

Effectiveness of Safety Management in Oil and Gas Industry

By

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14229

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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Approved by,

(Ir Idris Othman)

UNIVERSITI TEKNOLOGI PETRONAS
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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

MOHD FAKHREY FAEZ BIN ISMAIL

ABSTRACT

In any line of work, there will be hazards in the workplace. In the industry of oil and gas especially, as the industry will be always constantly adapting to changes over time, whether in terms of technology, market demands or price thus increase the operational risk in the operation. The purpose of this research is to study on the current practices of safety management implemented in the upstream part in the oil and gas industry and its effectiveness, altogether to emphasize on the importance of safety management system in the industry. The number of employment in the operation of the industry has increased greatly these past years due to a large number of demand in the workforces, thus making safety management system more important to make sure the overall safety and to reduce accidents in the operation in the industry. Major to minor accidents can happen including near miss, and this can give effect on the industry either in economic term or in workplace and workforce terms and operation in the industry require a large number of investment and long period of operation. This research will focus on the implemented safety management in upstream sector of oil and gas industry especially in PETRONAS Carigali Sdn. Bhd in Malaysia and evaluate and investigate its effectiveness. The research will put safety management as the main factor in preventing and reducing accidents and incidents to occur in industries of the oil and gas and emphasize on awareness and importance of managing safety in oil and gas industry. The data are collected from past researches and from questionnaire survey. The data and results gained from the survey are analysed using the Relative Importance Index (RII) where the outcomes is analysed and rank based on its importance and also by using Average Index (AI) where the feedbacks from the survey is analysed according to the degree of agreement by the respondents. This is to evaluate the effectiveness of the implementation of safety management in the upstream sector of the industry and in conjunction highlighting the importance of safety management.

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CHAPTER 1

INTRODUCTION

This chapter will deliberate on the introduction part of this study. It covers the background of the study, the problem statement of the study, objective and scope of work of study.

1.1 Project Background

Danger and hazards are always around us that can come in any aspect in any time and place including in the workplace. Every place of work has hazards. According to Ontario Ministry of Labour (2013), a workplace or occupational hazard is anything that have the potential of causing any harm to people and occupational hazards should be identified and should be assessed. Reducing and removing the risk of the hazard is an essential step to protect worker and to maintain workplace safety.

Oil and gas industry is also undoubtedly no exception from the occupational hazards. Oil and gas industry involved in investment in large number of money and also long period operations thus making it has higher risks. The industry of oil and gas are constantly adjust and adapt to change, whether in technology, market demand or prices and this makes the job done in the industry become more difficult and also the operational risks will also increase, both downstream and upstream (Rains, 2012).

According to reports from Pittsburgh Post-Gazette that was based on statistics from U.S Bureau of Labor, as of 2012, the injuries or deaths in the oil and gas industry are the largest number of injuries which are 142 in 2012 ever since the U.S Bureau of Labor and Statistics started to keep records of fatalities in 1992. As the number of employment increases in the oil and gas industries, the number of the fatalities also increases.

Oil and gas deaths in the U.S.

As employment increases in the oil and gas fields, so do the number of workers dying on the job.

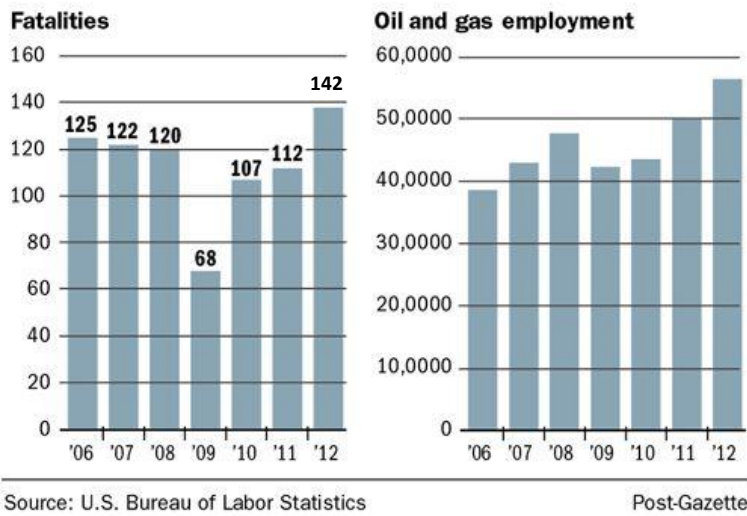


Figure 1: Statistics of no of fatalities together with the number of employment in the oil and gas fields

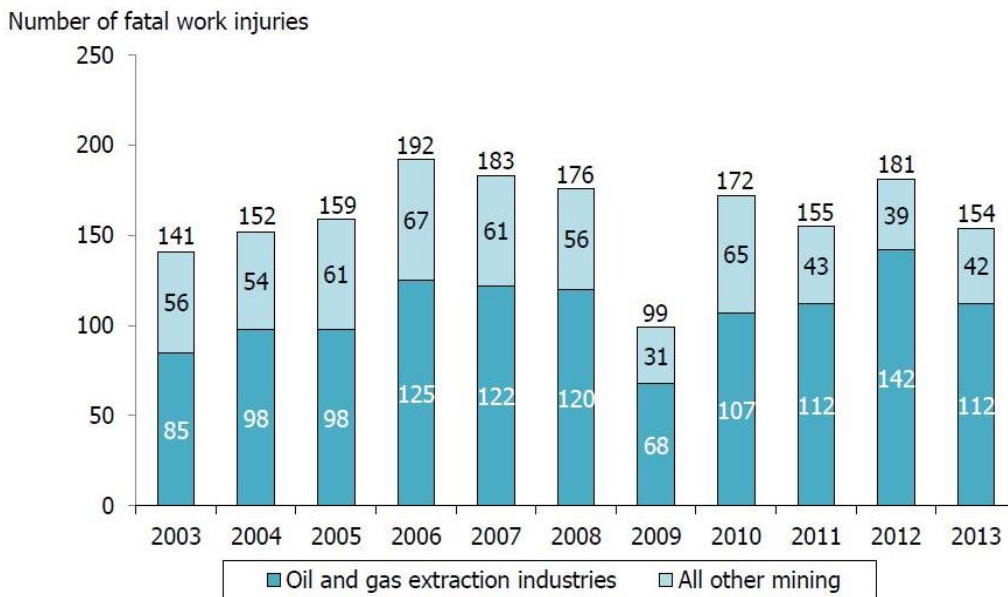


Figure 2: Statistics of Fatal Occupational Injuries in Oil and Gas extraction Industry, mining and quarrying sector from 2003 to 2013 (Source: U.S. Bureau of Labor Statistics)

From the both figure 1 and 2, it shows that there are still a number of fatalities or accidents occur in the oil and gas industry and these concerns on the safety of all workers in the industry.

There are some incidents and fatalities in oil and gas industries that has occurred in the past such as the explosion in Amuay Oil Refinery in Venezuela on 25 August 2012 that killed 48 people and wounded 151 people (Chauhan, 2013) and also Deepwater Horizon drilling rig explosion on 20 April 2010 that killed 11 workers and wounded 16 other people (Chauhan, 2013 & Leveson, 2011 & Rains, 2012) that alert and emphasize the need of proper way of managing safety to ensure the risks of fatalities to occur can be reduced. PETRONAS (2011) states that as they have experienced some incidents involving safety, it prompted and enlighten the urge of reviewing the systems, procedures and processes to make sure the safety of their operations.

Therefore, by implementing safety management system, the increased risk in the oil and gas industries may be avoided and reduced the occurrence of catastrophic incidents and fatalities (Rains, 2012).

1.2 Problem Statement

Working in oil and gas industries has higher risk on threats and danger. ABS Consulting (n. d.), which is a global safety, risk and integrity management company pointed out in their website that in the oil and gas industry, there will always be struggles and doubt with the concern of health and safety throughout the operations in the industry. Therefore, this study is based on:

- What are the importance of implementation of safety management in oil and gas industry especially in upstream sector?
- What are the current practices of safety management implemented and how effective is the system?

This study is the step of highlighting the importance of safety management in oil and gas industry and to evaluate and investigate the effectiveness of current safety management implemented in the oil and gas industry.

