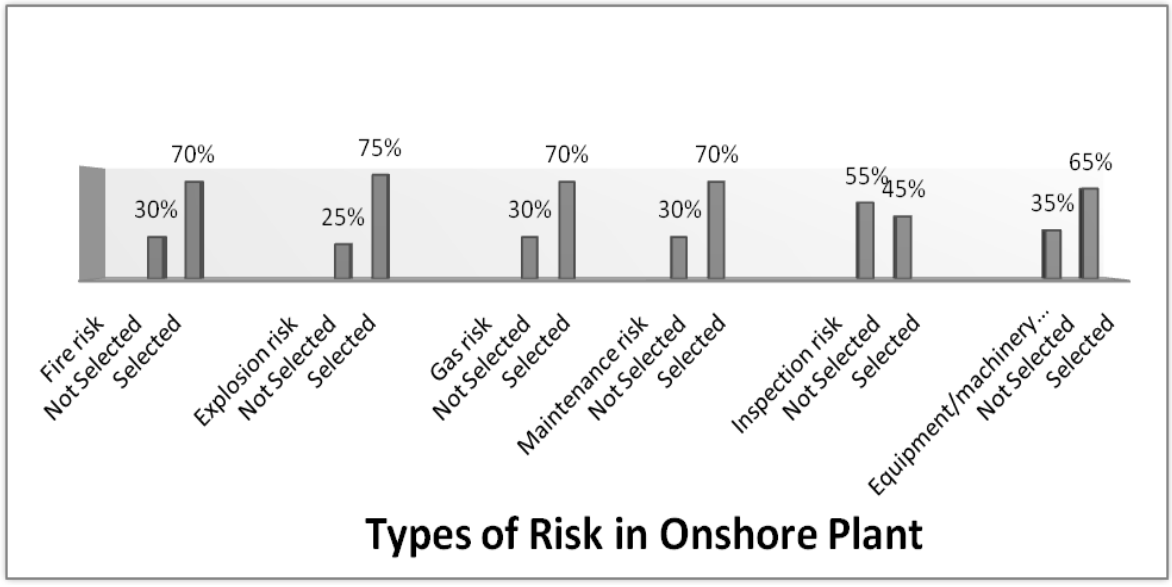

Figure 4.8 Types of Risk in Onshore Plant

Based on the statistics shown above, there are 30% of the respondents do not ticked for this type of risk while 70% of the respondents did ticked this risk. According to this situation, it is concluded that there is high potential for the plant to have fire risk. The fire risk is due to the processes in the plant by which mainly in contact with oil material and gaseous element which known as flammable materials as the onshore oil and gas industry is undergoing the assimilation process to transfer the crude oil and gases extracted and brought up by the activities at an offshore site into some other end product such as plastics and other derivative such as polyethylene. For those 30%, it can be concluded that the

respondents who did not tick for this type of risk option because the plant or workshop they work in is in contact with the flammable chemicals and materials or if there is any, it is not that much if compared to the respondents who work in the plant that mainly producing or surrounded with large source of fire.

The next variable represents “explosion risk”. For this variable, 75% of the respondents in this research survey rated that an explosion risk is present in the onshore oil and gas plant while the other 25% did not chose to tick this option of answer. Hence, it is clearly seen that most of the respondents are conscious with the potential of the explosion risk in the plant or workshop they work in. Corresponding to variable for explosion risk, the explosion risk is also one of the risks as there is fire risk due to the explosion is high possibly to occur if there is ignition of fire in the plant besides of results of gas leakage and other equipment failures in the plant. The statistics of the presence of explosion risk in the onshore oil and gas plant are supported by the occurrence of an accident happened in one of the plant in Kerteh Industrial Area.

By referring to the level of bar chart for next variable, it is clearly seen that the number of respondents who rated there is gas risk in the plant is higher compared to those who rated vice versa. This is proven by the considering the percentage of each answer. There are 70% of the respondents which means more than half personnel approached select the option of “gas risk” whereas only 30% of the total respondent did not tick the option. The percentages demonstrate that majority of them are alert to the existance of this category of risk. Furthermore, this statement points out that the personnel of the selected oil and gas companies are exposed to the gas risk when they are in the workshop or the plant as the onshore oil and gas industy is enfolded with an existence of various gases apart of other chemicals processed and derived in the plant.

Next discussion is on the finding for particular variable that represents an option of a maintenance risk. Based on the Figure 4.8, 30% of the respondents did not voted that there is no risk regarding to the maintenance run in the plant whereas the rest respondents state that there is high potential of bearing maintenance risk in the onshore plant. The respondents who rated the maintenance risk is not one of the risks that have high possibilities to take place in the plant may be those who work in the plant or workshop in the plant that undergoes little maintenance or in other words they thought that there is no

or small possibility for any undesired condition to happen during or due to the maintenance procedure which taking place in the plant. The plant will be shutdown or the operations in the plant will be ceased to allow the responsible personnel to carry out maintenance in the plant and thus reduce the level of an exposure to the risk is one of the reason of the judgment. On the other hand, most of the respondents tick the option of this type of risk because they recognize that there is still risk with regard to maintenance process although the operations in the plant or workshop are stopped and they are informed and admitted the fact that there will still have risk as a result of human or technical errors during the maintenance process undertaken earlier in the plant.

Variable number 12 signifies the option of an inspection risk. 55% of the respondents in this research denied that there is or high possibility of the inspection risk in the onshore oil and gas plant while the other 45% verify that the risk is present in their workplace. From the personal view and observation, there were several respondents were not familiar with the term of “inspection risk” stated in the questionnaire during the distribution of the survey papers. For that reason, it can be concluded that most of the respondents of the plant or workshop are not informed or sensitive on this type of risk. Besides that, it is understoodable that there is no or less possibility of inspection risk in the onshore oil and gas plant.

As in Figure 4.8, the pie chart for the next variable above represents the distribution of answers for “equipment or machinery risk”. Mainly of the respondents claim that there is this type of risk in the workshop or onshore plant with relative high percentage which is 65% while the other 35% of whole number of respondents participated in this research reject the argument that the risk is not having high potential to occur or will not occur at all. For further discussion, the higher percentage is considered. From this data value, it is analyzed that there is high chance for the risk related to equipment or machines used in the plant to take place. This is due to existence of numerous complex machines and equipment in the oil and gas worshop or plant as the operations in the plant are complex and dangerous.

- *Research objective 2: Risk analyses done that suit operations in plant.*

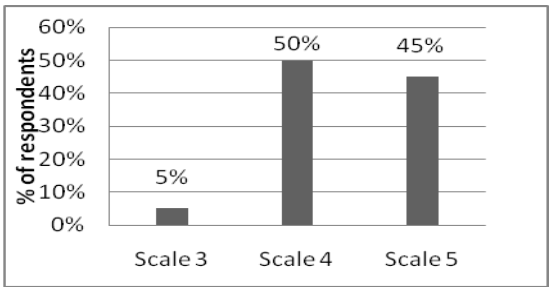

Figure 4.9 FMEA (i)

The Figure 4.9 is illustrating failure modes and effect analysis (FMEA) type of risk analysis. Based on the table and chart, there are none of the respondents rated 1 (strongly disagree) and 2 (disagree) for this section of variable. The minimum score value chose is 3 (average) followed by 4 (agree) and the maximum rate selected is 5 (Strongly agree). Among all these three selections, the rate 4 has highest percentage which is 50% whereas 45% of the total respondents were rating the score of 5 and the rate of 3 holds the least number of percentages. By interpretation of the 5%, only one respondent answered 3 which representing his or her balance rating between the degrees of disagree and agree. Thus, it is summarized that 95% of the respondents consent that the FMEA type of risk analysis is carried out for the onshore oil and gas plant as their answers are most fall on 4 refer to the statement of the possible failures are going to be identified when there is any break down in any particular operation. For that reason, it can be said that there is an implementation of the FMEA method to analyze risks that exist in the plant.

