QUALITY MANAGEMENT IN OIL AND GAS TURNAROUND/SHUTDOWN PROJECTS

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ABSTRACT

This study discusses the problem of defining quality in the oil and gas industry, to determine possible benefits of implementing quality, and to identify barriers of quality implementation in the oil and gas industry. Quality management is the process for ensuring that all project activities necessary to design, plan and implement a project are effective and efficient with respect to the purpose of the objective and its performance. Specifically in the oil and gas Turnaround Maintenance / Shut down Maintenance project, a comprehensive understanding of issues related to project quality is required. This research aims to investigate the benefit and barrier of quality management in the oil and gas industry. The main objective of this research is to determine the importance of quality management implementation in oil and gas TAM/SM projects. This research also aims to highlight the benefits of implementing the quality management to the overall project delivery. In addition, recommendations to improve the quality management implementation in Malaysia's oil and gas industry will be made. Data for this research was conducted by sending questionnaire survey to the oil and gas industry players. From the data collected, it has been found that the client satisfaction, education, and training are the most important measure to improve quality performance. The findings show that certified quality programmes such as the ISO 9000 series are important.

Keywords: *quality management; oil and gas; industry.*

ABSTRAK

Kertas penyelidikan ini membahaskan tentang masalah mendefinisikan kualiti dalam industri minyak dan gas, meneliti manfaat kualiti pelaksanaan, dan melihat halangan pelaksanaan kualiti dalam industri minyak dan gas. Pelaksanaan pengurusan kualiti adalah untuk mencapai kualiti tinggi yang tidak hanya memberikan nilai pulangan yang dapat diterima masyarakat tetapi juga memenuhi keperluan semua pihak yang berkepentingan dalam projek TAM / SM minyak dan gas. Penyelidikan ini bertujuan untuk mengkaji faedah dan halangan pengurusan kualiti dalam industri minyak dan gas. Objektif utama penyelidikan ini adalah untuk menerangkan pelaksanaan Pengurusan Kualiti dalam projek TAM / SM minyak dan gas dan bagaimana manfaatnya terhadap keseluruhan pelaksanaan projek. Di samping itu, cadangan untuk meningkatkan pelaksanaan pengurusan mutu di industri minyak dan gas Malaysia akan dikeluarkan untuk dijadikan panduan bagi penyelidik lain dan industri itu sendiri. Penyelidikan dilakukan melalui tinjauan soal selidik di kalangan pelaku industri minyak dan gas. Dari data yang dikumpulkan ditunjukkan bahawa kepuasan, pendidikan dan latihan pelanggan adalah langkah terbaik untuk meningkatkan prestasi kualiti. Hasilnya menunjukkan bahawa program kualiti yang disahkan seperti siri ISO 9000 adalah penting dalam mempertimbangkan ukuran / petunjuk kualiti terbaik dalam industri minyak dan gas. Penyelidikan ini tidak hanya mempetengahkan isu kepentingan pengurusan kualiti projek di syarikat minyak dan gas tetapi juga memperlihatkan reaksi pelanggan setelah projek ini selesai.

Kata kunci: *pengurusan kualiti; industri minyak dan gas.*

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LIST OF SYMBOLS AND ABBREVIATIONS

TAM	:	Turnaround Maintenance
SM	:	Shutdown Maintenance
QMS	:	Quality Management System
TQM	:	Total Quality Management
ISO	:	The International Organization for Standardization
QA	:	Quality Assurance
QC	:	Quality Control
PTS	:	PETRONAS Technical Standard
PETRONAS		Petroliam Nasional Berhad
ANSI		American National Standards Institute
IEEE		The Institute of Electrical and Electronics Engineers
ASTM		American Society for Testing and Materials
PMI		Project Management Institute
SPSS		Statistical Package for the Social Sciences

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CHAPTER 1: INTRODUCTION

Attainment of acceptable levels of quality in the oil and gas industry turnaround maintenance / shutdown project has long been a problem. Great expenditures of time, money and resources, both human and material, are wasted each year because of inefficient or non-compliance quality management procedures (Ibrahim & Daniel, 2019). During the last decades construction industry not just but also in oil and gas industry has been heavily criticized for its performance and productivity compared to other industries (D.Ashokkumar, 2014) (Parast, Adams, & Jones, 2011).

Poor quality in oil and gas industry especially in turnaround maintenance and shut down project is a common phenomenon in the industry (Pokharel & Jiao, 2008). Furthermore, the satisfaction of quality level in the turnaround maintenance and shut down project projects has not been achieved and, it is a serious problem (Obiajunwa, 2012). However, most of the countries have been evolved to implement quality standards to ensure construction quality. Therefore, it is necessary to investigate the importance of quality for turnaround maintenance and shut down project success. Hence, the purpose of this research is to determine the importance of quality for oil and gas turnaround maintenance / shutdown project success. The possible benefit and barrier of quality management implementation for this specific project is discussed accordingly.

Meanwhile in the construction industry, have embraced quality management as a strategy to address quality issues and to meet the end customer's needs. (Kanji, 1998). As suggested by Oakland and Aldridge (1995, p. 1): ‘if ever an industry needed to take up the concept of TQM it is the construction industry. This is because of the magnitude of

the construction sector is very likely to have a greater payback for performance improvements than any other service sector.

The implementation of TQM principles in construction is particularly difficult due to lack of standardization and the involvement of many parties. Companies around the world must have their own criteria for their goods to ensure consumers' satisfaction. (Löfgren, 2012).

The quality theory based on the principle of Crosby, Doing It Right the First Time, was the solution to the quality crisis. Crosby described performance as complete and total compliance with the requirements of the customers. Crosby also emphasizes that Zero Defects is a method and standard of performance that states that people should undertake to monitor details too closely and avoid errors. By doing so, project management team step closer to the goal of zero defect (Kenyon & Sen, 2015). Zero defects were not just a production concept, either, according to Crosby, but was an all-pervading ideology that should affect any decision make. (Kenyon & Sen, 2015).

From a project management's standpoint, cost, scope and quality are important successful criteria in project management to meet customers' need in achieving project objective in a timely manner (PMI, 2017). (Atkinson, 1999) also explains that Project Management is the use of a set of tools and techniques such as Critical Path Method and organizations matrices to guide the use of multiple resources to meet specific projects, dynamics, time, cost, and quality constraints. Each task requires a combination of specific methods and strategies designed to meet the project context and life cycle.

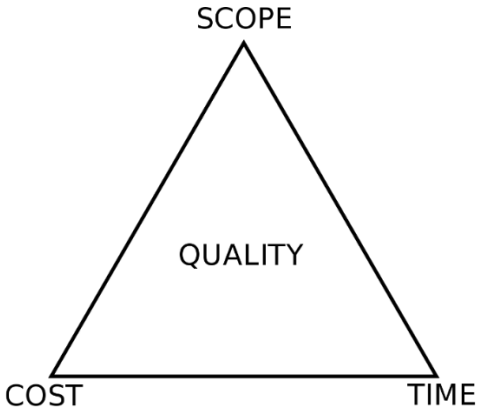

Figure 3.1 Project Management Triple Constrain (Source: PMI,2017)

The concepts of Project Quality Management, project quality management plan implementation is been oversee by project managers (Ray, 2018). The main idea is to deliver the product or service to customers or shareholder specifications. Without customer satisfaction, there is no quality. Although delivery meets all aspects of customer or stakeholder needs, the process itself is not satisfactory, there is a problem.

The project delivery must meet the agreed requirements or the project will fail because the project management products and projects do not meet the expectations of the customer or shareholder (H. Mallawaarachch, 2015).

In the oil and gas industry, ensuring the quality of all materials, structures, components, and systems used in construction, manufacture, and operation is important as it is subject to stringent regulations and standards. Typically, the Quality Management System (QMS) is commonly used in all industries, including oil and gas, and is characterized as 'all activities of the overall management process that decide and enforce the quality policy, goals and responsibilities, such as quality preparation, quality control, quality assurance and quality improvement in the production system' (ISO, 2000).

QMS has numerous uses in the industries and has been applied either at the business level or at project level. Quality in the construction industry is related to customer satisfaction, and the implementation of a quality management system is a crucial factor in achieving the customer satisfaction target effectively and efficiently (Man & Patil, 2015).

The quality management system (QMS) may be applied at the level of the enterprise or at the level of the project itself. For the implementation of quality management in construction projects, the concepts of quality planning, quality assurance and quality control in the quality management processes were defined by (PMI, 2017). Several tools and techniques were identified as part of the implementation process, like benefit-cost analysis, benchmarking, flow-charting, design of experiments, cost of quality, quality audits, inspection, control charts, pareto diagrams, statistical sampling, flow-charting and trend analysis (Man & Patil, 2015).