1.3 Objectives

The purpose of this researches are mainly focused on:

1. To study the current practices of safety management implemented in oil and gas industry in the upstream sector and its effectiveness.
2. To study the importance of implementation of safety management in oil and gas industry.

1.4 Scope of Study

The scope of work of this study is mainly focused on the safety management practices implemented in oil and gas industry in the upstream side and especially by PETRONAS Carigali Sdn. Bhd Sabah Operation (PCSB-SBO) in Malaysia. This study will put safety management as the main factor in preventing and reducing accidents and incidents to occur in oil and gas industries. The study will also emphasize on awareness and importance of safety management in oil and gas industry.

1.5 Company Background

1.5.1 PETRONAS Carigali Sdn. Bhd

PETRONAS Carigali Sdn. Bhd or PCSB is one of the subsidiary company in the Exploration and Production (E&P) operation of PETRONAS. PCSB is basically formed specifically for the upstream business of PETRONAS where it will operational in exploring, locating, developing and producing in the oil and gas industries in Malaysia as well as in the foreign country as its operation has been growth rapidly. It has developed dynamically to such extend in order to achieve its mission and vision to become a Multinational Exploration and Production company through continuous development and improvement while maximizing the profit and reserves in its projects.



Figure 3: Logo of PETRONAS Carigali Sdn Bhd

Main safety management in PCSB is based on Health, Safety and Environment Management System (HSEMS) that has been established in 1999 with the purpose of standardizing the practices of HSE management in PETRONAS based on its worldwide operation environment. Mapus et al (2009) & Wee and Jabar (n.d.) states that HSEMS is a structured system that has been formed based on a number of practices that were combined in term of safety, environment and health and in line with the approach of quality and risk management.

1.6 Project Relevancy and Project Feasibility within given Scope and the Time Frame

The project will be involving the author himself and will be done based on past researches, survey and questionnaire. The relevancy of this project is as the author has done researches and surveys on this topic and also based on the experiences that the author gained throughout his internship in the PETRONAS Carigali Sdn. Bhd. Sabah Operation (PCSB-SBO).

The overall time frame given for this project will be in eight month time which is for two semester. In order to ensure the completion of the project is on time, a Gantt chart was prepared and key milestone for this project has been set from the beginning. Therefore, as the progress of the project is done following the planned schedule, the project can be completed before the end of the second semester of the project and within time frame.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The world in oil and gas industry has been known as one of the industry that always involved in safety. According to the statistics from the U.S. Bureau of Labor in the reports by Litvak (2013), the number of employment in the industry of oil and gas keep on increasing. With the increasing amount of employment in the industry, the chances of accidents to occur also increase. Bigliani (2013) in her paper states that as the operational risk faced in oil and gas industry increases, the safety of environment and human continue to be the top priority in the industry.

This emphasize that oil and gas companies should implement a process safety management (PSM) or Safety Management (SM) system that fully integrates the change in management methodologies across multiple facilities, workers and technological advancement to avoid catastrophic incidents and in addition to increase the overall safety of an operation (Rains, 2012). Watson (1993) defined Safety Management (SM) System as several processes that collaborate and work side by side for the purpose of improving safety and also in order to reduce the number accidents occur into ZERO.

Watson (1993) also suggest that from the past investigations and researches, directly or indirectly, accidents happens are basically can be caused by 3 aspect, which are either people itself, materials or equipment or by the combination of these aspects. Hazards created can be relate closely to these aspects. Therefore, Rains (2012) quotes that Safety Management system are mainly focused on managing system to control and reduce hazards in the operations in 3 key areas, which are technology, facilities and personnel, the Management of Change Process also should be addressing to these 3 elements in order to have a holistic management system. However, the management of change must be evaluated carefully and reviewed, including by carrying out hazard analysis and consultation with safety engineering expert as any changes made have safety implication and as accidents often occur after changes implemented (Leveson, 2011).

According to Chauhan (2013), the suggestion of implementing and executing an Occupational Safety and Health Management System at every workplaces came into attention during the International Labour Conference at its 91st session on 2003, where the Conference Conclusions was to plan a world-wide approach on occupational health and safeties.

2.2 Current Practices, Implemented system and its Effectiveness

2.2.1 Common Practices and Systems in Oil and Gas Industry

There are some basic safety management tool and safety management system that are widely used in the oil and gas industry, such as Job Hazard Analysis (JHA) or Risk Assessment and A Permit to Work System (PTW). Job Hazard Analysis or Risk Assessment is a safety management tool that identified risk and hazards that may present in the specific job to be done and it is then evaluated and measured to eliminate or reduce the risk and implemented while Permit to Work System is a safety management system or called as safe system of work to ensure that safety on workplace and to ensure that all work are planned, controlled, communicated and carried out in safety manner (Rizwan & Al-Marri, 2012). In other words, JHA can be considered as the planning stages of a job, while PTW is on the implementing or carrying out the job. By performing JHA, the safety of employees are fully taken into consideration from the early planning stages of a job. The effectiveness of JHA are mainly depends on the employees and management as it should be done by taking both point of view on the job to identify the hazard and risk during operations. Besides, the JHA must always being reviewed and keep up to date in order for the JHA to be effective. Employees also should be clear and aware of all hazard and risks of the job from JHA performed. PTW consist of the details of work that need to be done, details of the safety precautions to be taken, identify all foreseeable risks and hazards, states the control measures to be implemented and ensure worksite in a safe condition when leaving or finishing the job. Arias & Tucker (2002) pointed out that it is important as by having PTW, managers also can get the introduction of the works based on PTW during visits and can verify the existence or lacking of the PTW.

Besides, by having specific procedures, precautions and hazards analysis, risk of accidents and having hazards can be lessen. In order to effectively implement safety management system, it is a must to first identify and manage unsafe acts or conditions in the operations, as this can lead to higher potential hazards of near miss or much worse that lead directly to accidents. Although near miss is still not an accident yet, but near miss is the last step before an accident occur and there might be only an inch of difference between near misses and accidents (Watson, 1993).

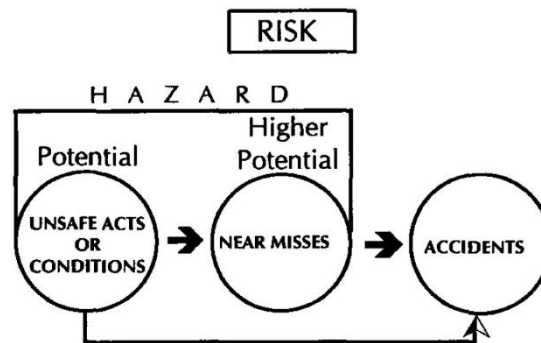


Figure 4: Risk of Hazards in Workplace

In addition, as mentioned earlier, from safety management, requirement of using Personal Protective Equipment (PPE) for proper job and proper training to employees has been implemented to avoid and prevent accidents from happening. Coleman & Salleh (1988) states that employees must be advised and provided with the appropriate protective equipment such as coverall, glasses, helmets and safety shoes for the hazardous job and materials that they will be handling in order to comply with the requirement of the Factory and Machinery Act 1969. Besides, in Malaysia, the procedures and guidelines for PPE should be based on Malaysian Code requirement. Leveson (2011) concludes that one way of strengthening the safety control structure is by appropriate certification and training to the employees, as lesson learnt from Deepwater Horizon or Macondo accident that little certification is required for the job and some of the employees have minimum training. This stressed that the importance of the training and certification to prevent accidents.

In any industry that involved with high risk of operations, such as the construction operation and especially in the oil and gas industry, safety toolbox meeting or known as on-site safety meeting always been conducted before executing any job. Safe and effective job execution can be achieved by conducting on-site pre-job meetings to outline all safety and technical procedures, contingency plans, discuss decisions that may be need to be made during executing the job, and all concerns about the job (Farooqui et al, 2003).

In term of PETRONAS side, Wee & Jabar (n.d.), Mapus et al. (2009) and Julaihi et al. (2012) states that the existing Health, Safety, and Environment Management Sytem (HSEMS) has been improved and reviewed in 2006 with more detailed in term of technical safety process standards which consists of eight (8) technical standards. These standards are; Process Safety Information, Process Hazard Analysis, Operating Procedure, Pre-Activity Safety Review, Management of Change, Mechanical Integrity, Proprietary and Licensed Technology Assessment (PLTA) and Design Integrity.