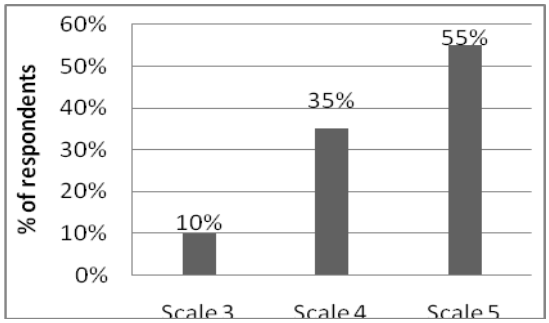

Figure 4.10 HAZOP (i)

The bar chart in Figure 4.10 represents the statement of proving that the hazard and operability studies (HAZOP) is used to analyze the risks in onshore oil and gas plant. According to statistics illustrated in the table and the bar chart, 55% of the respondents rated 5 and 35% rated 4 options. These two percentages show that majority of the respondents agree that the hazard of the equipment they used in the plant were studied and identified. This strongly verifies that the plant is carrying out the HAZOP in order to analyze the risks presence in the plant. The 10% of the remaining respondents are at balance of either disagree and agree towards the argument whether the plant or the workshop they work in is undergoing HAZOP type of risk analysis which indicates that they are only agree that the hazards are identified for certain equipment and some of the others are not studied on their existence of hazards.

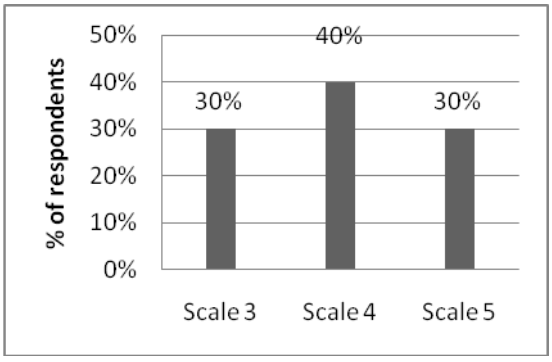

Figure 4.11 SWIFT (i)

Figure 4.11 represents the question which is aimed to define whether the type of risk analysis used in the plant is a structure what-if technique (SWIFT) type. Based on the above table and bar chart, 40% of the respondents rated that they are agree that they will consider what will be happened in the future if there is an operation to be stopped. Moreover, the rest half of 60% are strongly agree with the statement in the questionnaire while the other half of the remaining respondents are in average judgment between disagree and agree. These statistics validate that in the onshore oil and gas plant, the presence and occurrence level of risks are analyzed by using the SWIFT technique as the future impact that needed to be bearded if any undesired condition happened with regards to the operations are put into the considerations.

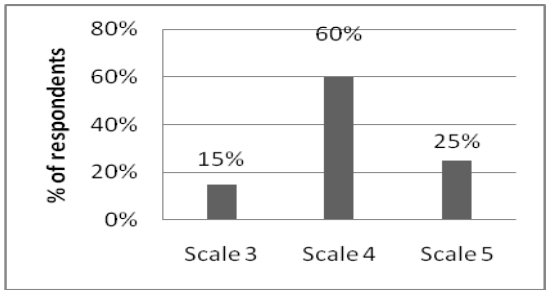

Figure 4.12 HAZID (i)

The pie chart in Figure 4.12 is the representative for hazard identification studies (HAZID). This risk analysis were not denied by 60% of the participated respondents, only 15% were in average decision while 25% of the left respondents rated that they were strongly agree that in the plant or workshop they work in, the risks are assessed or analyzed by using HAZID method. This argument are supported by 85% value when summed up which indicates most of the respondents are acknowledged that the HAZID method are used to analyze risks. The 15% of the respondents who were in average level of satisfaction as they were not sure whether the risks of a system in the plant are determined together with its sub-system also or only the big picture of the system is generally analyzed.

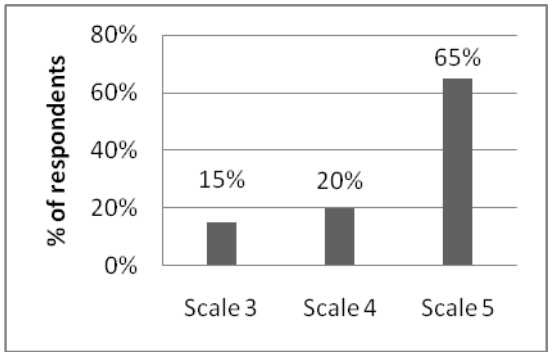

Figure 4.13 HIRARC (i)

The Figure 4.13 symbolized the implementation of hazard identification, risk assessment and risk control (HIRARC) in the onshore plant. Majority of the respondents with 65% values were strongly agree and 20% were agree that if a person is entering the area of the plant, he or she is needed to be provided with some protections. The percentage values are significant in proving that the elements of controlling risks are included during assessing the risks. Likewise, this is referring to HIRARC risk analysis

technique. In opposition, 15% of the respondents who were in balance justification are due to the condition of sometimes the protection tool such as PPE seem unnecessary to be provided for personnel when they are just entering the area but not for working on the operations in the plant. By considering the distribution of strongly agree and agree answers, it is determined that the risks in the plant are analyzed up to providing control measures to mitigate the risks also and not limited to only identifying the risks and their effects alone.

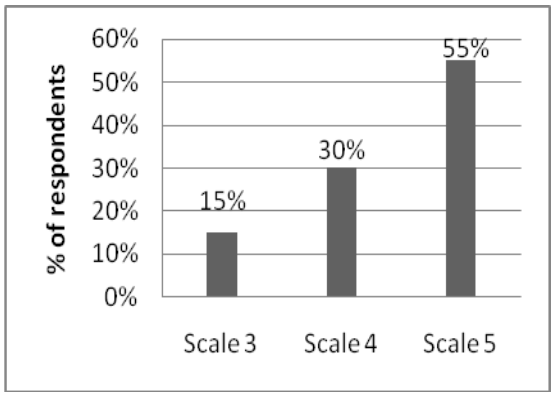

Figure 4.14 FMEA (ii)

The Figure 4.14 above shows the distribution of preferences or answers by the respondents which is also illustrating the justification and satisfaction of the respondents towards the second statement that referring to FMEA method. The statement in this section is about defining and examining level of the respondents' satisfaction on whether there is any identification of effect or impact regarding to the incidence of failures in particular operations. The rate that holds the highest percentage of selection which is rate 5 and the second highest percentages which is 4 with 30% values indicates that when there is risk of operations to fail, its consequences are also examined. Through this analysis of risks, it is proven that the FMEA system is practiced. The average satisfaction which holds 15% of the respondents rated 3 showing that the thing which is needed to be done during analyzing the risks is only determining the risk of failures' event itself instead of searching out their impact unless the failures will give huge losses when the failures in the plant's operations take place.