This research will focus on the problems of defining quality in the oil and gas industry, to determine possible benefits and barriers of implementing quality in oil and gas industry for TAM/SM project. Quality Management emphasizes on the processes in the project to produce effective project results. By complying with the standards and specification, would meet customer satisfaction and expectation for the overall delivery in the oil and gas TAM/SM project.

1.1 RESEARCH BACKGROUND

The petroleum industry, including the process of exploration, extraction, refining, carriage typically by oil tanks and pipelines, and marketing of petroleum products. Oil and gas are the largest number of industrial products (WPC, 2013). Petroleum (oil) is also a raw material for many chemical products, including, pharmaceuticals, solvents, synthetic fragrances, fertilizers, pesticides, and plastics. The oil and gas industry are typically divided into three main mechanisms upstream, downstream, and downstream (WPC, 2013).

Turnaround Maintenance (TAM), and Shutdown Maintenance (SM), is a cessation of manufacture designed to carry out comprehensive plant and equipment maintenance with the aim to restoring the process is in good shape (Al-Turki, Duffuaa, & Bendaya, 2019). In addition, the TAM provides an opportunity for the maintenance department to carry out roughly preventive maintenance activities that would not have been possible under normal operating conditions.

A TAM is a period of regeneration that is planned at the expense of crops or filtration. Most operations are currently offline, while crops are being inspected and renewed (Fayek & Robinson, 2014). Not only are the equipment and resources needed to carry out a turnaround incredibly costly, but the revenue lost by shutting down manufacturing elements can equate to a substantial portion of an annual budget. Turnarounds often raise more issues than expected, making it hard to keep track of them and requiring highly experienced managers (Obiajunwa, 2012).

With the world now completely reliant on oil and gas, planned cessations are a necessary part of the refining process. These turnarounds can be due to a need for

maintaining, renovating, or refitting facilities – usually every four years or so. Turnaround activities require well-organised labour and equipment for a few weeks at a time – the duration of which are usually measured in shifts. Most facilities will be inspected during shutdowns and turnarounds, and so may have their turnaround extended if additional issues are flagged. (Obiajunwa, 2012)

Extending turnaround activities can lead to shortages of fuel, price increases, or both. For other suppliers, strain is increased to meet demands, and turnarounds that become shutdowns can be disastrous for regional supply (Shamim & Amjad, 2014). Turnaround activities may include preventative care of equipment, general corrective repair of faults, strip-downs, complete replacement and overhaul, or maintenance. In general, the scope of turnaround maintenance covers mechanical, civil, piping, insulation, electrical and instrumentation specifically for equipment prevention, general corrective repair of defects, strip-downs, complete replacement and overhaul, or repairs may include turnaround activities (Al-Turki, Duffuaa, & Bendaya, 2019).

Shutdowns are not always scheduled as opposed to turnarounds. Often, when there is a shortage of supplies of natural gas or other reagents needed to produce gasoline, refineries will simply grind to a halt (Obiajunwa, 2012). These supplies can be found wanting if the natural resources are scarce, or prices are simply too high–often, one as a result of the other. Shutdowns and turnarounds may also happen when there are incidents, natural disasters, acts of violence, or political upheavals.

Throughout the TAM period, a proliferation amount of jobs are scheduled over a comparatively short period of time that can take up to numerous weeks, resultant in significant losses in production volume (Sabri, Rahim, Yew, & Ismail, 2014). The lost

amount is returned in the long run by preventing future uncertainty, improving the security and quality of the process and extending the life cycle of the facility. Therefore, TAM is essential to maintaining a reliable process throughout its life (Fayek & Robinson, 2014).

Turnaround/Shutdown quality of work is second to safety but, in many cases, is poorly managed, which causes rework and sometimes incidents. Owners may go to extremes with their quality programs, either giving full responsibility for quality of the work to the contractors, or taking it away by performing 100% quality checks with their own people or with a contractor. Both typically deliver poor-quality performance. (Pesenti, 2016).

In TAM/SM project, an "Engineering, Procurement, Construction and Commissioning" or short EPCC-Project is a specific form of contracting plan which has been carried out in the industry. It is typically large and complex project where the EPCC contractor is responsible for all activities from engineering design, procurement, construction, to commissioning and delivery of goods to the owner or operator and to ensure completion of the entire project as needed (Moghadam abyaneh, 2012). In addition, to providing full facilities, the contractor must provide the facility with a guaranteed date at a guaranteed price and perform at a specified rate. Failure to meet the criteria will usually result in financial loss incurred by the contractor.

There is a huge strain for finishing turnarounds as quickly as could reasonably be expected (Shamim Z. G., 2015). In addition, no big surprise, given not only the significant expense of support work, but also the fact that a disconnected plant does not contribute to any income effectively. The turnaround and shutdown window are stacked, and the execution of the project must be done within the timeframe. Therefore, time is extremely

the first consideration in project management preparation to be taken into account. Failure to complete the project's design and commissioning process would be especially costly for project completion and production (Fayek & Robinson, 2014). It crucial for the final commissioning meet the customer specification and requirement in order to avoid uncertainty that may jeopardise the process function and safety (Sabri, Rahim, Yew, & Ismail, 2014).

With reference back to the Project Management Triple Constrain, (PMI,2017) quality is in the centre of the constrain any failure on each of constrain affect the quality. High standard and approach of quality assurance in oil and gas turnaround and shutdown projects is a common practice in the industry. Additionally, the satisfaction with the quality in the turnaround project must be achieved successfully and is a serious step to be taken in relation to the implementation of quality management that requires attention (Harris Abd. Rahman Sabri, 2014). This is because any failure in term of quality can be disaster and costly.

If thinking about a scheduled shutdown of maintenance, the refinery operator will stop producing any delay from the expected shutdown window will be expensive for production. First, any failure in the process will impact the refinery's safety issues that pose a risk, risk or threat of damage, injury or loss to the operator's workers and/or property and reputation (Jiao, 2008).

To achieve high quality that not only provides an acceptable return value to the community but also meets the needs of all stakeholders in the infrastructure project, a thorough understanding of issues related to project quality is required (Ismail, Hashim, Ismail, Kamarudin, & Baharom., 2011).

Fundamental skills and abilities of the Turnaround/Shutdown workforce contribute to success. The trade practices and workforce competencies are key to mitigate quality issues. During the planning stage of the Turnaround/Shutdown, it is fundamental for the organization to identify critical areas and provide the processes and tools to manage the skills and abilities of the workforce so as to obtain the desired level of quality, in a way similar to that in which Safety behaviour is managed (Pesenti, 2016).

A well-defined quality ownership role can achieve an optimum quality in Turnaround/Shutdown (Pesenti, 2016). The Quality Control (QC) should stay with the contractor, and the Quality Assurance (QA) using sampling methodology should be managed by the owner (Pesenti, 2016). An effective quality program Turnaround/Shutdown will mitigate rework and incidents during start-up and improve plant availability for the next cycle (typically translates to an availability improvement of 2% to 5%) (Pesenti, 2016).

This paper not only highlights the importance of project quality management issues in oil and gas companies but also exposes customers' reactions after the project is completed. Efficient project implementation is a key objective in many areas of the business as well as the oil and gas industry.

1.2 PROBLEM STATEMENT

In a turnaround, part or all of the operations of a plant are shut down, so that the machinery can be checked and maintained, serviced, repaired and/or replaced if necessary. The ultimate goal is to return equipment and all its components to a similar new condition in order to ensure that it continues to function at peak performance

(Shamim & Amjad, 2014). Achieving this goal requires cooperation among many groups, including the company's primary employees as well as a slew of outside vendors like OEMs, parts suppliers, and service providers.

In the past, it was normal in many industries to perform a turnaround on a yearly basis. Now turnarounds occur less frequently, thanks to advances in equipment reliability and maintenance programs. In the oil and gas industries, for example refineries, many companies move to a schedule of every 3 to 5 years. The cycle in chemical processing can be as long as 10 years (Ismail, Hashim, Ismail, Kamarudin, & Baharom., 2011).

Turnarounds also take varying amounts of time, typically between 10 days and 2 months, depending on the industry, the plant and the interval between shutdowns, when shutting down a plant for disassembly, service and reconstruction of the equipment is a significant process. (Shamim & Amjad, 2014). Here are some of the big challenges companies commonly encounter. This paper discusses the problems of defining quality in the oil and gas industry, examine possible benefits of implementing quality, and look at barriers to quality implementation in oil and gas industry.

1.3 RESEARCH AIMS

This research aims to improve the implementation of quality management system in Malaysia's oil and gas industry.

1.4 RESEARCH OBJECTIVE

The research objectives of this research are as follows:

(i) To defining perception of quality management implementation in oil and gas industry.

(ii) To determine the barriers and benefits in quality management implementation in oil and gas projects.

(iii) To provide recommendation on area that can be overcome in the barrier of quality management implementation in oil and gas projects.