In addition, in PETRONAS, including PETRONAS Carigali Sdn. Bhd Sabah Operation (PCSB SBO), one of the basic rules that addressed in term of safety is ZeTo Rules. PETRONAS (2011) defined ZeTo Rules or known as Zero Tolerance Rules as an obligatory and compulsory rules that is established and implemented to address all operations that have high risk of danger and threat. ZeTo Rules is introduced in 2010, with purpose to make sure that all operations are being conducted and done carefully and safely. This rules intended to help improving the performance in the operations in term of safety as it is needed to be complied by every personnel and contractors in PETRONAS and failure to obey the rules will cause disciplinary action to be taken. PETRONAS (n.d.) states that ZeTo Rules is consists of ten (10) rules that need to be obey, which are:

- i. Permit to Work (PTW) necessary for the job is valid in order to work.
- ii. Before work started, energy separation or isolation need to be verified.
- iii. Before safety critical equipment is being disabled or override, authorisation need to be acquired.
- iv. Before confined space being entered, authorisation need to be acquired.
- v. When working at high places, we must be protected against a fall.
- vi. When using or holding dangerous chemicals, specific and valid personal protective equipment need to be used.
- vii. Before entering or digging a trench, authorisation need to be acquired.

- viii. Never be in a spot or location that is under suspended load.
- ix. Never bring any potential sources of fire into operation areas or smoke other than in designated area without authorisation.
- x. While driving, seat belt need to be used, speed limit need to be followed and mobile phone or walkie talkie cannot be used.



Figure 5: ZeTo Rules

2.2.2 Key to effective Safety Management

Watson (1993) suggests that effective systems of safety management needs continuous process of training, applying, examining, taking action, and management assessment that can be achieved with proper key elements, which are:

1. **Management Participation** – by identifying safety needs and hazards, planning and formulating safety management and providing procedures on how to control or eliminate hazards in the workplaces.
2. **System (Proactive)** – A proper and effective safety management system that take into consideration of all those affected by the system which also identifying and correcting any complication regarding safety before accidents happen.
3. **Implementation** – Implement the safety management system globally across all operations in the company once the systems have been established and prepared. Assistance during implementation and training on the systems should be done step by step from management to all personnel.
4. **Measuring** – Monitoring, evaluating, and gathering feedback based on the system implemented.
5. **Review/ Action** – Reviewing feedback to determine what recommendation of changes should be made to the system and implementing and take action to adjust and improve the system.
6. **Improvement Process** – Steps to improve the systems from measuring and review and taking action are being done continuously.

Directly or indirectly, hazards that created and can lead into accidents are caused and dependent on the factors of people, equipment, and materials. Hazard management is one of the basis of practical and positive safety and vital to prevent or reduce accident. Watson (1993) also suggests that the step of proactive system of safety management can be divided as follows:

1. **Eliminate** identified hazards from place of work.
2. **Control** the danger identified that cannot be eliminated.
3. **Train** employees to identify and know hazards and specific procedures and precaution implementation to avoid accidents.
4. **Require** certified procedures, usage of control devices and personal protective equipment (PPE).

Moreover, Brasher (2004) also discussed on the effectiveness of safety management system can be achieved by proper management review/ participation, implementation of the system, measures and identification of the safety performance of the system, evaluating the system, identifying the gaps in the system, and lastly by identifying actions that need to be done to improve the system. Thus, it can be seen that the proposed key to effective safety management by Watson (1993) is still valid and agreed.

Besides, Chauhan (2013) gives a solid agreement in her paper on Watson (1993) statement and states that according to the Occupation Safety and Health Management Systems (ILO-OSH 2001) guidelines, the structure of nation-wide or organizational should have occupational Health and Safety Management Systems that contain the components of policy, planning, organizing, implementing, evaluating and also action for improvement which in line with what Watson (1993) has proposed for the key elements for effective safety management. In addition, Brasher (2004) in her paper stress the importance of management role in safety management system as continuous review and evaluating process of the system is important to make sure the system to be still valid and good whether in term of safety, financial goals, policy and also performance goals set by the company.

As the demand in the industry continue to increasing altogether with increasing in term of prices, it is important that the operations in the industry did not give any harm or threats to neither people nor environment. Thus, in order to achieve this goal, Chauhan (2013) & Brasher (2004) indicate that most of the company has started to use the principles of Plan, Do, Check and Act (PDCA) for their safety management system approach.

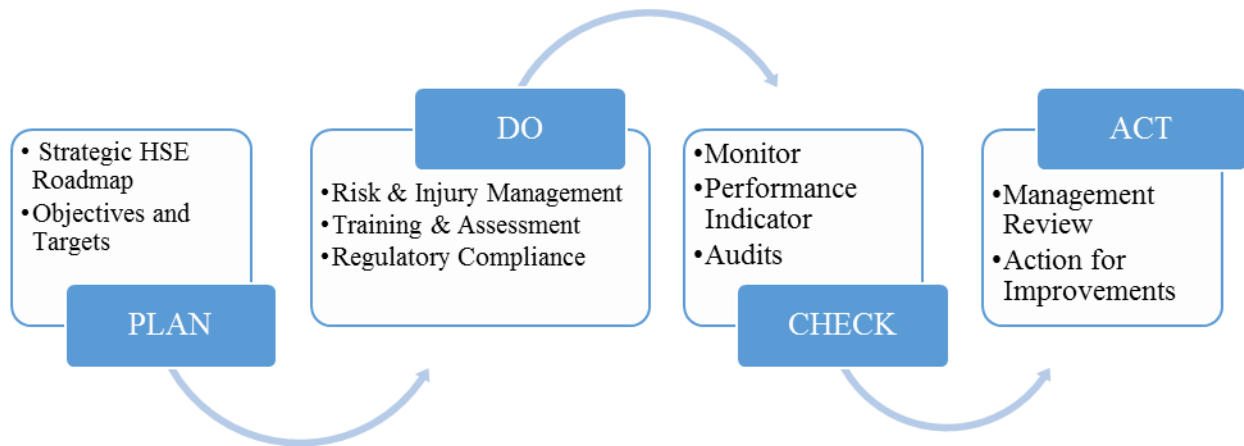


Figure 6: Plan, Do, Check and Act Principle

2.2.3 Evaluate Effectiveness Safety Management

However, although there are safety management system that has been implemented, the effectiveness of these system can be questionable. Leveson (2011) states that although safety management systems exist in corporations, however these systems are not designed well sometimes. For example, one of the outcomes from the explosion of the Refinery of Texas City Oil on 23 March 2005 that had caused 15 people dead and hurt people of 180 people (U.S. Chemical Safety and Hazard Investigation Board, 2005) was that the safety management system of BP in term of oil refineries need much development.

National Energy Board (2013) pointed out that from studies of major accidents occurred, there are many companies find the difficulty to effectively implement safety management system. Therefore, National Energy Board (2013) recommend that the effectiveness of management systems should be based on 3 key below, which are:

- **Consistently applied:** Element of the system are being applied consistently across the facilities, operational programs and also geographic regions.
- **Highly integrated:** The importance of elements of management system as all data are required in planning processes and the data needs to be collected, tested and verified to confirm the compliancy with policies and standards of organization altogether with regulatory requirements.
- **Assign accountability:** All management and employees play their role to ensure the goal of the organization in term of safety and security.

In addition, Chauhan (2013) proposed that the effectiveness of safety management system is based on:

- The element of the system should be applied correctly that indicates on the risks, processes, and controls in all operational sites whether in the Upstream, Downstream or Midstream segments of Oil and Gas industry.
- The management system should be planned well, with proper strategies and action plans for the availability to the workers and also to be understand easily.
- The workers should follow the system implemented and following safe practices in the operations.

The effectiveness safety management proposed by Chauhan (2013) are in line with what National Energy Board (2011) recommended thus making it valid to be applied to evaluate the effectiveness of the safety management in Oil and Gas Industry in upstream sector.

Thus, Rains (2012) states that efforts from oil and gas sector in order to reduce risk have improved and catastrophic accidents have become unusual.