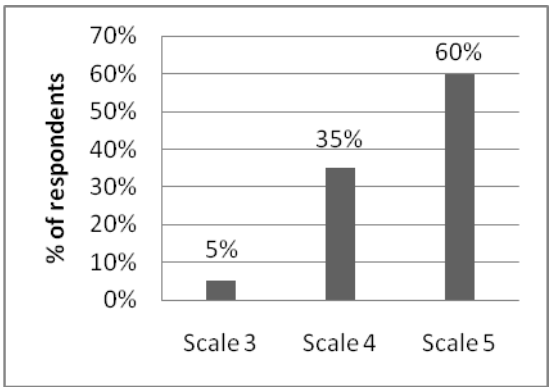

Figure 4.15 HAZID (ii)

The variable's answers shown in above figure correspond to the next supported question in identifying application of HAZID method to analyze risks in the onshore oil and gas plant. As previous variables, the rate 5 embraced the highest value of selection. The 60% of the respondents show that the respondents were mainly rated strongly agree by which the technique of doing a checklist on the equipment's hazards is also done in order to analyze the risks in the plant. By having this type of activity, it verifies that the plant or workshop they work in is actually conducting the HAZID method. In addition, this verification is sustained or supported by another 35% of the respondents who were agreeing that during the process of evaluating the risks in the plant, the hazards related to the equipment they used are figured out via the checklist.

On the other hand, the 5% of respondents rated that they were in average towards the statement because either they think that not all the time that hazards of the equipment is checked up or they were just not sure whether the checklist is present at the time the risks are assessed. Directly, this condition refers that some of the respondents are cannot to determine whether the plant is carrying out a risk analysis by using HAZID. By aligning the previous 17th variable in the questionnaire and this variable, it is absolutely identified that the HAZID method is also used during the process of analyzing the risks in the onshore oil and gas plant.

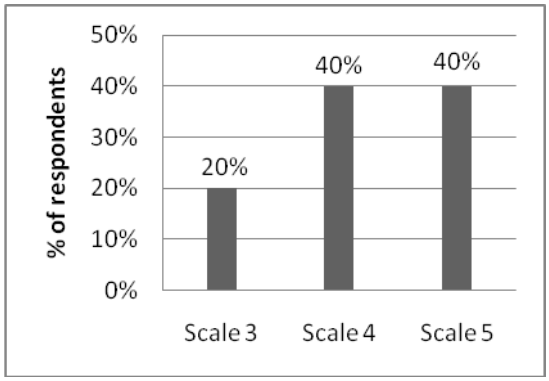

Figure 4.16 SWIFT (ii)

The next variable is variable as illustrated in Figure 4.16 represents the statement that able to prove that the plant is conducting its risk analysis by using SWIFT. The Figure 4.16 above figures out that both scales 4 and 5 are having same numbers of selection which are 40% respectively whereas the scale 3 carries another 20% out of all respondents involved in this research. The value of 20% indicate that several personnel in the plant are not satisfy that much that the plant they work in is identifying the consequences of the changes made on any procedure of operations in the plant or workshop due to there is not that much changes made and if there is any changes undertaken, it has no or has no large impact to them. The 80% of the respondents who are both strongly agree and agree towards the statement and together with the results for variable 00016 specify that the risks in the oil and gas plant are analyzed by using the SWIFT risk analysis by which the consequences or effect in the future time if the risks occur are taken into serious consideration and concern in investigating and evaluating the risks in the plant.

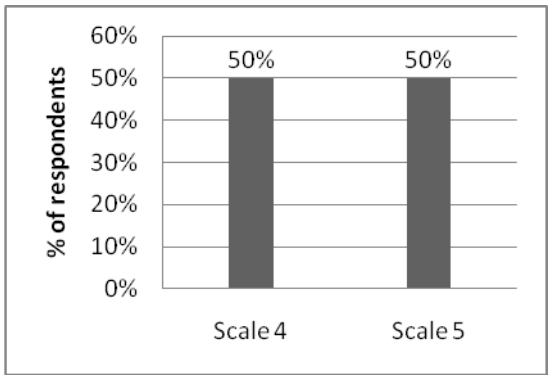

Figure 4.17 Fault Tree Analysis

The variable represents section in the questionnaire which is for identifying whether the risk analysis carried out in the onshore oil and gas plant is involving the usage of fault tree analysis. By looking at the bar chart in Figure 4.17, it is demonstrated that half of the personnel are strongly agree while the other half are agree that any system or operation that is going to be conducted are needed to be determined its risks at the time the system or the operation is taking place into action. The statistics shown above are significant which means the risk analysis is conducted in the plant is practicing the method of fault tree analysis to assess the onshore oil and gas plant's risks.

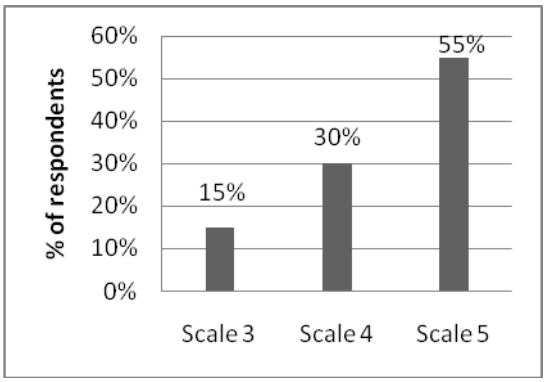

Figure 4.18 HIRARC (ii)

The second statement that supports the presence of HIRARC risk analysis is the statement which mentions that there are methods to control risks practiced in the plant. Based on the bar chart as shown in Figure 4.18, it can be seen clearly that 55% of the respondents were strongly agree while 30% were agree with the statement. Besides that, only 15% were selecting scale 3 which means average satisfaction. According to these numbers, it show that most of the respondents were having an idea that there are methods to control the risks although the risks are impossible to be neglected as undertaking the risks is crucial to ensure the continuity of the operations in the plant and even the risks have relatively high probability to happen. Here, it can be summarized that it is important for the risk analysis to include along the mitigation measures for the controlling methods of any risks that had been analyzed.

As a summarization, there are several different methods can be used to analyzed risks in the onshore oil and gas plant. These include FMEA, HAZOP, SWIFT, HAZID, the

fault tree analysis as well as HIRARC. The suitability of these methods is seen as match for the operations carried out at onshore sites. Therefore, the risks in the plant can be analyzed by applying more than one method of analysis techniques as long as they are fitting to the operations or the systems applied in the workshop or the plant.

- *Research objective 3: The challenge/s regarding to quantitative and qualitative risk analysis.*

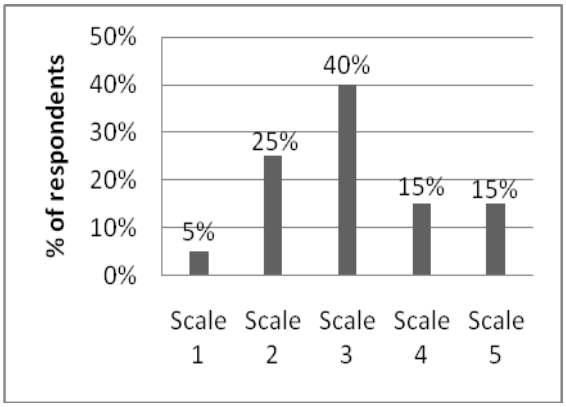

Figure 4.19 Not All Operations Dangerous

The variable by which representing the first statement that is used to judge either the particular statement can be considered as a “challenge” statement or vice versa. For the discussion of the findings for this variable and the other variables, only the highest percentage will be discussed as the highest percentage is considerable and significant in determining which statements are considered as challenges and what are not. In this variable’s bar chart, different percentages of answers’ scale were selected by the respondents are figured out as shown above.