1.5 SCOPE AND LIMITATION

The research focused on quality management as elements to be taking note in as a strategic to achieve quality in oil and gas industry TAM/SM project. In order to achieve the objectives of the research, the study on several aspect related to the Most of the literature concentrates on: (1) the problems of defining quality in the oil and gas industry, (2) examine possible benefits of implementing quality, (3) and look at barriers to quality implementation in oil and gas industry TAM/SM project. The respondent for this research is the project manager and quality practitioner both Owner and contractor side in oil and gas industry. These respondents are chosen basically because they are involved directly during the process.

1.6 SIGNIFICANCE OF RESEARCH

The research will be beneficial to identify the benefit and barrier in implementation of quality management in oil and gas turnaround and shutdown maintenance project and to investigate the perception of quality management implementation. Quality

management is very important especially in managing the project. Hence, this study will be providing recommendation on area that can be overcome in the barrier of quality management implementation in oil and gas projects.

This study will practically help the project manager and project management team to improve on the understanding of quality management that can also reduce the barrier in the implementation of quality management and together achieve the goal of the project.

1.7 RESEARCH METHODOLOGY

To achieve the research objectives of this research several activities will be carry out. The research methodology flowchart is shown in the Figure 2.

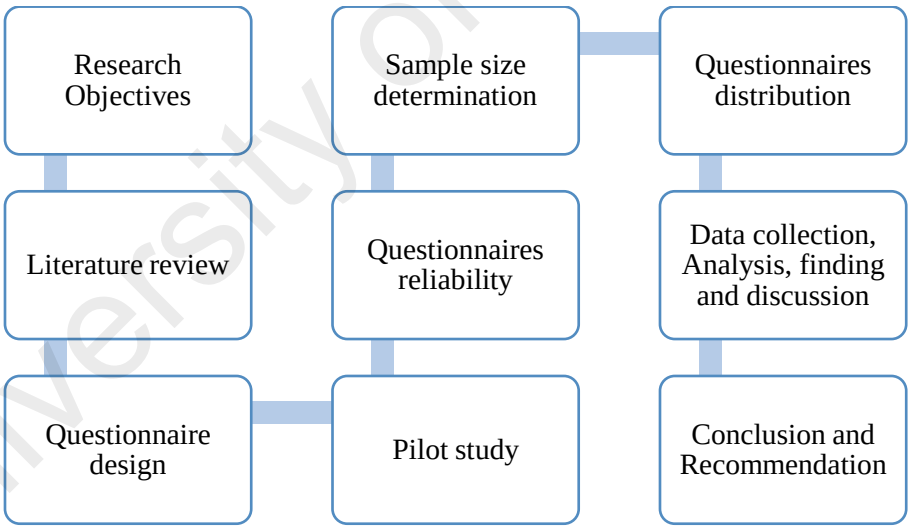

Figure 1.4: Research methodology flowchart

The first stage is done by reviewing the current and previous literature by referring to the related journals, books, research papers and online database as the secondary sources to understand the generation gap issue, to learn more about oil and gas TAM / SM quality assurance processes / procedures, to achieve first, second and third objectives. This is also to ensure a correct understanding of the matter and to increase the level of knowledge.

From the literature review a questionnaire surveys related to the study is then produced. The questionnaire survey is chosen for the research method because it will allow for a broad group survey and provide a widely understood and measurable result. The pilot study will be carried out from the design of the questionnaire, and its reliability will be tested on the questionnaire survey. The questionnaire survey will be distributed by postal and online survey to all practitioners in Malaysia's oil and gas industry. Two weeks' time is given to get the questionnaires feedback back.

The next stage of research is to collect all the data obtained and conduct the analysis. The final stage will be the presentation of the analysed data and write the report with conclusions and future suggestions.

1.8 Summary

In this chapter, the researcher will describe the overview of the research topic on the TAM / SM project quality management. This chapter also covers research issues, goals, and research objectives. The methodology and scope of the research study will be included in this chapter to make the study clearer and to avoid misunderstandings.

CHAPTER 2: LITERATURE REVIEW

2.1 Definitions of Quality

The approach to project performance is to make the transfer of proven quality approaches to a general project management field more efficient and meaningful (D.Ashokkumar, 2014). The first move is to answer the "What is quality?" question. There has been extensive research on this subject, and many quality experts have written a lot about performance. Mr. Philip B. Crosby provides the most relevant and widely accepted concept of quality, which states "Quality is Conformance to requirements."

Loushine, Hoonakker, Carayon, & Smith (2006), in their review of the literature on quality and safety management in the construction industry, examined the definition of quality authors used. Quality researchers in the construction industry have given the following definitions for quality performance 'meeting customer expectations' (Torbica, 1999) ‘reduced rework or defects’ (Love, 1999), ‘repeat business’ (Neyestani, 2016), ‘conformance to ISO 9000 criteria’ (Teinonen, 2014), and ‘completion on-time and within budget’ (Ahmed, 1995). In PETRONAS, the target on quality is define “on time, on budget and on scope” and in the TAM/SM project the target is to achieve “Zero Leakage and Zero Lost Time Injury”. Obviously, in the oil and gas industry it is difficult to find a clear description of quality. To examine how contractors define quality, how they measure it, how they think it can be improved, and what the barriers are to quality in the oil and gas industry, questionnaire surveys conducted with both client and contractors.

2.2 Definition of Quality Management

Base on the definition of quality in the previous section, this is where quality management system come in, A quality management system (QMS) is defined as a formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives (Chin Keng & Hamzah, 2011). A QMS helps coordinate and direct an organization's activities to meet customer and regulatory requirements and improve its effectiveness and efficiency on a continuous basis.

ISO 9001:2015, the international standard specifying requirements for quality management systems, is the most prominent approach to quality management systems. While some use the term "QMS" to describe the ISO 9001 standard or the group of documents detailing the QMS, it actually refers to the entirety of the system. The documents only serve to describe the system (Bubshait, 1996). The goal of the QMS can be achieve by the implementation Quality Assurance (QA) and Quality Control (QC) Program is to guarantee the generation of precise and accurate analytical data. QA and QC exist within a Quality Management System whose goal is to maximize the quality of the deliverables of a project or product.

A Quality Management Plan identifies the structure of the Quality Management System (Salvi, 2020). It contains the following parts:

i) Quality Standards

A listing of the quality standards that apply to the project/product. Most industries have well developed standards from the owner of the project, or if not, then a standard can be purchased from a standards organization such as American National Standards Institute (ANSI), Institute of Electrical and Electronics

Engineers (IEEE), or American Society for Testing and Materials (ASTM) (Salvi, 2020).

ii) Quality Control

It identifies what will be measured, how often, and what the acceptance/rejection criteria are. This section should also include the applicable inspection forms (Salvi, 2020).

iii) Quality Assurance

It identifies the QA activities, which usually include regular quality audits of the various processes at specified intervals. It might also include reporting criteria for performance of the quality system and potential improvements to the system. Since QA is a process of continual improvement, it is not usually possible to identify every aspect of process improvement up front, however laying the groundwork can give the project team a head start (Salvi, 2020).

iv) Continuous Improvement

Continuous Improvement is a cornerstone ISO-9001, the gold standard for certification of an organization's Quality Management System. Although there are not many black-and-white rules within ISO-9001 due to the many differences in quality standards from industry to industry, continuous improvement is one of them, and rightly so.

The Quality Assurance system should be structured as to ensure that the process is always looked at critically with room for improvement no matter how much progress has already been made. Continuous Improvement dictates that there is never enough QA (Salvi, 2020). That is, when quality improvement has stopped, quality is effectively moving backwards.

This program involves the planned and systematic actions necessary to provide confidence in each analytical result. Further definition explained as per below:

2.2.1 Definition of Quality Assurance

Quality Assurance need to fits its two principles: "Fit for purpose" (the product should be suitable for the intended purpose) and "right first time" (mistakes need to be eliminated). This can be focuses on the methods used effectively in the project to generate deliverables for the quality of the project. This includes the following standards and requirements of execution, progressive enhancement of project work and reduction of project defects (Lakhal & Pasin, 2006).

The quality of the product is promises with quality assurance, which means that the process guarantees that the product produced from the process is free of defects and complies with all of the stated customer requirements. It is said to be a process-based approach whose main purpose is to prevent delays in delivery at the planning stage to avoid hard work, which increases the cost of the process (Kiew, Ismail, & Yusof, Integration of Quality Management System in the Malaysian Construction Industry, 2016).

The Quality Assurance Activities: Planning, Auditing and Analysing Project Quality (Josh, 2017). These activities are the roles that the quality team conducts in evaluating the quality requirements, auditing the outcomes of control assessments and reviewing the quality performance to ensure that proper quality practices and procedures are implemented within the project.