2.3 Importance of Safety Management

As oil and gas industry strive for satisfying the world demand increase for the remaining fossil fuels, there will be increase of new and more dangerous operations as the field of oil and gas are constantly changing , adapting and evolving, thus making the operational risk increases proportionally (Rains, 2012). Besides, Brasher (2004) stress that it is important to make sure the operations in Oil and Gas industry did not give any harm or threats to neither environment nor to people although as nowadays worlds demand need high productivity with competitive price and with good operational cost to ensure the financial goal of the company is achieved.

Good safety management can reduces and prevent accidents and fatalities from happening (Rizwan & Al-Marri, 2012, Rains, 2012, Leveson, 2011, Chauhan, 2013). Lack of safety management can cause dangers to the worker and employees in the oil and gas industries. National Energy Board (NEB, 2013), an independent regulatory agency to supervise international and also inter-provincial aspects of oil and gas industries formed by Government of Canada states that failure of the safety management leadership to take parts in the company can cause major accidents in their operations.

One of the catastrophic incidents that occurred on 20 April 2010 were the blast at the drilling rig of Deepwater Horizon or known as Macondo well blowout where 11 workers were dead and 16 other people injured had severe economic effects such as loss of jobs, loss of financial cost that estimated to be more than US\$ 37.2 billion on few countries in the Gulf of Mexico (Bigliani, 2013; and Rains, 2012). This shows the importance of safety management not only in term of reducing the accidents but also in order to avoid waste of money as high investment of money is done in the operations of oil and gas. In addition, Chauhan (2013) indicate that the dangers and serious safety threats to the workers in oil and gas industry makes safety and health management as one of the main elements in the oil and gas operation.

Furthermore, Coleman & Salleh (1998) stress that the usage of safety facilities and equipment such as the Personal Protective Equipment (PPE) are important in indicating on the performance of the workers. This means that, this can be the main factor on the reducing possibility accidents to occur including to ensure smoothness of execution of work and also in order to get the job done within schedule.

Therefore, Rains (2012) concludes that by effectively implementing good safety management system, not only overall safety in the oil and gas operation can be improved and disastrous accidents can be avoided, but also optimizing the quality, the smoothness and efficiency of the operation and also maximizing the effectiveness in investment of money.

CHAPTER 3

METHODOLOGY/ PROJECT WORK

3.1 Project Activities

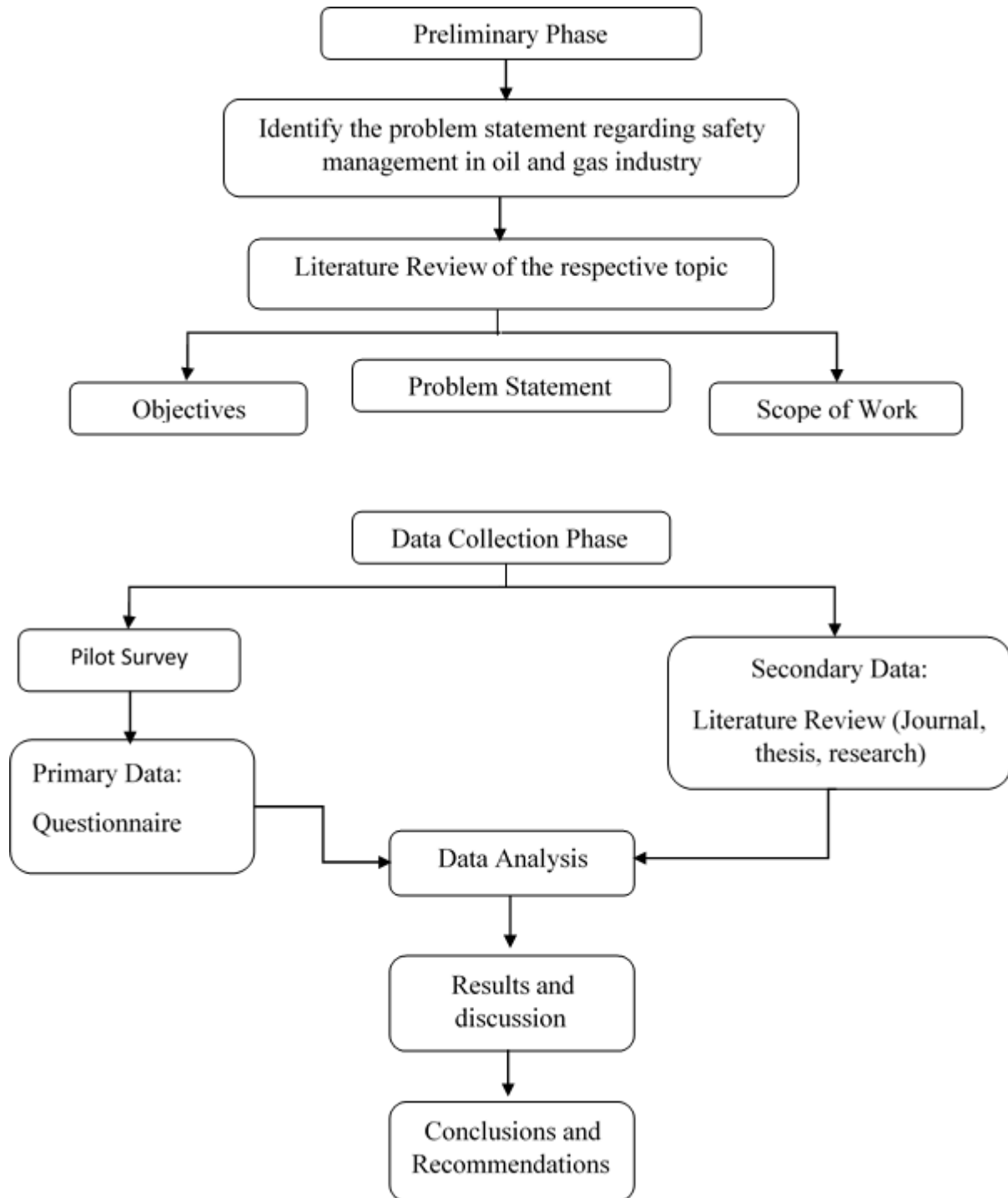


Figure 7: Methodology of Project

3.2 Methodology

Methodology of the project comprise of 2 phase, which are Preliminary Phase or Literature review Phase and Data Collection Phase.

1. Preliminary Phase or Literature review phase is the stages where it is to identify all the objectives, problem statement and the scope of work of this project including to get the overall overview and background study of the topic. Data from journals, thesis, researches, books etc. are searched and used.
2. Data Collection Phase is the stages that collect, analyses and discuss data that obtained from the main data which is from the questionnaire and also data from the research found in the Preliminary Phase to achieve the objective of the project. Pilot Study is also done where the questionnaire will be administered and clarified by professionals in oil and gas and then will be refined. From the comments of the professionals, finalized questionnaire will be developed in order to have proper clarified questionnaire. This is to ensure the suitability and the effectiveness of the questionnaire.

3.3 Data Collection

3.3.1 Pilot Survey

Pilot survey can be defined as a preliminary or exploration survey that is done in order to obtain information prior to conducting the main survey or large scale of survey. It is first done to a small group or several number of professional to improve the efficiency and effectiveness of the survey. Besides, this survey is also done to check on its correctness and suitability, and also the lacking in the survey. From this pilot survey, it is also testing on the instructions and understanding of the respondents on the survey. Thus, the main survey can be adjusted and revised to a more appropriate survey.

3.3.2 Primary Data: Questionnaire

Survey questionnaire will be done and distributed to a number of respondents regarding the safety management in oil and gas industry. After that, data response from the respondents will be used as the primary data of the project. The questionnaire will be consist of three section – questions regarding the background of the respondents, Importance of Safety Management in Oil and Gas industry and the effectiveness of current practice and implementation of Safety Management System in Oil and Gas Industry.

3.3.3 Secondary Data: Literature Review

Data obtained from past research papers, thesis, journals related to the subject in the literature review are being used and referred as secondary data to relate and in obtaining the result. Besides, from the data obtained, the overall summary of the study.