There are 5% of the whole respondents whose answers are strongly disagree, 25% disagree, highest percentage which is 40% represent those rated their satisfaction as average or neutral and another 30% answered agree and strongly disagree with equal distribution of remaining percentages respectively. The personnel in the plant or in the workshop have balance justification towards the argument by which not all operations in the plant are dangerous. This showing that the respondents were not very sure either all operations are unsafe or only several of them are dangerous. As they rated the average

scale, it refers to an undecided determination of answers. Therefore, this variable is considered as the first challenge in conducting the risk analysis in the plant.

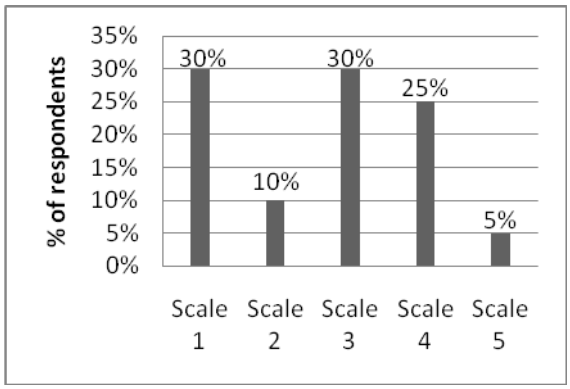

Figure 4.20 Accident Not Informed

Next variable refers to the statement of “sometimes, you are not informed when an accident happened in the plant”. This results generated by the SPSS for part of questions illustrating that there were 30% of the respondents approached chose the scale of “strongly disagree”, 10% were disagree, 30% were average, 25% of the respondents were agree and 5% of the respondents were strongly agree towards the statement. Based on the findings as displayed in Figure 4.20 above, the scale 1 and scale 2 have same amount of percentages. In other words, with the summation of percentages for the first three scales, the respondents’ justification have more tendency towards disagree correspond to the argument. Hence, it is determined that most of the personnel in the plant were well informed when there is any accident occurs. So, this variable is judged as the challenge of the risk analysis.

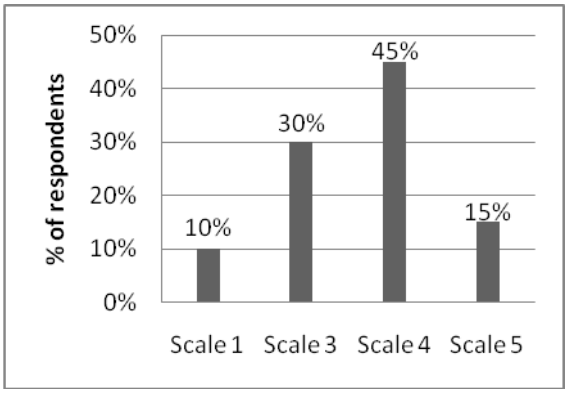

Figure 4.21 Have Lots of Accident’s Record

Based on the Figure 4.21 that symbolized the answers for 6th variable, 10% of the respondents is strongly disagree that they were having a lots of information and records of accident that had happened in the plant. Furthermore, 30% were in average range, 45% were agreeing while the remaining 15% were strongly agreed. By comparison, the highest percentage is held by scale 4 or option “agree”. Thus, it is understandable that the respondents who were participating in this research are provided with wide range of information and records regarding to the past accident took place in the plant. Accordingly, this statistics are showing that this variable is also believed as the challenge to carry out the risk analysis in the onshore oil and gas plant.

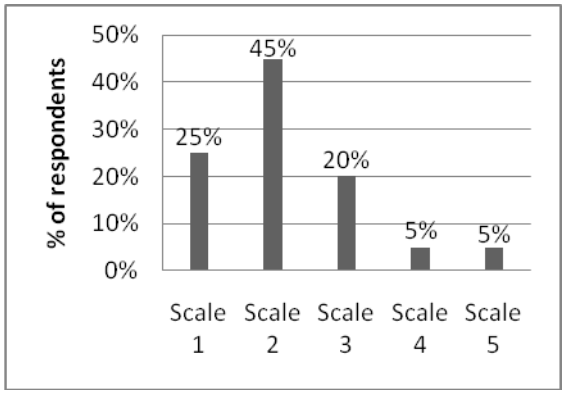

Figure 4.22 Risk Does Not Impact

The statistical findings shown in the bar chart as in Figure 4.22 represent the results of analysis for the next variable. 25% of the respondents were strongly disagreeing, 45% were disagreeing and 20% were rating the “average” scale. In addition, the half10% of the left respondents were agreeing and the other second half were strongly agreeing with the phrase that which stating that “you think that some of the risks in the plant will not gives you impact when they occur”. The highest percentage found is the one for scale 2 which means most of the respondents rejected the statement. In their point of view, there are impacts affecting them when the risks exist in the plant occur. This is illustrating that the respondents aware that the risks in the plant have particular consequences. Therefore, this justification demonstrates that this variable is not considered as one of the challenge that needs to be identified in this research.

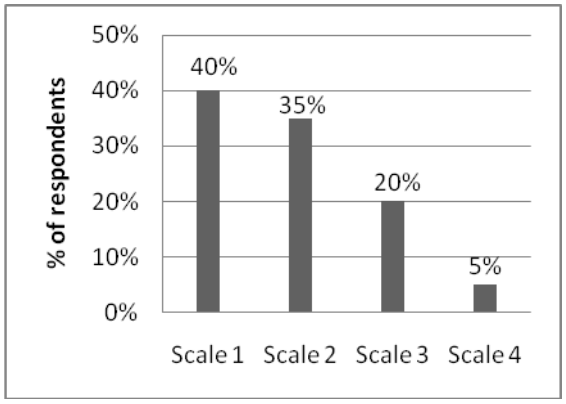

Figure 4.23 Not to Report Minor Accident

The next variable is representing the next statement which is “when there is minor accident taking place in the plant, you prefer not to report it to the management unless it is very serious”. This lengthy sentence is included in order to highlight the preferences of the personnel in the onshore plant towards reporting the accident to their superior or to the other management level. Based on the chart presentations, the highest percentage is 40% which refers to the scale 1, 35% chose scale “disagree” whereas 20% of all respondents are in average satisfaction and only 5% were agreeing to the statement. The significance highest percentage shows that majority of the plant’s personnel preferred to report the accident happened to the management level although the accident is classified as minor accident only. This is also shown that every accident that is taking place in the plant surrounding is reported and even the one which is not that very serious is not hidden from the consent of the management level. Consequently, this variable is not falls under the category of risk analysis challenges.

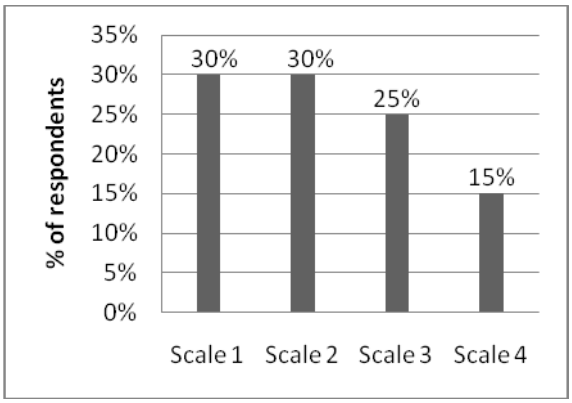

Figure 4.24 Involvement of Safety Department Only

The next Figure 4.24 represents the degree of respondents' judgment on the issue of involving safety department only in conducting risk analysis. Through the research survey, it is extracting that 30% of the respondents were strongly disagree, another 30% were disagree, 25% were in average range of satisfaction and lastly only 15% of the whole number of the respondents involved were agreeing that risk analysis is only need to involve the safety department. Thus, it is observed that there are two scales have the same high percentage of 30% for each scale which symbolized most of the respondents were not agreeing the statement. As a whole, the risk analysis that is going to be done is involving the participation of the personnel or their representatives from all departments instead of only allowing the safety department. For that reason, it can be said that this variable is not explaining and not determined as the challenge with regards to risk analysis.