According to the American Association for Quality, ASQ QA defines it as most quality management is focused on ensuring that quality requirements are met. The confidence given by quality assurance is twofold - internally and externally to Owners, government agencies, regulators, certification, and third parties. An alternative explanation is all planned and organized activities performed in a quality system can be established to assure that the product or service meets the quality specification." (Hiraishi & Nyenz, 2012)

The focus of QA is on the product design and development stage or in project life cycle is on the planning and execution stage. To ensure that all aspect of need quality the production or services process is well control is built in (Kiew, Ismail, & Yusof, Integration of Quality Management System in the Malaysian Construction Industry, 2016). while all the process is reliable there will be a less need to inspect production or services delivery outcome (quality control).

2.2.2 Definition of Quality Control

Quality Control is the process of checking the output of a product or service to ensure that a quality standard is required. According to the American Quality Association, ASQ the quality control can be defined as one of quality management attentive on meeting quality specification. While quality assurance is related to how

the product is made or how the process is implemented, quality control is a characteristic of quality management inspection. Alternative definitions are techniques and operations used to meet quality specification.

Quality Control is by far still the traditional wat of managing quality, that the main objective involves checking and review output mainly about "detecting" defective output rather than preventing it (Cao, 2010). The process requires sampling to spot and removes sub-standard of output this also a very costly process. Three main point in operations when inspection is used in quality control:

i) When raw materials are received before entering the production site or project.
ii) Although the product will go through the production process
iii) When product or service are finished – take place before product or delivery (handover) to the customer.

The benefit of QC is that the sub-standard output is spotted before it reaches to the customer. A well organize QC inspection sampling will also minimizes the distribution of the production by applying a consistent standard to quality.

2.3 Importance of Total Quality Management in Project

A core definition of total quality management (TQM) describes a management approach to long-term success through customer satisfaction. In a TQM effort, all members of an organization participate in improving processes, products, services, and the culture in which they work (Mosadeghrad A. M., 2014). Many authors argue that TQM can be a solution to the problems faced by the construction industry (that is, costs, productivity, occupational safety and health) (Burati, 1993). According to (Arditi, 1997)

by applying TQM better construction can be achieved. Studies regarding the status of TQM implementations in engineering and construction by (Kuprenas & Kenney, 1998), Found that the overall motivation for implementing TQM remained essentially the same over a period of three years, and that most firms understood the benefits of TQM implementation. The methods and effectiveness of implementing TQM, however, did vary substantially between companies over the three years. Some firms completely abandoned their TQM implementations while others achieved award-winning results.

Philip B. Crosby devised the zero defects practice, which means, basically, do it right the first time. Crosby says that costs will increase when quality planning isn't performed up front, which means the organization will have to engage in rework, thereby affecting productivity (Atkinson, 1999).

Prevention is the key to Crosby's theory. The prevention of defect from occurring in the beginning will lower the cost, the ability to conformance to requirements, also, the cost estimation for quality turns into the expense of nonconformance instead of the expense of rework (Arditi, 1997). These requirements may be basic or complex, or they may be stated as far as the final product is needed or as a definite description of what might be possible.

The definition of traditional quality is based on issues such as how well a building mixes with the environment, the psychological impact of the building on its occupants, the ability of landscape design to match the theme of the adjacent structure, and the use of new design concepts that boldly capture people's imagination (H. Mallawaarachch, 2015). However, quality is gained if the conditions specified are sufficient and if the completed project meets the requirements (D.Ashokkumar, 2014).

Some design experts trust that quality is estimated by the style of the of the facilities they design (solomon, Obodoh, & Onoh, 2016). Quality can also be characterized by a functional perspective, where the project almost adapts to its needs. The idea of quality management is to ensure efforts are made to meet the quality standards required for planned and structured products (Peter Hoonakker, 2010). However, in the construction industry, quality can be defined as meeting the needs of designers, builders, and regulatory agencies and owners (Neyestani, 2016)

Quality assurance is important in the oil and gas industry because of the risks involved in any project. The risks involved in not completing the project on time are high, as many external factors will affect the performance of the project. It is important that a quality assurance system is built to avoid any inconvenience that may result in the poor quality of products and services to customers (Sankar, Chari, R, & Rao, 2016). Everyone involved in the oil and gas business, in a different way, benefits from the same approach to quality work (Shamim & Amjad, 2014). Efficient quality work decreases the cost of let-down on the job itself and on the final product. These standards can do a better job of creating uniformity.

It is important for the contractor's quality assurance system to prevent their problems and regenerate and allow the owners to rest. One of the quality system standards is the ISO 9000 standard, which has been used by many countries around the world and used in many industries including the oil and gas industry (Zafarani, 2011).

2.4 Method of Implementing Total Quality Management

Total Quality Management is the item of overseeing all activities and tasks required to maintain the desired level of excellence. These include defining quality policies,

establishing and implementing quality assurance and planning, and quality control and quality improvement (Ray, 2018). Also includes all management activities, such as planning, organization, implementation, inspection, monitoring, auditing, so that the quality of the product meets the latest requirements (Barad, 2000).

The idea of quality management is to ensure that well designed and coordinated efforts are made to achieve the necessary level of quality for the product. In the oil and gas industry, however, performance can be characterized as meeting the architect, supplier, and regulatory agencies as well as the owner's requirements or standards. In particular, through the execution of short-term strategies, quality management focuses on long-term goals (Fayek & Robinson, 2014).

To serve a short-term strategy, quality management focuses on the long-term goals of the form. The quality policy is the intent and direction of organizations related to quality. Approved by top management. Project teams can often apply the "as is" quality policy that organizations implement for their products (solomon, Obodoh, & Onoh, 2016). The project management team should develop a quality policy for the project, if the organization does not have a formal quality policy, or if the project involves several implementing organizations such as joint ventures. The Project Management Team is responsible for ensuring that project stakeholders are fully aware of quality policy.

Instead, it is also known as Total Quality Management (TQM). At its core, TQM is a business philosophy that promotes the belief that the company's long-term success is based on customer satisfaction (Idris, 2011). TQM requires all business partners to work together to develop their own processes, products, services, and culture (Arditi, 1997).

This TQM philosophy is supported by Arditi (1997), stated that TQM's management philosophy is committed to focusing on the continuous improvement of products and services with full involvement of the workforce. The features of TQM are as follows (Arditi, 1997):

- Attitude is essential toward TQM
- The whole business recognizes the quality requirements and takes action to achieve them
- All personnel in the organization is concerned with quality at every stage of production or project life cycle.
- Quality is determined by the worker, not the inspector
- Put customers at the centre of the production process
- Employees feel more involved and make decisions.
- Less waste than removing damaged products
- Eliminate inspection costs
- Need strong leadership that is often lost in business
- Substantial investment in training and support but not an immediate return on investment
- Bureaucracy
- Disruptions and costs may outweigh the benefits.

Most of the literature concludes that it is necessary to transpose and translate the principles, practices and techniques used for TQM in manufacturing to construction (Barad, 2000) (Joiner, 2006) (Idris, 2011) (Burati, 1993). Total Quality Management (TQM) techniques have been used widely and beneficially in the manufacturing and industrial engineering industries to monitor processes and avoid accidents until they

occur, saving millions of dollars in the end (Ohtaki & Georgiev, 2019). The building industry wants the same kinds of tools and for the same purposes, but because of the variations between the industries, they cannot be implemented as they are'. (Formoso & Revelo, 1999) conducted a study aimed at developing a method for improving the materials supply system in small-sized building firms using total quality management (TQM) principles . The proposed method was based on simple, well-known quality techniques such as flowchart, brainstorming, checklist and Pareto diagram for problem identification, analysis and solution. The results showed that such techniques and principles are difficult to apply in small-scale construction companies (Formoso & Revelo, 1999).

A same conclusion drawn from the results of a study in Hong Kong by (Tam, Deng, Zeng, & Ho, 2000). The Hong Kong Housing Authority has introduced of ISO 9000 as a compulsory quality program for contractors who bid for housing construction. (Tam, Deng, Zeng, & Ho, 2000) also developed and adopted an objective measure of quality: The Performance Evaluation Scoring Scheme (PASS). Results of the study by (Tam, Deng, Zeng, & Ho, 2000) It showed that the general quality level had not improved seven years later and that the expected continuous improvement in the quality of the construction had not been achieved. Based on further data analysis, the authors concluded that the greatest barrier to quality implementation is the culture of the construction industry (Peter Hoonakker, 2010).

Bubshait (1996), have also tried to tie a TQM approach to other, existing management systems, such as project management, partnership, Project Quality Plan (PQP), and/or to the ISO 9000 and 14000 standards, with mixed results. Implementation of TQM in the construction and construction sector is not an easy matter. One of the reasons for this is

the 'transient nature' of construction and construction, the lack of standardization and the many parties involved (occupations, professions and organisations) (Peter Hoonakker, 2010). Another explanation is that the building industry is conservative in nature. Lansley, for example, characterized the behaviour of the UK industry in this way:

This method shows the construction industry is still seeking to borrow ideas from past or other experiences. They don't invent. Development is gradual. The bulk of the industry is waiting to see if a few companies, which are renowned for developing innovative innovations, can make a particular system or process work, and only then can they find the merit of that invention if circumstances demand that they do. When it looks useful then the concept can be replicated with all the advantages but with low risks (Neyestani, 2016).