3.4 Data Analysis Method

The data analysis of the survey is done right after when the data collection from the questionnaire and literature review has been done. All the data and results obtained from the questionnaire distributed will be then analysed according to its suitability and proper method of analysis. The result will be then summarized. Data analysis is a part of the methodology approach in order to evaluate and combine all the data collected. The data analysis of the questionnaire is done by using the Average Index (AI) Formula, and Relative Importance Index (RII). From the data acquired from the questionnaire, the scores are developed and analysed by using following formula based on its importance marks.

3.4.1 Relative Importance Index (RII)

The data acquired from questionnaire results is analysed by Relative Importance Index (RII) method where the data were put into an Excel Spreadsheet in order to determine and rank the relative importance of the ‘Importance of Safety Management System in Oil and Gas Industry’.

$$\text{Relative importance index (RII)} = \frac{\sum x}{ZN}$$

Where x is the weighting parameter from 1 to 5 for the factor given in the questionnaire, while Z is the highest weighting parameter (5 for this research) and N is the total amount of respondents.

3.4.2 Average Index (AI)

The data acquired for the Current Practices and also Current Implemented System and its Effectiveness from the questionnaire were analysed by using Average Index (AI) formula as it is used to evaluate the degree of agreement by the respondents with the statement pointed out in the survey.

$$\text{Average Index (AI)} = \frac{\sum xn}{N}$$

Where x is the weighting parameter from 1 to 5 for the factor given in the questionnaire, while n is the number/ frequency of respondents and N is the total amount of respondents.

Majid & McCaffer (1997) proposed that based on the value of average index, the agreement attributes of the results can be analysed whether:

Table 1: Average Index Rating Scale based on Majid & McCaffer (1997)

Weightage Scale	Range of Average Index	Agreement Attributes
1	$0 \leq \text{AI} < 1.50$	Strongly Disagree/ Not ever
2	$1.50 \leq \text{AI} < 2.50$	Disagree/ Rarely
3	$2.50 \leq \text{AI} < 3.50$	Moderate/ Sometimes
4	$3.50 \leq \text{AI} < 4.50$	Agree/ Frequent
5	$4.50 \leq \text{AI} \leq 5.00$	Strongly Agree/ Always/ Very Often

CHAPTER 4

RESULT AND DISCUSSION

4.1 Pilot Survey

The pilot survey for this project has been completed and done where the questionnaire has been sent out to professionals such as engineers and technicians in the oil and gas industry. The questionnaire has been analyzed, reviewed and clarified by the professionals, and based on the pilot survey, suitability of the questionnaire, and other problems and issues regarding the questionnaire have been addressed. After that, the questionnaire are being developed more and revised based on the lacking and comments from the professionals according to the suitability of the respondent of the questionnaire. After finalized questionnaire developed, the questionnaire survey is being distributed.

4.2 Questionnaire Survey

A survey was conducted towards the upstream operations company and upstream operations practitioners with total number of 26 respondents from PETRONAS Carigali Sdn. Bhd Sabah Operation and their contractors, such as ESSEM Corporation, Deleum Oilfield Services Sdn. Bhd, Uzma Berhad, Vantage Oilfield Solutions (VOS) and Setegap Ventures Petroleum (SVP) to get more clear results and wide view in term of safety in the upstream operations in oil and gas industry. The finalized questionnaire for this project survey had been distributed to the professionals in the PETRONAS Carigali Sdn. Bhd Sabah Operation and also to their contractors, which consists of engineers, technicians, and technical assistants to fill in the survey and the feedbacks had been received with total of 26 responds. As the study is a qualitative study, thus, the feedbacks obtained from the professionals should be enough. The results from this survey is used as the primary data of the project. Basically, the questionnaire will be consist of three section – questions regarding the background of the respondents, Importance of Safety Management in Upstream Sectors of Oil and Gas industry and Currents Practices of Safety Management in Oil and Gas Industry and its effectiveness.

4.3 Results Based on the Relative Importance Index (RII), and Average Index (AI)

Formula.

4.3.1 Importance of Safety Management in Upstream Sectors of Oil and Gas Industry

Table 2: Ranking based on the Relative Importance Index (RII) for the Importance of Safety Management

Rank	Importance	Weightage (People)					Relative Importance Index (RII)
		1	2	3	4	5	
1	Increase overall safety operation	0	0	1	5	20	0.95
2	Reduce the probability of accident occurrence	0	0	1	8	17	0.92
3	Ensure smooth execution of work	0	0	3	4	19	0.92
4	Increase confidence of workers during working	0	0	1	9	16	0.92
5	Enhance knowledge and skills of workers	0	0	0	11	15	0.92
6	Increase confidence of client	0	0	2	8	16	0.91
7	Increase/maintain the productivity of workers	0	0	5	8	13	0.86
8	Improve business profitability	0	0	4	11	11	0.85
9	Complete job within schedule	0	0	4	12	10	0.85
10	Reduce operational cost	0	0	6	15	5	0.79

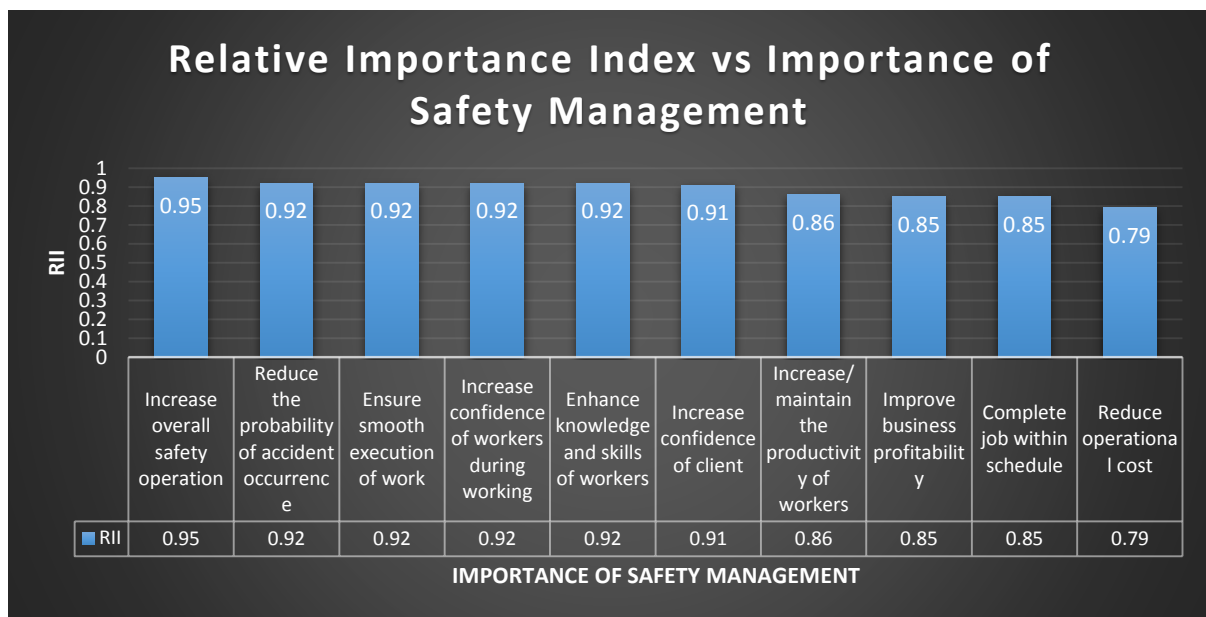


Figure 8: Importance Safety Management

Based on Table 1, the respondents rank that the highest in the importance of safety management is to increase the overall safety operation with 0.95 relative importance index and followed by to reduce the probability of accident occurrence, ensure smooth execution of work, and also to increase the confidence level of workers during working with 0.92 relative importance index. Basically, all of this are correspond to the increased in the overall safety operation. This also shows that safety management in the industry is very important in order to ensure the safety of the workers and will then result in the reduction of accidents to occur while ensuring the smoothness in the work to be completed within time. Besides, from the Table 1, it shows that the awareness between PETRONAS' employees and also their contractors towards the importance and the need of safety in the operation is very high.