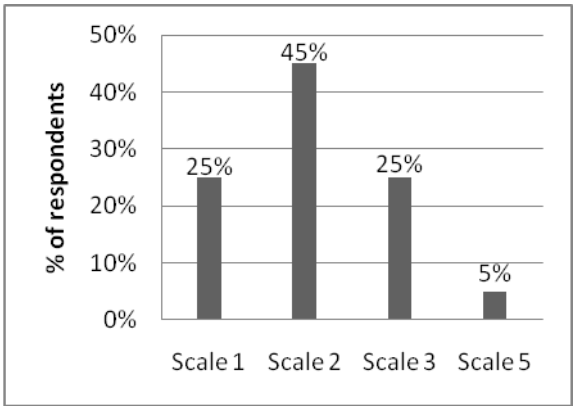

Figure 4.25 Risk Analysis for Several Operations Only

The pie chart in Figure 4.25 above indicates the variable which is included to represent the statement that conveying the justification of the respondents towards the necessity of conducting risk analysis for only several operations in the plant. As a result, the statement is strongly disagreed by 25% of the respondents, 45% were disagreeing, 25% is in balance between disagree and agree and only 5% rated that he/she was strongly agreeing that only several operations in the plant need the risk analysis. Still, the ratings were more skewed towards denying that only several operations need to have risk analysis. So, it can be concluded that all operations in the plant require the process of analyzing their related risks since all operations in the plant are relatively dangerous. Hence, this variable is considered as not the challenge in performing the risk analysis in the oil and gas plant.

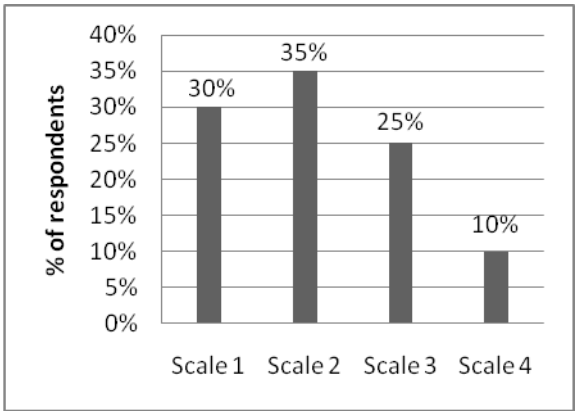

Figure 4.26 Risk Analysis Only Liable on Risk Manager

The next Figure 4.26 representing the results of findings for the 31st variable in the research instrument. This variable is representing the idea or opinion of the plant personnel on the roles and responsibility in conducting the risk analysis in the plant. The scale of strongly disagree was rated by 30% of the respondents, another 35% were disagreeing, 25% were in neutral or in average satisfaction while only 10% out of 20 respondents were agreeing that only safety manager or risk manager is responsible to conduct risk analysis.

By referring to these statistical numbers, it is perceived that the responsibility to conduct risk analysis supposedly and not limited to only the safety or risk manager. On the other hand, all positions in the plant or in the companies are responsible and liable to carry out the risk analysis. In other words, the respondents' answers show that all level of personnel in the plant were participating together with the safety or risk manager to work out the risk analysis needed in the workshop or the plant they work in. Hence, the findings for this statement verify that this variable is not identified as one of the challenges to do risk analysis in the plant.

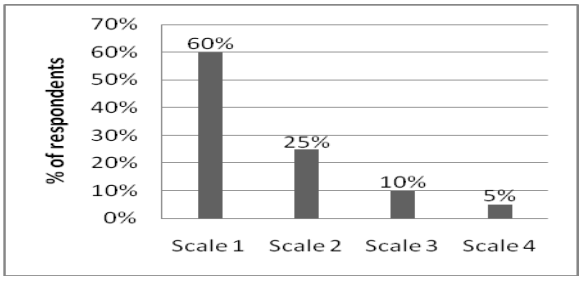

Figure 4.27 Risk are Only Prediction

The next variable to be discussed is the variable by which well displayed its result in Figure 4.27. Under this variable, the statement is on “risks are only prediction and not to worry much about the risks”. Only four scales were selected by the respondents where it was starting from scale 1 and stopped at scale 4. There were 60% of the total respondents chose that they were strongly disagreeing with the statement, 25% rated their satisfaction or justification as disagree, about 10% neutral or average and small amount of 5% answered agree. By observing the most significant percentage which is the highest one, it can be summarized that the plant’s personnel justified that the risks in the plant are not only prediction but can be real if come up to certain level and hence they have to worry much and always be alert regarding to the risks and its possibility of occurrence. Consequently, this variable is not classified as the risk analysis’ challenges.

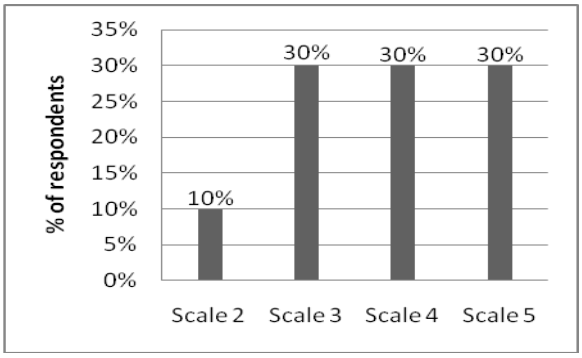

Figure 4.28 Confidence in Having All Protections

The pie chart above represents the results for the variable that demostrates the statement about the respondents’ degree of sureness towards whether they are really sure that they are having all of the protections needed while working in the plant. The respondents in this variable were really sure in answering the section since majority of their answers were slanting more towards the positive answers by which 30% of the respondents answered “strongly agree”, 30% answered “agree” whereas another 30% contributed to “average” scale which refers to balance justification between agree and disagree. Nevertheless, there were still respondents who answered disagree but the percentage is very low which only 10% out of all respondents. As a summary, it can be stated that more than half of the plant personnel who took part in this research were very sure that they are having all of the protections needed when working in the plant or in the workshop. This variable is considered as the challenge.

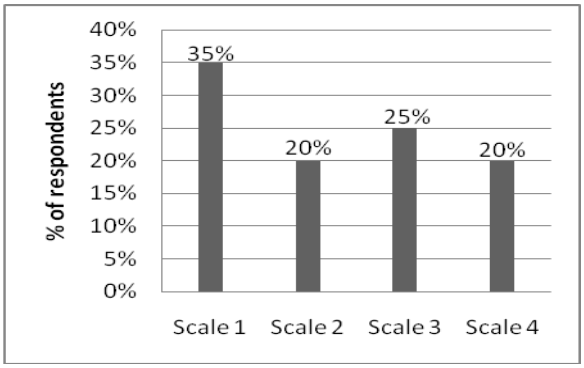

Figure 4.29 Leave Safety Issue to Safety Department

Furthermore, the next variable is the representative for the statement which mentioning that “you prefer to leave safety issue to the safety department to handle it”. From the SPSS generated result, the highest percentage is 35% which shows that majority of the respondents were strongly disagreeing to the statement. About 20% disagreed, another 25% were average while the remaining 20% be the contribution for the scale “agree”. Therefore, it is seen that mostly of the personnel in the plant are together working out on any safety issue arise and are not transferring the safety issue to the safety department solely. Thus, this is considered as not one of the searched challenges because the this condition precisely prove that with the involvement of more personnel in the plant and not only limited for the safety department to take care the issue, the lack of transparency can be avoided and the issue is not being able to be easily manipulated as if the issue is leaved to the particular department only, the true picture of the situation with regards to analyzing risks in the plant can be altered or hidden for the department’s reputation benefits. Hence, this variable is reflecting on the “lack of transparency and easily manipulated” is not the challenge faced in conducting risk analysis in the onshore oil and gas plant.