(Peter Hoonakker, 2010) The same attitude was observed in conducting a study on measures taken by construction firms in the Netherlands to improve the quality of their working lives. Just one out of 20 building and design firms interviewed had adopted the concepts of TQM like teamwork. The other companies knew about this creative effort, but decided to 'lean backwards' and watch the results, making statements such as 'This will never work in the building sector.' Same attitude regarding the role of organizational culture in motivating innovative building companies: 'The main tendency in the construction industry is to implement innovations that have already proven themselves on the market. (Hartmann, 2006).

These examples demonstrate how difficult it is to introduce change in the building and design industry, but also the value of good practice. If construction and construction firms see that an idea is actually working, they are more likely to implement it, particularly if it

will reduce costs. In addition, the provision of a roadmap for businesses to implement TQM would increase their confidence and willingness to implement change.

There are also few studies that examined the effects of Quality Management implementation. On the basis of a large study among 1500 construction firms in the mid-western US, (Mcintyre & Kirschenman, 2000) concluded that substantial economic benefits can be attained through the implementation of Quality Management. Chase concluded, in the construction industry, application of Quality Management to the jobsite has been proven to speed-up projects while increasing profitability (Chase, 1998). Torbica and Stroh (1999, p. 1) Examined how implementation of Construction Quality Management affects customer satisfaction. They concluded: 'For the first time an empirical analysis has verified that implementing Quality Management is positively correlated with satisfaction of home buyers'. Results of a study by (Liu, 2003) an increased in customer satisfaction after ISO 9000 implementation has been shown on quality implementation in public housing projects in Hong Kong. In addition, the average number of defects in housing projects built by ISO 9000 certified companies was significantly lower than the number of defects in housing projects built by non-ISO 9000 certified companies. Thus, although there are few studies which have examined the effects of quality implementation in the construction industry, the results show that it can benefit both customers and contractors.

2.4.1 Implementation of Quality Management in Oil and Gas Industry

From the point of view of oil and gas companies, quality management in TAM/SM projects will mean maintaining the performance of construction work to the standards needed to achieve customer satisfaction that will ensure long-term profitability and continuity of business for companies. (Keng & Kamal, 2016)

The application of the ISO 9001 standard is a critical aspect of the oil and gas industry. The ISO 9001 Quality Management System is one of the ISO 9000 standards set which includes a collection of instructions on how to build a quality management system for processes that impact their products or services. There are many benefits that ISO has to offer but it does not mean that if a company successfully obtains certification, they will be able to experience all the beneficial results (Chin Keng & Hamzah, 2011).

The project management implementation of quality management is the ideas of quality planning (quality standard identification), quality assurance (evaluation of overall project performance) and quality control (project specification monitoring) in the quality management process. Among those, QAQC are for the most part utilized in the oil and gas industry (Zafarani, 2011). In the TAM / SM project quality control procedures are based on tender documents, specifications, shop drawings, testing requirements, and so on, therefore, the pre-screening stage in the process and the quality of the tender process should be taken care of. (Cao, 2010).

Quality Assurance is a system that includes tasks necessary to ensure the quality of the work to fulfil the project requirements (H. Mallawaarachch, 2015). The QAQC program for construction phase shall provide a guideline for implementation of quality assurance activities during the construction and installation in accordance with the manufacturer's instructions to ensure compliance with design specifications and equipment.

The QAQC activities shall inclusive but limited selection of Construction Contractor, Construction equipment and material control, Document control, Pre-Fabrication and construction control, Handover control of completed works. The program shall apply for all construction stages inclusive pre-fabrication, erection and installation of new facilities, installation of new equipment removal and re-installation of existing equipment and any other construction or installation work implemented for the project (Fayek & Robinson, 2014).

This program continues in the commissioning stage to the handover to Owner stage. In the QAQC program for Commissioning shall provide guideline to assure the facilities and/or equipment are commissioned or de-commissioned properly, Without risk to the safety of workers or the environment and limited interference with the operation of existing facilities with any appropriate modifications having been suitably authorized and recorded, and the facilities or equipment are safely handed over to Owner (Ismail, 2012).

2.4.1.1 Activities

Not all elements will be used for a specific project, but all projects will have QA input and Project Quality Plans as part of the Implementation Plan for the project. To maintain asset quality and achieve its goals, a project must "self-regulate so that technical, administrative and human factors that influence the quality of its products are regulated (Jaapar, Endut, Ahmad Bari, & Takim, 2009). All such controls should be focused on towards reducing, eliminating and, most importantly, preventing quality absences as defined in ISO 9001. A well-structured quality system allows management

to optimize and control quality in terms of cost/benefit and risk (Ingason, 2014).

Management systems are documented in the Project Quality Plan, addressing critical activities, such as:

- Determine customer requirements;
- Definition of the method to be used;
- Critical evaluation of activities and products;
- Allocation of responsibilities and definitions of control;
- Creating and maintaining quality records;
- QA audit and review;
- Improved quality.

2.4.1.2 Documentation

Primarily, the role of documentation in quality assurance would be to keep a record. This record shows all the activities done in the development of a project. In addition, it can also serve as a reference. This is in case something happens to the project which has happened before. Documentation makes it possible for the quality assurance team to go over past details. This will enable them to see if they find anything helpful in resolving a current project issue.

Documentation lays a very important part is quality assurance. It can save an organization a lot in terms of money and time. A client can review project processes easily, all because of proper documentation. Documentation is

important because it includes details which are helpful in quality assurance and project development.

The quality assurance documentation is a formal document that documented the critical activities that are performed according to written procedures or work instructions based on proven techniques, and evidence of compliance recorded. It is accordingly essential that engineers (with the operators) exercise proper judgement in deciding which hardware systems and activities are critical (Ismail, 2012). Quality can for example be assessed by properly controlled sample checking; complete validation is not always necessary (Ingason, 2014). Which this documentation will be handed over to the plant operator/end user for their future reference.

Having established that an activity is critical, the way in which it is to be controlled is decided by the engineer concerned, who is responsible for specifying the necessary standards and devising and documenting the management controls (such as design reviews or inspection). Quality assurance activities are incorporated into the work scope of the project and are scheduled and monitored through the Quality Plan (Ingason, 2014).

2.4.1.3 Work Instructions and Procedures

Procedures must be provided for critical activities in which the department interface is involved, but not vice versa (Barad, 2000). For organizations comprising mainly professional staff, the number of detailed procedures and work instructions needs to be reduced; Professional competence is the main control.

The important balance to be attacked is between professionalism and procedure and regulation. Engineers must ensure that the current builder has the necessary skills, or can be trained to the required standard (Pesenti, 2016).

The Work Guide is used for critical repetition tasks without any interface, the purpose of which is to make the instructions clear and maintain where they are used. They have to answer the question "Who? Why Where? When? And How?" on the subject's activity (Harris Abd. Rahman Sabri, 2014).

2.4.2 Standard Use in Malaysia Oil and Gas Industry

In Malaysia, Petroliam Nasional Berhad (National Petroleum Limited) (PETRONAS), it is the Malaysian oil and gas company. The company is wholly owned by the Government of Malaysia that is accountable for developing and adding value to oil and gas reserved in Malaysia (Munirah, 2019). Hence, PETRONAS is the biggest entity in Malaysia's oil and gas industry.

Petronas has developed its own Petronas Technical Operations Standard (PTS) technical standards based on experience gained through design, construction, operation, and maintenance of units and processing facilities (PTS, 2010). Where appropriate, they are based on national and international standards and codes of practice, or references are made to them. The goal is to set the recommended standards for good technical practices used by PETRONAS in oil and gas production facilities, oil refineries, gas storage, chemicals plants, marketing facilities or such facilities, thereby achieving full technical and economic benefits from standardization (PTS, 2010).

Users will be provided with the information stated in this publication for their consideration and decision. This is particularly important as PTS in each area may not cover every variety of needs or circumstances. It is hoped that the PTS program will be versatile enough to allow individual operating units to adapt the information provided in the PTS to their own environment and needs (PTS, 2010).

PTS is used by contractors or manufacturers and suppliers; they are solely responsible for the quality of work and achievement of the required design and engineering standards. In addition, the Principal expects them to abide by all design and engineering that will maintain the same level of integrity as specified in the PTS for non-specific criteria. When in doubt, the Contractor or Manufacturer / Supplier should consult with his Chief or Technical Advisor without disregarding his own responsibilities (PTS, 2010).