Moreover, the respondents rank the least in the importance of safety management as to reduce the operational cost with 0.79 relative importance index. This is then followed by to improve business profitability and complete job within schedule with 0.85 relative importance index. Probably, this may be caused by as most of the respondents are basically engineers and technician, which are about 21 person while from management part are only 5 person, thus causing the cost, profits and completing the job within time are somehow less important to them. Thus, these importance are rank overall based on engineers and workers view, and not by the view from management part. These three (3) importance can be related together and combined as this will give the most impact on the management side.

Therefore, based on the results, it can be concluded that different party have its significant importance regarding the subject and will then give different impact and view in the importance.

4.3.2 Current Practices of Safety Management in Oil and Gas Industry

Table 3: Ranking based on Average Index (AI) for Current Practices of Safety Management

Rank	Current Practices	Weightage (People)					Average Index (AI)
		1	2	3	4	5	
1	Safety signboards at workplace is put at the site	0	0	1	7	18	4.65
2	Emergency response plan is used at the site	0	0	3	6	17	4.54
3	HSE policy is available and displayed to all worker	0	0	2	10	14	4.46
4	Safety awareness campaign is conducted by the company	0	0	2	11	13	4.42
5	Health safety officer is employed and is present to ensure the safety at the site	0	0	2	11	13	4.42

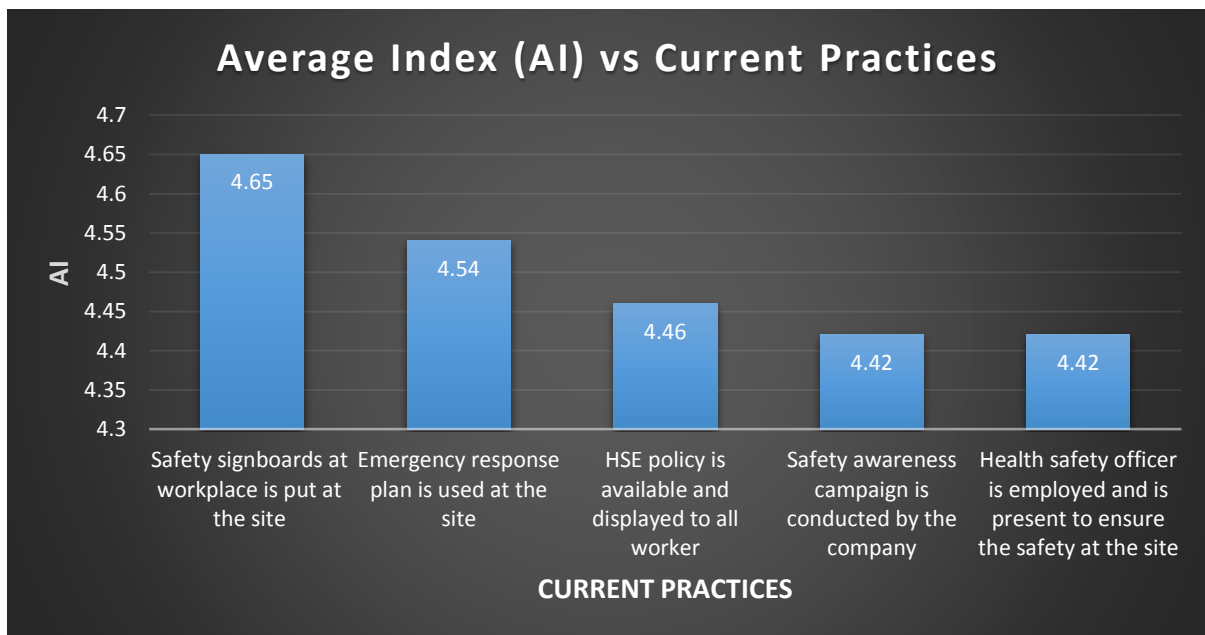


Figure 9: Current Practices of Safety Management in Oil and Gas Industry

The result in the Table 2 are ranked based on the average index as this results is based on their experiences and observations. The respondents rank the current practices that is most regularly experienced and observed is safety signboards is being used and displayed at the worksite and workplace with average index of 4.65. In other words, the Table 2 shows that the availability of safety signboard at workplace more prone to exist as the highest average index. About 18 people strongly agreed, 7 people agreed while 1 persons rated this practices as moderate. This is a clear indication that the workplace and worksite environment had already been designed and set to remind workers about the safety and also the possible hazards or dangers. This signboards can also be viewed as precautions of reducing and avoiding accidents to occur. In addition, emergency response plan are also being used at workplace and ranks as the second highest average index. This indicate that safety management are being implemented effectively as one of the most important actions are being taken. This is because in the event of emergency, every second are critical. In the event either in the need for workers to evacuate or in the event of lockdown, quick warning or actions may save lives. This shows that there may be proper explanation or training on the event of emergency for all the workers.

The least observed and experienced current practices with 4.42 average index are ‘safety awareness campaign is conducted’ and ‘health safety officer is employed and present to ensure the safety at worksite’. These may be rank as lowest because safety awareness campaign are done based on yearly basis on 6 monthly basis while there may be a few safety officers in the site as there will be also supervisors to supervise the safety of the operation. Although the respondent rank the HSE officer existence and safety awareness campaign as the lowest in current practices, the average index are still high and this proves that the management plays their role regarding safety.

4.3.3 Current Implementation of Safety Management System in Oil and Gas Industry and its effectiveness

Table 4: Average Index for Current Implementation of safety management based on its key effectiveness

No.	Current Implemented System	Key Effectiveness (based on Average Index)		
		Consistently Applied	Highly Integrated	Assign Accountability
1	Safety Management System (SMS) is implemented at worksite.	3.92	3.81	4
2	On-site meeting or Safety tool box meeting is conducted before executing any job.	4.38	4.15	4.19
3	Personal Protective Equipment (PPE) is required to be wear at the site.	4.77	4.65	4.54
4	Risk Assessment and Job hazard analysis (JHA) is conducted and validated for every job to be executed.	4.46	4.42	4.38
5	Permit To Work (PTW) system is implemented.	4.62	4.54	4.5
6	Worker's competency is validated before executing any job. For example : Proper training, certification	4.5	4.42	4.5