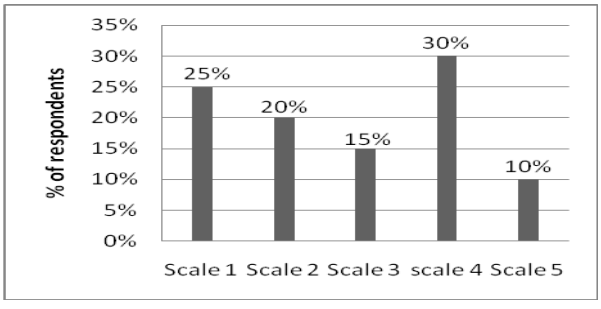

Figure 4.30 Only Aware Types of Risks

In addition, there is a statement that refers to see either the personnel in the plant only know the presence of the risks but they do not know their level of seriousness. According to the pie chart demonstrated in Figure 4.30 as in for next variable, 25% of the respondents were strongly disagreeing, 20% disagreed, 15% were in balance state, 30% were agreeing and another last 10% rated that they were strongly agreeing to the statement. This percentage numbers show that the personnel in the plant were only know the existence of the risks in their circumstances but they do not having an idea or lack of information about to what level the risks can be serious and which are not. This conclusion of argument is made since the scale that shows the agreement of the respondents has the highest percentage with the support of another 10% who strongly agreed.

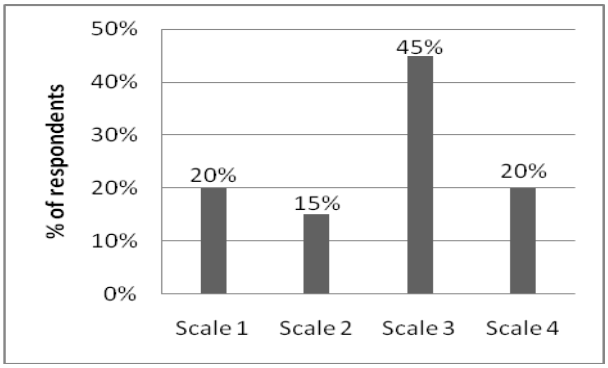

Figure 4.31 Descriptions of Risks are Adequate

The above pie chart is demostrating the answers' distribution for variable by which indicates the statement is about to define whether it is sufficient by having the descriptions of the risks instead of get knowing the other facets of the risks in analyzing the risks. Based on the data presentations, 20% of the whole respondents were strongly disagreeing and 15% were disagreeing. Moreover, the highest percentage for this variable is 45% which is the percentage for scale "average" and about another 20% stated that they were agreeing to the phrase. Since the highest percentage is referring to the undecided answers since most of the respondents were in average justification. This is because sometimes they think that it is enough to have the descriptions of the risks and sometimes they need to know more than those descriptions. Besides that, as this result is indirectly showing that having up to the descriptions is relatively adequate to the personnel in the plant without other additional explanation, this verifies that there are not really enough of

measurement and discussion of the risks and any uncertainties as well relatively low pace of communication towards the risks as sometimes the personnel more paying their attention to the operations in the plant and less attention to the details of the risks which may cause them to overlook the reality of the risks. Thus, this variable is considered as the challenge of doing risk analysis in the plant.

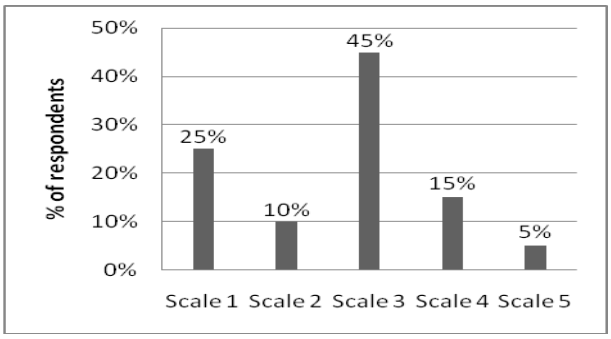

Figure 4.32 Risk Document is Complex

Last variable in the questionnaire is the variable by which is aimed to find out whether the personnel in the plant having difficulties with regards to the measurement, description and communication of the risks and uncertainties. Based on the results displayed in Figure 4.32, about 25% of the total respondents strongly disagreed and 10% were disagreeing that the risk document which has a lot of numbers written in it is too complex and complicated to understand. Moreover, the “average” answers have the highest percentage among the others scales which 45% and another remaining respondents were answering that they were agreeing and strongly agreeing with the statement with percentages of 15% and 5% respectively. This SPSS output prove that the personnel were not very sure whether they really able to understand the complex risk document which contains lots of numbers. Therefore, it is proven that lack of understanding in describing, measuring and communicating the risks during the analysis of the risks is one of the challenges that is needed to be faced when conducting the risk analysis in the onshore oil and gas plant.

For summarization for the discussion of the findings for variables in the Part C, there are four challenges identified from the findings as shown previously. The first challenge is having limited data during conducting risk analysis. The variable in Figure 4.30 is related to determine this first challenge. From the finding of this variable, it is shown

that the there is lack of data and information to carry out risk analysis in the plant. This is because despite the existence of the risks are identified and concerned yet the level of seriousness and their impacts are not really taking into the considerations. Besides that, the explanation of the impacts is not well elaborated since the personnel in the plant only know the risks will result such impact when they occur but the further information is limited.

Next challenge is an optimistic estimating. An optimistic estimating refers to the only or very positive justification of certain situation. This challenge is verified through the findings of the variable discussed based on Figure 4.28. This single variable is considered as challenge since the findings show that the personnel in the plant are very sure that they are given all sorts of protections needed while they are working in the plant. Moreover, most of the personnel are having balance justification towards the level of dangerousness of operations in the plant. This will affect the process of risk analysis as the detail of the analysis depends on the dangerousness classification of the operations. Therefore, based on these two variables' argumentations, it can be concluded that having an optimistic prediction will influences the goodness of the risk analysis process.

In addition, the limited level of description, complexity of the measurements and limited communication on the risks and uncertainties in the plant is also being the challenge that has to be faced while carrying out the risk analysis in the onshore plant. This point of challenge is illustrated through the findings of variables represented by Figure 4.31 and Figure 4.32 which verify that the personnel justified that they are having neutral satisfaction on the statement of having descriptions of the risks is enough and there are many numerical ,measurements that are needed to be calculated in analyzing those risks. For these reasons, the process of conducting risk analysis regarding to the operations in the plant will be difficult and complex since there are so many operations and systems that are needed to be put into the process.