PTS covers all discipline in Oil and Gas operation such as civil engineering, mechanical engineering, electrical engineering, drilling and production, environmental, Health Safety and Environment, Instrumentation & Telecommunication, Safety & Fire fighting, Safety and General Engineering (PTS, 2010). Below are some of the normative references of standard that been used in the industry:

- API American Petroleum Institute
- ANSI American National Standard Institute
- ASME American Society of Mechanical Engineer
- AWS American Welding Society
- BS British Standard

- IEC International Electrotechnical Commission
- IEEE Institute of Electrical and Electronics Engineers Standards Association is an organization
- NFPA National Fire Protection Association
- ASTM American Society for Testing and Materials
- ATEX Directive (Appareils destinés à être utilisés en ATmosphères Explosives)
- Local Authorities and Statutory Requirements
- PTS 82.00.10.10 Petronas Technical Standards - Project Quality Assurance
- MS ISO 9001 :2008 Quality Management Systems – Requirements
- MS ISO 10006:2005 Quality Management Systems - Guideline for Quality Management in Projects
- National Board Inspection Code (ANSl/NB-23)
- Environmental Quality Act 1974 (act 127) Regulations and Rules
- Factories and Machinery Act 1967 (Act 139) Regulations and Rules.
- Occupational Safety and Health Act 1994 (Act 514) Regulations and Rules.
- Oil Gas Safety Passport (OGSP)
- Construction Industry Development Board (CIDB

2.5 The Relationships between TQM Practices and Performance

2.5.1 Overall TQM Practices

Most of the preceding studies note that overall TQM activities have been positively linked to productivity and production efficiency (Chenhall, 1997), quality performance (M. M. F. Fuentes, 2006), employee satisfaction/performance, innovation performance, customer satisfaction/results (Eboch, 1998), competitive

advantage (S. A. Brah, 2002), market share, financial performance, (Eboch, 1998) and aggregate firm performance.

2.5.2 Leadership

Leaders in a TQM system see the organization as a system; promote employee development; create multipoint contact among employees, managers, and customers; and make efficient and effective use of information (Sadikoglu & Olcay, 2014). Thus, leaders are encouraging employee engagement in decision making and inspiring the workers. Top management engagement and participation in TQM practices are key factors for the success of the TQM practices. Managers can show more leadership than traditional management behaviours to raise awareness among employees of TQM quality activities and practices (Mora & Criado, 2009).

Javed (2015), in his studies on impact of top management commitment on quality management found leadership improves operational performance, inventory management performance, employee performance, innovation performance, social responsibility and customer performance, financial performance and overall firm performance (Sadikoglu & Olcay, 2014).

2.5.3 Knowledge and Process Management

An effective knowledge management ensures that workers access reliable, appropriate, correct and relevant data and information in a timely manner because they need to do their job in the firm efficiently and effectively. Only in this way, the expected benefit from the TQM practice can be achieved (Sadikoglu & Olcay, 2014). Process management emphasizes operations by means of a series of analytical and behavioural practices as opposed to performance. This requires

preventive and constructive Quality Control strategies to reduce process variability and enhance product quality. Awareness and efficient process management activities track quality data to efficiently control processes (Idris, 2011). In this way, turnover rate of purchased materials and inventory can be improved. Also, errors in the processes can be identified and corrected on time. The processes are improved by periodic process control and continuous monitoring of quality data. Effective design of knowledge and process management minimizes the adverse environmental impacts. In addition, as the systems are prevention-oriented, the company's costs are reduced and benefit increases.

Previous studies have shown that awareness, process management and statistical control / feedback boost inventory management efficiency, product performance , social responsibility, customer outcomes, competitive advantage, financial performance and overall firm performance (Sadikoglu & Olcay, 2014).

2.5.4 Training

Job quality turnaround / shutdown is second to safety but is poorly managed in many cases which causes rework and accidents at times. Owners can go to lengths with their quality programs, either transferring full responsibility to contractors for the quality of the work, or eliminating it by performing 100 percent quality controls with their own people or with a contractor. Both usually offer poor performance (Obiajunwa, 2012). Customer satisfaction is a function of perceived quality and disconfirmation-the extent to which perceived quality does not meet the expectations of repurchase. Customers compare the perceived performance of a product (service, goods) to some standard performance (Karna, 2004).

As the contractor training for quality should start on the first day with company (Shreyas Gowda, 2015). Let new hires know how serious are the company are about quality and what standards the company expect them to adhere to. This matter toward the project management team or permanent staff of the company, when come to TAM/SM project will hire freelance start with the some of the project management team to the general work, company can afford to organised quality assurance training to all of level of employee (Fayek & Robinson, 2014). In addition, that the window of the project schedule is tight time is not on the contractor side and the expertise of the freelance will be expensive.

TQM companies should give all their staff the requisite training to develop their job skills. Good management preparation and quality improvement offer the businesses prosperity. Efficient awareness and learning potential of employees can provide continuity of the company's quality control. In addition, learning organizations are rapidly adapting to the changes and developing unique behaviours that distinguish them from other firms and enable them to achieve better results. Quality does not commence in one department or function; it is the responsibility of the entire company. All employees should be trained on the basis of the results of the assessment of their training needs (Mora & Criado, 2009).

The employees know the industry and the company's structure with effective training (Mora & Criado, 2009). Additionally, effective training will enhance employee loyalty to the firm, motivation, and performance at work. If employees are trained to produce reliable and high-quality products and/or services, it would be more fruitful for them to participate fully in the production stage. That will increase customer satisfaction and reduce customer complaints.

2.5.5 Supplier Quality Management

Supply chain management in TQM involves reducing and streamlining the supplier base to promote the management of supplier relationships, forming strategic partnerships with suppliers, collaborating with suppliers to ensure requirements are met, and early participation of suppliers in the product development process to take advantage of their skills and know-how (E. E. Adam, 1997).

Supplier inputs represent the first step in a company's output of the goods and/or services. The high-quality inputs include goods and/or services of high quality. Therefore, the suppliers should adopt TQM and be involved in this process. Good supply management practices enable suppliers to implement quality control and deliver consistent and high-quality goods and/or services in good time (Sadikoglu & Olcay, 2014).

2.5.6 Customer Focus

TQM businesses concentrate on servicing outsourced clients. Contractor companies will first know the preferences and requirements of the customers and then, accordingly, deliver the products / services. Output can be organized in relation to the needs, desires and grievances of the customers by means of active customer focus efforts (Sadikoglu & Olcay, 2014). TQM encourages companies to produce high quality and reliable products / services on time with increased productivity and efficiency. When customer expectations are met, it will increase their satisfaction, and the company's sales and market share will increase (Love, 1999).

2.5.7 Strategic Quality Planning

Strategic quality planning encompasses company vision, mission and values. They are formed in the light of the concept of quality. Active strategic quality assurance programs use workers as an input in creating the vision, mission, objectives and goals. That facilitates employees' acceptance and support of strategic quality plans. Productive strategic quality assurance initiatives must take into consideration the potential environmental side-effects of the program prior to output. This will manifest and improve social responsibility of the firm (Sadikoglu & Olcay, 2014).

2.6 Factors Affecting Total Quality Management in Project

Different factors that are listed below influence the performance of the TAM / SM project:

2.6.1 Project Requirement

The reliability of any construction project meets the requirements of the respective Owner. This will meet the requirements of the architect, the developers, and the requirements of the operator. Figure 2, below indicates the basic requirements of the project.

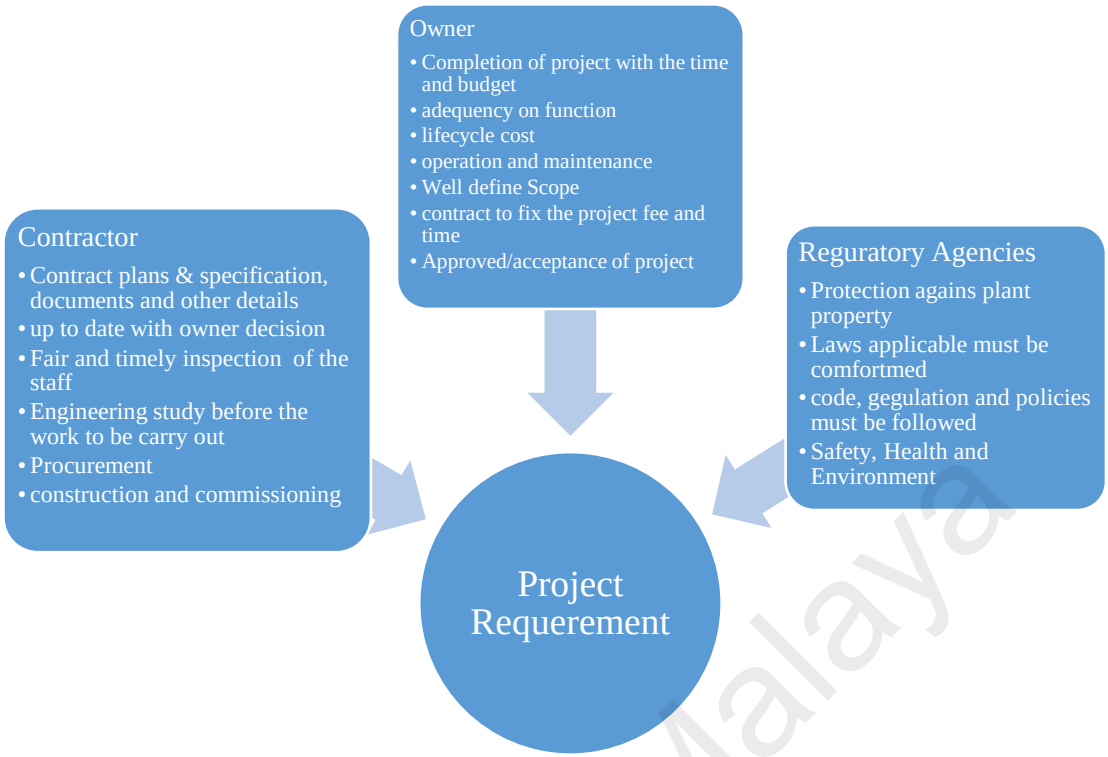

Figure 2.1: Project Requirements – Factors Affecting Quality in TAM/SM Project (Source : (Mishra, 2010)