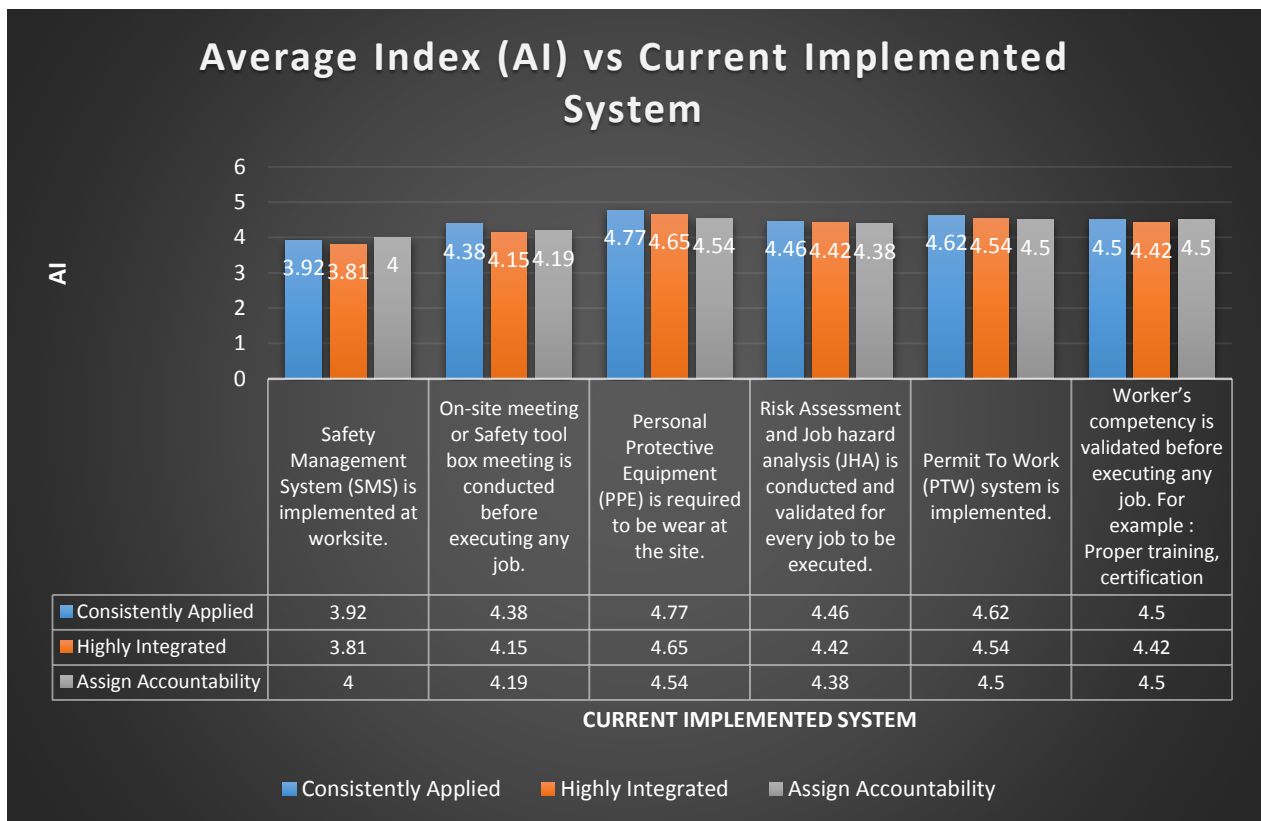


Figure 10: Current Implemented System and Its Effectiveness

The result in Table 3 are analysed based on the average index too as it is based on observation and experience of the respondents. The current implemented system and its effectiveness is analysed based on three (3) different aspect which are consistently applied, highly integrated and assign accountability.

Based on Table 3, the results shows that based on the current implemented system and its effectiveness, the requirement of Personal Protective Equipment (PPE) is the most effective implemented system. This is because, this is the most basic thing to be observed at the worksite. Besides, workers need to use PPE before they even enter the site, thus ensuring the usage of PPE to be the most effective. While the least effective of current implemented system is the implementation of Safety Management System. Although the Safety Management System is a compulsory for every organization and operation, this may be rated as the least effective because of the less initiative taken by the management in order to ensure the existence and implementation of the Safety Management System at the worksite to be known by all the workers.

Thus, it can be concluded that all the respondents were agreed that all the currents practices and implemented systems as listed were being done and implemented as the average index of each practices is between 3.5 to 4.5 and more than 4.5 (Majid & McCaffer, 1997).

4.4 Literature Review

These are the summary from past research which related to the importance of safety management system and also safety management implementation in Oil and Gas industry and its effectiveness. These past researches are being used as clarification and references in order to ensure the current study objectives can be achieved. Table below shows the finding/ key statement from each research:

Table 5: Past Researches and its Findings

NO	Articles	RESEARCHER (AUTHOR)	KEY STATEMENT/ FINDINGS
1	Increasing the Agility of Process Safety Management Systems	Rains, 2012	<ul style="list-style-type: none"> • Increased risk and danger in oil and gas can be reduced and avoid occurrence of incidents & fatalities by implement safety management • Industry constantly adapting to changes thus increasing risk of hazards. • Accident such as Macondo well blowout have economic effect to several countries and resulting in loss of jobs and money (more than US\$ 37.2 billion. • Emphasize implementation of Process Safety Management (PSM) and Management of Change (MOC) based on technology, facilities and personnel. • Efforts from oil and gas sector in order to reduce risk have improved and catastrophic accidents have become rare events.
2	Safety Managemnt in Oil & Gas Industry – The How’s and the Why’s	Rizwan & Al-Marri, 2012	<ul style="list-style-type: none"> • Safety management are main key in operations and the implemented safety management should be effective to reduce accidents • Explained the common safety management system used: Job Hazards Analysis (JHA), Risk Assessment, Permit to Work (PTW). • Emphasize the important role of management and employees for effective management system.
3	Safety and Health Management system in Oil and Gas Industry	Chauhan, 2013	<ul style="list-style-type: none"> • Emphasize need of effective safety management as workers in oil & gas industry exposed to danger and point out accidents such as explosion of Amuay Oil refinery on 2012 and Deepwater Horizon rig explosion on 2010. • From the Occupation Safety and Health Management Systems (ILO-OSH 2001) guidelines, the structure of nation-wide or organizational should have Occupational Safety and Health Management Systems (OSHMS) that contain the components of

			<p>policy, planning, organizing, implementing, evaluating and action for improvement.</p> <ul style="list-style-type: none"> • Explain on hazards related to oil and gas industry and its possible causes. • Explain components needed for effective OSHMS.
4	Risk Management in the Oil and Gas Industry	Leveson, 2011	<ul style="list-style-type: none"> • Common factors of major accidents and recommendations to be done to prevent accidents. • Emphasize that accidents occur after changes, thus MOC must be evaluated carefully and reviewed, including carrying out hazard analysis and consultation with safety engineering expert as any changes made have safety implication. • Emphasize importance of appropriate certification and training as safety control structure. (Macondo blowout) • Although safety management systems exist in companies, however sometimes they are not well designed (Texas City Oil Refinery Explosion)
5	Emerging Issues in oil and gas industry safety management	National Energy Board (NEB), 2013	<ul style="list-style-type: none"> • Failure safety management leadership to take part can cause major accidents. • There are many companies find difficulty to effectively implement safety management system. • Effectiveness of safety management can be evaluated from: consistently applied, highly integrated, assign accountability.
6	Effective safety management systems	Watson, 1993	<ul style="list-style-type: none"> • Effective safety management can be achieved by management participation, proactive system, implementation, measuring, review/ action and improvement process. • Specific procedures, precautions and hazards analysis can lessen risk of accidents and in order to effectively implement safety management system, unsafe acts must be identified as it can lead to near miss or much worse which is accidents.
7	Corporate Safety's Responsibilities and Duties to Petronas Offshore Facilities	Coleman & Salleh, 1988	<ul style="list-style-type: none"> • Employees must be advised and provided with the appropriate protective equipment such as coverall, glasses, helmets and safety shoes for the hazardous job and materials that they will be handling in order to comply with the requirement of the Factory and Machinery Act 1969. • In Malaysia, the procedures and guidelines for PPE should be based on Malaysian Code requirement.

As shown in the table above, there are numbers of researches that have been made regarding the topic, however, there are some gaps or some unclarified topic that have not been discussed in each researches. Table below shows the list of gaps identified from the above research:

Table 6: Past Reseaches and its Gaps

NO	Articles	RESEARCHER (AUTHOR)	GAPS
1	Increasing the Agility of Process Safety Management Systems	Rains, 2012	<ul style="list-style-type: none"> Did not mention on effective safety management and how the effectiveness of safety management can be achieved.
2	Safety Managemnt in Oil & Gas Industry – The How’s and the Why’s	Rizwan & Al-Marri, 2012	<ul style="list-style-type: none"> Discuss effectiveness based on employees and management only but did not discuss the proper steps to achieve effective safety management.
3	Safety and Health Management system in Oil and Gas Industry	Chauhan, 2013	<ul style="list-style-type: none"> Did not mention on the safety management implemented in oil and gas industry. Did not discuss on the importance of keeping the safety management up to date as industry keep adapting to change.
4	Risk Management in the Oil and Gas Industry	Leveson, 2011	<ul style="list-style-type: none"> Did not mention on how to achieve effective safety management and key component of safety management.
5	Emerging Issues in oil and gas industry safety management	National Energy Board (NEB), 2013	<ul style="list-style-type: none"> Did not mention on key aspect of an effective safety management system.
6	Effective safety management systems	Watson, 1993	<ul style="list-style-type: none"> Did not mention on the safety management implemented in oil and gas industry.
7	Corporate Safety’s Responsibilities and Duties to Petronas Offshore Facilities	Coleman & Salleh, 1988	<ul style="list-style-type: none"> Did not mention on effective safety management and how to effectively implement safety management system.