The last challenge that is successfully identified is interpreting historical data to express future risks. This challenge is grouping the variables demonstrated through Figure 4.20 and Figure 4.21. Based on the findings, the personnel are well informed and having a lot of information regarding to the accident happened in the plant. Hence, they will tend to use the past records as much as possible to predict the probability of the risks occurrence in the future by referring to the frequencies and other types of related data in the records.

Nevertheless, this is not giving good examples to analyze risks because the operations and the systems in the plant may undergo changes from time to time and this will cause the judgment to be difficult since the current conditions are differ to those in the past which may result different type of risks and dissimilar level of seriousness of the risks.

Based on the findings for variables illustrated by Figure 4.22 until Figure 4.27 and Figure 4.29, a conclusion can be drawn is less or no challenge of lack of transparency and manipulation on the analysis of the risks. This conclusion is made and supported by the results of analysis of these four variables previously. The justification is due to the risk analysis is not only involve the safety department, every accidents either minor or major ones are reported to the management level, risk analysis are not only conducted by the risk manager or the safety manager and it is necessary to worry much on the risks identified so that the risks will be well analyzed during the process of risk analysis. Involvement of all level or department in the plant will prevent the data or information with regards to the risks from being manipulated and increase the transparency and integrity of the data in the risk analysis carried out.

4.6 SUMMARY

The findings for all of the variables are able to provide routes towards achieving the all three research objectives. In the nutshell, there are more than one type of risks exists in the onshore oil and gas plant. They are fire risk, gas risk, explosion risk, maintenance risk and equipment/machinery risk.

Furthermore, there are also more than one methods that is used and can be implemented in analyzing the risks in the onshore plant. They are FMEA method, HAZOP, HAZID, SWIFT HIRARC as well as the fault tree analysis techniques.

Last but not least, there are four challenges highlighted in this research. There are limited data presence, optimistic estimating, complexity and difficulties on description, measurement and communication of the uncertainties and risks in the plant and also interpreting the historical data to express the future risks. Therefore, all of the three research objectives are successfully achieved.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

In this chapter, there will be some items to be underlined. First, this chapter will cover the implication of the research for both theoretical and practical dimensions. Theoretical part will describes what had been learnt or knowledge which had been gained throughout the process of conducting and completing this research.

On the other hand, the practical part will include experiences obtained in the real situation such as during the process of collecting data that are to be analyzed and discussed further. In addition, the limitation of the research also will be highlighted in the chapter. The limitation of the research is defined as any constraint that was needed to be faced in the route of accomplishing this research.

Furthermore, in this last chapter, there will be some recommendations which can be used for future study. The recommendations will be useful for the future study with regards to risk analysis or to risk management. Last but not least, conclusion of the whole research will be done so that the crucial parts of this research can be highlighted and understandable as a whole.

5.2 IMPLICATION OF STUDY

This research is mainly about the aspect of risks in the onshore oil and gas plant. For that reason, the implication of the research generally is towards those who are the personnel of the plant. Since this research is discussing the “circle of onshore oil and gas plants’ risks”, the personnel can know better about the risks they had identified and assessed. Besides that, by referring to this research, they will know how they can react to the risks as they know more than boundaries in the existence of risk analysis instead of having information about the risk management itself only.

Through this research, they can improve the way of how the risks were analyzed traditionally by overcoming the challenges that had been identified in this research as they already knew what are the items that weaken the effectiveness of the risk analysis done to assess the risks in the onshore oil and gas plant.

5.3 THEORETICAL IMPLICATION

The three major components which are vital to the main idea of this research are the types of risks that are high possibly to occur in the onshore plant, the types of risk analysis used to analyzed those risks as well as the challenges that are needed to be faced in carrying out these risk analyses in the plant. In other words, all of these three elements are the research objectives which are compulsory to be achieved in order to complete the research as the aim of this research is to find out what are the challenges in conducting risk analysis in onshore plant. Based on the discovery of those three elements, the reader who refers to this research can increase their knowledge by referring to the data and information to get closer in analyzing the real scenario of the risks analysis regarding to the onshore oil and gas industry and specifically the state of the risks in the plant.

5.4 PRACTICAL IMPLICATION

Furthermore, the research is also affecting and giving impact practically. In general, this research is relating the risk analysis with the operations in the plant. In further discussion, it is understandable that the risk analyses done in the plant are also discovering the risks which are related to the operations. Besides that, the risks in the plant are not analyzed at one time for the whole plant and the process of analyzing the risks are considering and match it with the operations in the plant. This can be proven when the findings show that the plant is practicing the types of risk analysis with regards to the operations and equipment used in the plant such as FMEA and HAZOP. As the section in the questionnaire is not stating type of risk analyses directly but only stating the phrases which demonstrate that they are using the methods to analyze the risks in the plant, this research questionnaire be an instrument to outline or emphasize those risk analyses. Therefore, the personnel in the plant and also the future researcher can know the types of risks analysis that can be used or are actually currently used in the plant.

In this research, those types of method are clearly emphasized in the previous chapter. In real situation, the personnel can practically conduct the same types of risk analysis in the other onshore oil and gas plant as long as they are suit and appropriate to the other types of system and operations in the plant instead of choosing only single types of risk analysis methods to analyze risks. Besides that, the future researcher can apply the types of risk analysis that had been highlighted through this research to be their references in conducting the risk analysis for a particular plant or extensively establishing and come out with new or innovated risk analysis methods in the future.

5.5 LIMITATION OF STUDY

There are some limitations in doing this research. Several limitations that are needed to be faced in reality of doing the research related to oil and gas industry. The limitations are due to the nature of the industry itself as this industry is surrounded with confidential data and lots of risks even though in the onshore plant instead of on the offshore platform. These limitations directly limit the numbers of data collection for the research questionnaire.

The first limitation is the needs of protection on the privacy issue and intellectual properties in the plant. When this research was in progress, it was relatively difficult to collect data from certain personnel of particular plants. In addition, it was very difficult to approach the respondents since there was rigid and firm security procedures. Not all of the plant's personnel were easily allowed to answer the questionnaire of this research. For some companies, the questionnaire must be undergoing the human resource department or any related in charge person to validate the questionnaire before it is distributed to the other personnel. This condition had cause the process of getting more respondents to participate in the research to be hard and complicated.

Next limitation is the barrier to enter the plant area. Some of the plants chosen were accommodated with respective safety rules, procedures and policies. In order to enter the plant area, it is compulsory to have certain certificate. For that reason, it is forbidden to enter the area since there is no certificate provided as needed. However, there was a plant that allowed visitor to enter the area but not more than the management office. Nevertheless, it is still a compulsory to register and have a pass to enter the office. Due to these safety regulations, there were some of the questionnaire distributed by

emails and some of them were given to the personnel at the outside area of the plant or workshop.

Third limitation is the accuracy of the respondents' answering the questionnaires. After carried out the data screening, it was found that there were some respondents answered two scales of answers such for part C. The scales should be chosen only one because it is difficult to be analyzed and besides it is not valid. Consequently, some of the question papers were needed to be rejected. Hence, this had shortened the numbers of respondents originally obtained for this research. Hence, it causes more other respondents to be approached to replace the rejected ones.

Last but not least, the time limitation to complete this research is also one of the limitations. As known that the oil and gas industry involves a lot of risks, safety policies and loads of procedures to get information, more time is needed in order to collect data. If more time given, the number of respondents participated in this research will increase. Thus, the results of findings can be more convenient and more discussions can be made.