2.6.2 Project Management Organisation

Complacency in teams inhibits TQM progress in organisations (Mosadeghrad A. M., 2014). Poor communication, lack of time to meet as a team and cultural values are major causes of organizational teamwork. For TQM implementation and sustainability, teamwork and participation are important. Good teams have a higher spirit than people and are more successful. Everyone must work with the whole company to improve the process.

To succeed, teams need qualified facilitators, dedicated and responsible leaders, missions and timelines to complete projects for quality improvement (Mosadeghrad A. M., 2014). Managers should encourage teamwork within the organization by

providing adequate training for employees working in teams, empowering them to work in teams, make decisions, and use team-based rewards.

Based on dissimilar studies, it is concluded that the leadership and commitment criteria of the construction organization will influence the quality of the project. When management practices are weak, there is a reduction in the efficiency of construction.

2.6.3 Quality Teams

A structured environment is provided with a high-quality team for the project. Structured and continuous practice with regular quality inspection (Ismail, Hashim, Ismail, Kamarudin, & Baharom., 2011). Quality teams consist of all disciplinary engineer and supervisor from the contractor and owners to bring quality goals.

Recruiting members of the team begins by writing clear, crisp job descriptions that stipulate candidate features and typical job tasks. First, define the necessary skills and experience. For instance, according to the United States. The Labour Statistics Bureau usually requires dexterity, math skills, mechanical skills, physical endurance and strength, and technical skills (Neyestani, 2016). Typically, members of the quality assurance team have a high school diploma or equivalent.

First, identify the tasks for the work. Furthermore, the job descriptions will set expectations about the team members positions (Sabri, Rahim, Yew, & Ismail, 2014). For example, to develop a responsibility matrix to define who is responsible for each part of the quality assurance process, depending on the complexity of environment and product or service development operations. If the quality control

processes include evaluating the findings of laboratory or technical data, team members need to have superior analytical skills (Löfgren, 2012).

2.6.4 Participation of Team Members

The involvement of the quality team members is important not only during the planning phase but also during the project construction phase.

2.6.4.1 Define Objectives

Defined targets for QA teams are definitely advancing the production cycle, ensuring that whatever team meetings, all test case requirements, retests, functionality analysis, detection of defects, and solutions, as well as reported results, are carried out in alignment with the protocol (Salimi, 2019). Furthermore, enforced recognition of dependencies and the transfer of essential inter-team information (including, for example, automated test environments, module development processes, or system requirements development) fully evaluates production quality and ensures successful deployment.

2.6.4.2 Motivate Teams Through Mutual Respect

Increase the importance of communication between teams and team members and require mutual respect. Require teams to explain and illustrate criticality levels when assessing the feasibility of the experiment (Salimi, 2019) (Mosadeghrad A. M., 2014). Boost respect and constructive discussions between teams and team members when communicating with formats or analysing logistics design tests.

The extent to which positive interactions improve the performance of the modular design and metric analysis, as well as productivity in product testing, validation, and results reporting (Lakhal & Pasin, 2006). Establish standards of honesty, ethics, and tolerance for open, honest communication, building trust among QA teams (Salimi, 2019). A culture of mutual respect aligns teams to prioritize concerted project delivery efforts as it motivates teams to integrate talent and promote cross-functional production in a cohesive manner (Mosadeghrad A. M., 2014).

2.6.5 The Effect of Organizational Culture and the Relationship between Leadership

In the mid-1960s, the roots of organizational or corporate culture began as the first authors to mention the link between organizational culture and excellence (Blake, 1969). However (Hofstede, 1998), the concept of organizational culture has become a common parlance two decades after it was used by (Blake, 1969) as an aspect of the organization. (Steven L. McShane, 2018) defined organizational culture as a pattern of shared basic assumptions that the group has earned as it solved its problems of external adoption and internal integration that has worked well enough to be considered valid. The new members should then be taught the right way to view, think and experience these problems. In this definition (Steven L. McShane, 2018) also describes organizational culture as being deeper than behaviour and artifacts. Study by (Shurbagi, 2012) Concluded that when running their organization, leaders follow a revolutionary leadership style, while the dominant culture is Hierarchy culture, and respondents were pleased with all aspects of job satisfaction. Consequently, the results suggest

a relationship exists between transformational leadership, job satisfaction, and the effects of organizational culture on the relationship between transformational leadership and work content. The study also concludes that the relationship between transitional leadership, organizational culture and work satisfaction is significantly positive (Shurbagi, 2012). The study may draw attention on the need to strengthen the leadership style, model, approaches and direction for petroleum sector for future development. Certainly, business leaders in petroleum sector should play a dominant role in industrial development. Finally, he stresses the important of human capital development in petroleum sector in particular the development of leadership to spearhead the economic development (Shurbagi, 2012).

2.7 Barriers of Implementation Quality Management in Oil and Gas TAM/SM Project

The oil and gas industries were heavily regulated. It is continuously faced with the challenge of meeting rising quality expectations and meeting strict regulatory requirements (Zafarani, 2011). Quality Management is a management philosophy that seeks to integrate all organizational functions (marketing , finance, design , production of engineering, customer, etc.) with a view to meeting customer needs and organizational goals. (Keng & Kamal, 2016). It maintains that organization that organization must always strives to continuously improve this process by incorporation knowledge and experience worker.

Quality management has increasingly been adopted by not just construction but also oil and gas companies as an initiative to solve quality problems and to meet the needs of the final customer (Peter Hoonakker, 2010). The total quality implementation is similar

to that of other decentralized control. methods in developing Quality Management, companies need to understand how consumer define quality in both goods and services offer (Steyn, 2008). If a company pays more attention to quality in its production processes, there will be fewer problems when the product is in the hands of the customer. The management will commit to evaluating a product 's output in relation to its price through customer survey (Peter Hoonakker, 2010). which can help manager to identify design, manufacturing or any other process that has a bearing on a quality of a product or service, and therefore provide an opportunity for continuous improvement.

Many of the management practices used to support construction organisations are being challenged. The industry's clients are moving forward. Clients demand improved service quality, faster building and innovations in technology. It is no accident that the construction industry has turned to the manufacturing sector as a point of reference and source of innovation (Peter Hoonakker, 2010). Successful concepts derived from manufacturing, such as Total Quality Management (TQM), Lean (or Just-in-Time) Production and Reengineering, are being adopted and integrated into the construction industry. Implicitly, the successful implementation of these concepts is heavily dependent on a culture of teamwork and cooperation at both intra- and inter-organisational levels.

An obstacle is an entity, a thing, an action or a circumstance that can be physical, social, economic, technological or political, creating an obstruction. There are growing obstacles facing the Implementation of Quality Control mechanism that would jeopardize the overall project delivery.

The quality standards specified in the EPCC contract's scope of work can determine the successful delivery of a TAM/SM project. Therefore, the quality management provided by an oil and gas company is essential in fulfilling the contractual obligation to meet the quality (Salimi, 2019).

Project requirements generally define project quality standards and are therefore part of the Contract Owner's agreement. If the requirements are met, the fact that the contract is not fulfilled underscores the importance of quality standards and quality management in any particular TAM/SM project (Shardy Abdullah, 2013). Technical specifications may include references to the Quality Management System (QMS) and refer not only to product and materials validation requirements but also to confirm construction and completion work quality (Moghadam abyaneh, 2012).

Companies around the world can take steps to meet quality standards and be recognized and/or comply with international quality standards. Normally validates the performance of its quality management system. Includes Quality Assurance System (QA) and Quality Control System (QC) (Hiraishi & Nyenz, 2012).