From the both table above, there are many authors that has done researches on the topic regarding safety, including on the importance of safety management system, the current practices or systems implemented in oil and gas industry, the key to effective safety management, and the proper way to achieve good safety management system and, however none of them discussed all these aspects as a whole.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

Throughout the operations in the Oil and Gas Industry, there will always be a concerns regarding safety as working in the industry has high risk on danger and accidents. Besides, as the industry always evolving and continue to adapting to change, the risk on threat will always exist. From Table 5, it can be shown that all the authors from past researches agreed on the importance of safety management system in the Oil and Gas Industry in order to ensure the safety of the workers and to reduce the possibility of accidents to occur. Moreover, based on the questionnaire, it can be concluded that all the respondents agreed on the need and the importance of safety management in the industry. From the results, the importance of the safety management system are ranked based on their Relative Importance Index (RII). In addition, as per mentioned by some of the authors from past researches regarding the implementation of proper Safety Management System, and the common type of safety system implemented such as Job Hazard Analysis, Risk Assessment, Permit To Work (PTW), compliancy and competency of the workers, requirement of using Personal Protective Equipment (PPE), and also combined with the results on the respondents' agreement regarding the existence and implementation of these system, the effectiveness of the system can be evaluated. Therefore, as a conclusion, the objectives of this study are achieved.

From the analysis of the results based on the survey, it can be concluded that the awareness among the workers in PETRONAS Carigali Sdn. Bhd Sabah Operation and its contractor regarding safety is high. Besides, based on the average index of current practices and current implemented system and its effectiveness, it can be identified that the company has play their role very well in term of safety, whether in designing the work site environment, the emergency plan, hazards and risk assessment, awareness of workers etc. This shows, overall, the safety management is good and stable.

However, this does not reflect overall situation or condition in the other oil and gas companies the survey is within the company and their contractors. The situation may differ according to different companies.

As a recommendation for further the study, in order to get more accurate results, the result from the questionnaire can be combined together with direct observation from site survey to get more reliable and better results. However, as the author does not have Basic Offshore Safety Induction and Emergency Training (BOSIET) to go to offshore to survey and experience by-hand on the safety management in the industry. Furthermore, as the number of respondents only consist of 26 respondents, and the survey is done based on small scale which is within PETRONAS Carigali Sdn. Bhd Sabah Operation and their contractors, thus giving results that indicate in small scale of survey. The result can be improved and get more accurate data by doing large scale survey, increasing number of respondents, and by involving much more companies in the oil and gas industry into the survey.

Other than that, in term of the company itself, the company head or the management team should realize the importance of safety management system correspond to the performance and productivity of the workers, the profits of the company, and also the safety of the workers as they play much bigger role regarding safety. They should be implement the safety system implemented systematically and globally throughout the operations, and make sure that all workers know, remember and comply with all the system implemented especially to the new workers. Moreover, the company can introduce some safety incentives or bonus and penalties for the safe and unsafe behavior. This may help to improve the performance of the safety management of the workers. In addition, the management team should always keep track on their safety management system itself, to keep up to date whether in term of technology or facilities, and keep reviewing and improving their system to ensure the safety of the workers. Besides, the awareness about the safety management among the workers and compliancy and competency by workers need to be improved.

Therefore, in a nutshell, based on the occurrence of the major accidents in the past, the safety management system has been implemented globally and greatly improved by every company in order to reduce the number of accidents occur concurrently increase overall safety in operation. However, the safety management system should be monitored and reviewed frequently for its effectiveness specifically based on key areas of highly integrated, consistently applied, and assign accountability.

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APPENDICES I

Questionnaire Form



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QUESTIONNAIRE

CASE STUDY ON SAFETY MANAGEMENT IN UPSTREAM SECTORS OF OIL AND GAS INDUSTRY:

Objectives:

1. To analyse the importance of safety management system implementation in oil and gas industry especially in the upstream sectors.
2. To identify the current practices and implementation of safety management in upstream sectors of oil and gas industry by certain companies including PETRONAS and its effectiveness.

Instructions:

1. Please fill in the space available and tick in the space or respective box provided.
2. All information's will be treated as **CONFIDENTIAL** and shall be used for academic purposes only.
3. All the data information will be on aggregated basis and no individual data will be published.
4. More information required, please contact Mr. Mohd Fakhrey Faez Ismail at:
Phone: +6012-8326569
Email: fakhrey92@gmail.com

SECTION A: GENERAL INFORMATION OF THE RESPONDENT

1. Company/ Organization: Client Contractor
2. Gender: Male Female
3. Age (years old): 21- 25 26-30 31-35 36-40
 41-45 46-50 Over 50
4. Working experience: Less than 10 years
 10 years or more
5. Job position: Management Engineer Technician
 Others (*specify:*

**SECTION B: IMPORTANCE OF SAFETY MANAGEMENT IN UPSTREAM SECTORS
OF OIL AND GAS INDUSTRY**

For each statement below please tick on the appropriate number to indicate whether it is:

Strongly Disagree	Disagree	Moderate	Agree	Strongly Agree
1	2	3	4	5

No	Items	1	2	3	4	5
1.	Increase overall safety operation					
2.	Avoid and reduce the probability of accident occurrence to the workers					
3.	Complete job within schedule					
4.	Reduce operational/maintenance cost					
5.	Improve business profitability					
6.	Increase or maintain the productivity of the workers					
7.	Enhancing the knowledge and skills of the workers					
8.	Increase confidence of the workers during working					
9.	Ensure smooth execution of work					
10.	Increase confidence of client					

SECTION C: CURRENT PRACTICES OF SAFETY MANAGEMENT IN OIL AND GAS INDUSTRY AND ITS EFFECTIVENESS

For each statement below please tick on the appropriate number to indicate whether it is:

Strongly Disagree	Disagree	Moderate	Agree	Strongly Agree
1	2	3	4	5

PRACTICES:

No	Items	1	2	3	4	5
1.	HSE policy is available and displayed to all worker					
2.	Safety awareness campaign is conducted by the company					
3.	Emergency response plan is used at the site					
4.	Safety signboards at workplace is put at the site					
5.	Health safety officer is employed and is present to ensure the safety at the site					

IMPLEMENTATION AND ITS EFFECTIVENESS:

The effectiveness of system below is examined based on:

- ▶ **Consistently applied:** System are being applied consistently across the facilities, operational programs and also geographic regions.
- ▶ **Highly integrated:** All elements of management system and data collected are tested and verified to confirm the compliancy with policies and standards of organization altogether with regulatory requirements.
- ▶ **Assign accountability:** All management and employees play their role in the safety management system.

For each statement below please fill in appropriate number to indicate whether it is:

Strongly Disagree	Disagree	Moderate	Agree	Strongly Agree
1	2	3	4	5

No	Items	Consistently Applied (Example: 3)	Highly Integrated (Example: 3)	Accountability (Example: 3)
1.	Safety Management System (SMS) is implemented at worksite.			
2.	On-site meeting or Safety tool box meeting is conducted before executing any job.			
3.	Personal Protective Equipment (PPE) is required to be wear at the site.			
4.	Risk Assessment and Job hazard analysis (JHA) is conducted and validated for every job to be executed.			
5.	Permit To Work (PTW) system is implemented.			
6.	Worker's competency is validated before executing any job. For example : Proper training, certification			

APPENDICES II

GANNT CHART AND KEY MILESTONES

FYP 1

Week number Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Project Topic Selection														
Approval Project Topic														
Preliminary Research/ Analysis Project (Literature)														
Submission of Extended Proposal														
Proposal Defense														
Continue on research (Familiarization on Pilot Study & Questionnaire)														
Surveying on Questionnaire topic														
Developing Questionnaire														
Conducting Pilot Survey														
Interim Draft Report Submission														
Improving Interim Draft														
Interim Report Submission														

Process

Key Milestone

FYP 2

Week number \ Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Continue project research (Literature Review)	Process	Process	Process	Process	Process	Process	Process							
Improving Questionnaire	Process	Process												
Finalizing Questionnaire			Process	Process										
Distributing Questionnaire				Process	Process	Process								
Submission of Progress Report							Key Milestone							
Data Gathering (Result)							Process	Process	Process					
Analysis data and discussion							Process	Process	Process					
Pre-SEDEX										Key Milestone				
Final Report Draft Submission											Key Milestone			
Dissertation Submission for soft bound												Key Milestone		
Technical Paper Submission												Key Milestone		
Viva													Key Milestone	
Project Dissertation Submission for hard bound														Key Milestone

Process

Key Milestone