5.6 RECOMMENDATION FOR FUTURE STUDY

As this research is covering the scope of onshore oil and gas plant, it is highly recommended that the future study can prefer to covers the range or scope of an offshore oil and gas platform. In the future research, the future researcher is encourage to find out the challenges in conducting the risk analysis on the platform since the challenges might be different to those identified in this research. Furthermore, the future researcher can investigate the appropriate or common risk analysis practiced on the offshore platform since the operations in the offshore oil and gas industry are dissimilar to the operations in the onshore oil and gas plant.

In addition, it is suggested to the future researcher to determine the solutions that can be provided to overcome the identified challenges in this research. This is because this research scope is only up to the challenges in carrying out the risk analysis in the plant and not till offer or give the key answers to work out on the things that can be done to either lessen or to get rid of the challenges from continuing weaken the effectiveness and value of the risk analysis prepared with regards to the operations in the onshore oil and gas plant.

In the nutshell, it is very advised to the future researcher to not only stop their action at using this research by making it as references, but also use it as the pioneer or starter to solve or giving contributions to any research related to the oil and gas industry.

5.7 CONCLUSION

As what had been introduced in the previous chapter, this research is about the risk analysis related to the operations in the oil and gas plant. Comprehensively, this research is aiming for finding out the challenges that have to be faced when analyzing the risks in the onshore plant. By listing out the challenges, it is hope that the problems emphasized in the problem statement earlier can be solved or minimizes their impacts. Moreover, there were three research objectives that had been drawn in the first chapter. They are to identify the types of risks that have high possibilities to take place in the plant, to determine the types of risk analysis used to analyze the risks in the plant as well as to investigate the challenges that have to be faced in conducting the risk analysis which related to the operations in the onshore oil and gas plant.

After collecting the necessary data to accomplishing the objectives as stated above, the data were analyzed by using the SPSS software to find out its reliability, goodness of the data and also the other numerical findings for each questions or variables in the questionnaire. The findings were further discussed to provide enough explanations and arguments which then used as a method to achieve every single of the research objectives respectively. According to the discussions, there are more than one type of risks that have potential to take place in the plant such as the fire risk, explosion risk, gas risk, maintenance risk and the equipment or machinery risk.

Moreover, there are also several types of risk analysis methods that are implemented to assess those risks. They are the FMEA, HAZOP, HAZID, SWIFT, HIRARC and the fault tree analysis methods. It is concluded that in analyzing the risks which regards to the operations in the plant, the techniques to apply in assessing or analyzing the risks is not limited to only one type of techniques. More than one type of methods can be used as long as it is suitable with the conditions and the systems in the onshore oil and gas plant. Thoroughly, the challenges that had been outlined in the next discussions are the limitation of data, optimistic estimating, complexity and difficulties on description,

measurement and communication of the uncertainties and risks in the plant and interpreting the historical data to articulate the future risks.

Finally, it can be said that the all three research objectives are successfully achieved throughout the process of completing this research. The aim of this research which is mainly on exploring the challenges that have to be taken in carrying out the risk analysis in the plant is fully realized although there are some limitations that are need to be confronted.

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APPENDIX A

(DESCIPTIVE STATISTICAL TABLE)

Variable 1 → Variable 13

Std. Deviation	.716	.587	.795	.598	.000	.000	.000	.470	.444	.470	.470	.510	.489
Variance	.513	.345	.632	.358	.000	.000	.000	.221	.197	.221	.221	.261	.239

Variable 14 → Variable 26

.598	.686	.795	.641	.761	.754	.605	.768	.513	.754	1.119	1.309	1.099
.358	.471	.632	.411	.579	.568	.366	.589	.263	.568	1.253	1.713	1.208

Variable 27 → Variable 37

1.056	.912	1.070	.988	.988	.883	1.005	1.174	1.399	1.040	1.182
1.116	.832	1.145	.976	.976	.779	1.011	1.379	1.958	1.082	1.397

APPENDIX B

(GANTT CHART : FYP 1 and FYP 2)

WEEK / ACTION	1	2	3	4	5	6	7	8	9	10	11	12	13
Title approval													
Chapter 1 (draft)													
Review Chapter 1 (draft)													
Chapter 2 (draft)													
Review Chapter 2 (draft)													
Chapter 3 (draft)													
Construct instrument and pilot test													
Review Chapter 3 (draft)													
Submit research proposal (Chapter 1, 2, 3)													
Chapter 4 (draft)													
Review Chapter 4 (draft)													
Chapter 5 (draft)													
Review Chapter 5 (draft)													
Full report (draft)													
Full report submission													

APPENDIX C

(RESEARCH INSTRUMENT : QUESTIONNAIRE)

This questionnaire consists of three parts: part A, part B and part C.

Please kindly answer all questions.

Part A

This part is to provide detail of the respondent in the survey.

You may TICK more than one answer

1) What is your age?

☐ Below 25 ☐ 25-30 ☐ More than 30

2) What is your level of education?

☐ SPM/Certificate ☐ Diploma/Degree ☐ Higher than degree

3) How long have you worked for the company?

☐ Less than 2 years ☐ 2-5 years ☐ More than 5 years

4) Which section or department are you currently in?

☐ Operational ☐ Management ☐ Others

Part B

This part is to identify the type of risks and the risk analysis used in the plant.

Please tick ONLY one answer

5) This company had given you some sort of safety training.

☐ Yes ☐ No

6) There are safety policies that you need to follow.

☐ Yes ☐ No

7) There are hazard signages displayed in the plant you work in.

☐ Yes ☐ No

Please tick the risks that are high possibly to occur in the plant.

8) Fire risks ☐

9) Explosion risks ☐

10) Gas risks ☐

11) Maintenance risks ☐

12) Inspection risks ☐

13) Equipment/machinery risks ☐

Please rate your answer.

1. Strongly disagree **2.**disagree **3.**average **4.**agree **5.**strongly agree

	1	2	3	4	5
14) When there is operation break down, the possible failures are going to be identified.					
15) Hazard of the equipment used in the plant is studied and identified.					
16) When there is an operation to be stopped, you are considering what will happen in the future.					
17) Risks of the system including the sub-system are identified.					
18) Some protections are needed to be provided when a person is entering or visiting the plant.					
19) The effects or impacts of some failures take place in the operations are needed to be identified.					
20) Checklist of the hazards of equipment in the plant is done.					
21) When there is a change in the operation procedure, the consequence of the change is also identified.					
22) Any system or operation to be carried out must be identified its risks when it is implemented.					
23) There are methods to control risks practiced in the plant.					

Part C

This part is included to identify the challenges in conducting risk analysis.

Please rate your answer.

1. Strongly disagree **2.**disagree **3.**average **4.**agree **5.**strongly agree

	1	2	3	4	5
24) Not all operations in the plant are dangerous.					
25) Sometimes, you are not informed when an accident happened in the plant.					
26) You are having lots of information and records of accident that had happened in the plant.					
27) You think that some of the risks in the plant will not gives you impact when they occur.					
28) When there is minor accident in the plant, you prefer not to report it to the management unless it is very serious.					
29) Risk analysis is only need to involve safety department.					
30) Only several operations need risk analysis.					
31) Only safety manager or risk manager is responsible to conduct risk analysis.					
32) Risks are only prediction and not to worry much about the risks.					
33) You are really sure that you are having all of the protections needed while working in the plant.					
34) You prefer to leave safety issue to the safety department to handle it.					
35) You only aware the types of risks in the plant instead of also know its level of seriousness when it occur.					
36) Having descriptions of the risks is adequate.					
37) You think that a risk document with lots of numbers written in it is very complex to understand.					

Thank you for your cooperation