However, there are obstacles to its implementation success that all organizations involved in the process of obtaining certification and/or meeting quality standards for TAM / SM projects need to overcome: including Owners, contractors, experts, engineers, and other project participants (Mosadeghrad A. M., 2014). Businesses need to find easy-to-use and cost-effective solutions and processes.

Barriers to the successful implementation of any quality management program of TAM/SM are closely related to the complexity of today's TAM / SM venture process. According to (Mane & Patil., 2015) barriers to working with a quality project team due to poor customer focus followed by poor planning, lack of proper training / inadequate human resources development, irresponsible management/rejection/ neglect, competitive market, lack of quality leadership, lack management commitment, labour resilience and lack of cultural dynamism (Lakhal & Pasin, 2006).

The reason for implementing quality management practices is improving customer satisfaction, product and/or service quality, productivity, production line capacity, employee performance, work-of-life quality, market share and competitive position. Another reason is that production development time, inventory waste, process work, costs, delivery times, employee turnover and complaints are reduced (Sadikoglu & Olcay, 2014). Table 3 gives the barriers to Quality Management practices.

Table 2.2. Barriers to Quality Management practices (Sadikoglu & Olcay, 2014)

The main barriers to TQM practices	References
Resistance of the workforce; inadequate use of empowerment and teamwork; failure to develop employee participation. Worker attitude or 'bad seed' effect.	Harris, 1995 [83]; Whalen and Rahim, 1994 [85]; Masters, 1996 [78]; Goetsch and Davis, 2010 [27]; Bohan, 1998 [86]
Lack of proper training, preparation and skilled workers	Whalen and Rahim, 1994 [85]; Masters, 1996 [78]; Bohan, 1998 [86]; Burril and Ledolter, 1999 [87]

Lack of supervision structure or culture of the firm for implementing TQM	Whalen et al., 1994 [85]; Masters, 1996 [78]; Mcabe et al., 1998; Burril and Ledolter, 1999 [87]
Lack of involvement and commitment of top management	Baillie 1986 [88]; Smith et al., 1994 [84]; Whalen and Rahim, 1994 [85]; Masters, 1996 [78]; Bohan, 1998 [86]; Goetsch and Davis, 2010 [27]
Tight schedules in executing the project	Smith et al., 1994 [84]; Masters, 1996 [78]; Bohan, 1998 [86]; Goetsch and Davis, 2010 [27]
Inability to build a learning organization that provides for continuous improvement lead to wrong identification of processes	Masters, 1996 [78]
Lack of proper equipment and Product problems	Whalen and Rahim, 1994 [85]; Masters, 1996 [78]
Ineffective measurement of quality improvement and lack of access to data and results	Whalen and Rahim, 1994 [85]; Masters, 1996 [78]
Downsizing and Turnover in company	McCabe and Wilkinson, 1998 [89]

However, the lack of quality-oriented culture in organizational culture also appears to be an important factor in successful quality management programs (Joiner, 2006). Cultural variables are found responsible for more than 50 per cent of the variance in quality management implementation (Joiner, 2006). According to (Arditi, 1997), The main reason for the failure of quality circles in the UK is the lack of attention to organizational culture. The quality management program is more likely to succeed if the

organizational culture is in line with the values and assumptions proposed by the quality management discipline (Idris, 2011). For example, the introduction and implementation of the quality management program may present difficulties in high-power countries. Managers in this culture may be reluctant to accept their own responsibilities and subordinate (Peter Hoonakker, 2010). Therefore, any attempt to use participation management techniques in such contexts should be allowed.

The importance of quality management systems in TAM / SM projects is based on customer satisfaction followed by shareholder satisfaction, competitive market, management commitment, and owner satisfaction (Ilias Said, 2009). Also, importance is given to the test reports from suppliers by the respondents and they believe in the implementation of on-site quality management plans. There are no exceptions for quality management. There are several variables related to human, physics, and projects to consider.

2.8 Benefit of Quality

The movement towards introducing a quality management protocol is gaining traction in all organizations, as the use of a quality management system has considerable advantages. Some of the benefits are explained below:

2.8.1 Achievement of Project Scope

This system facilitates a business, to achieve the goals defined in the strategy of the organization. It ensures the achievement of continuity and reliability regarding the methods, equipment, and services being used in a project. All project activities are incorporated and matched to the quality of the goods (Atkinson, 1999). These

efforts commence by identifying the customer needs and expectations, and culminate in their contentment.

2.8.2 Customer Satisfaction

A fully understood and applied quality control program can ensure that the customer meets their requirements and thus increase customer trust (Ahmed, 1995). Attaining customer satisfaction is a great achievement for the organization, that will assist in capturing the market, or increase the market share.

2.8.3 Consistent Products

Implementing a quality management system can help to achieve greater consistency in project activities and improve efficiency by improving resources and time consumption (Sadikoglu & Olcay, 2014).

2.8.4 Implementation of Best Practices & Process Improvement

The discipline of quality includes the efforts directed towards the improvement of processes, being used to maintain consistency, reduce expenditures, and ensure production within the schedule baseline (Hong, 2008). By introducing best practices such as modern production methods, using primavera project management software like Primavera P6 and using appropriate quality assurance methods, systems, products and processes are continuously improved (Hong, 2008).

2.8.5 Increase in Production

Improved production is achieved by applying proper evaluation techniques, and better employee training. A strict process control is directed towards performance consistency, and less scrap. Supervisors receive fewer late-night phone calls, as the staff are skilled in troubleshooting (Neyestani, 2016).

2.8.6 Less Rework

Quality is measured continuously due to the appropriate procedures that ensure immediate corrective actions on occurrence of defects. Since efforts are aimed at quality goods, the rework is minimized due to warranty claims (Keng & Kamal, 2016). This reduction increases customer confidence, and increase in business.

2.8.7 Increased Financial Performance

Increased financial performance pays off investments in quality control programs. UCLA conducted research on the companies traded on the New York Stock Exchange and found that the financial performance of the companies obtaining ISO 9000 Quality Standard certification was significantly improved compared to the other companies. (Bubshait, 1996).

2.8.8 Improvement in Internal Communications

The quality management system puts the emphasis on operations management issues. This promotes frequent interaction between departments or groups of projects, and promotes harmony (H. Mallawaarachch, 2015). All these factors contribute to improved quality, and customer satisfaction.

2.8.9 Implementation of Quality Management System

Initially, an efficient quality management system should accurately determine the customers ' expectations and needs, and then transform this into quality products. It is essential for the successful implementation of a TQM system that the executive management provide full support and leadership, provide an appropriate quality policy and set measurable goals (Joiner, 2006). The project management team should be active in the quality program, and adequate preparation should be organized to develop the skills. A functional framework should be a tactical device designed to promote the attainment of project objectives. It is crucial to evaluate the usefulness, efficiency, and capability of a quality management system. Review and evaluation should be carried out regularly to audit the quality requirements, achieve the project goals and ensure customer satisfaction (solomon, Obodoh, & Onoh, 2016). This review will ensure that the quality management system benefits are being fully obtained, and amendments in the system are implemented wherever necessary.

2.9 Costs of Poor Quality

It is always expected that TAM/SM projects will create a balance between cost, time and quality. While improving quality is not always the project's main objective; poor quality could create organizational costs (H. Mallawaarachch, 2015). Poor quality costs relate to the costs of providing poor quality product or service. Costs due to failure, evaluation and avoidance are three main classes of costs that may be affected by poor quality (Rodchua, 2006). As (Rodchua, 2006) The cost of failure can also be internal and external failure. Costs of internal failure include repair, crap, reinspection, re-testing, redesign, material review, etc. Whereas the costs of external failures include the

processing of customer complaints, customer returns, claims for warranty and repair costs, product liability and product scans.

In addition, the cost of assessment can be carried out in the measurement, evaluation or audit to ensure compliance with quality. These costs include initial inspection, inspection, testing, process or audit services, measurement and testing of calibration equipment, supplier monitoring, receipt inspection, etc. (Murugan Rasamanie, 2011). Preventive costs include costs associated with all preventive and preventive activities, such as new product reviews, quality planning, supplier surveys, process reviews, quality improvement teams, education, and training, etc. (Waje, 2012).

It therefore creates a need to improve the quality of TAM/SM projects in order to bring them to successful completion. Therefore, according to the existing literature, the adoption of value in the construction process is of utmost importance. In TAM/SM project, failure on the part of the procurement, and construction, may result from malfunction in the commissioning phase. Nonetheless, in most cases it comes from a mixture of actions by several or all of these parties (H. Mallawaarachch, 2015). According to previous researches by (Murugan Rasamanie, 2011), Therefore, both owners and contractors must be able to effectively deal with all parties interested in making the project a high-quality product. Consequently, the implementation of the quality management plan should begin at the project inspection stage and should continue throughout the life cycle phase.

Improving the quality of sketches and specifications in the early stages that could affect the quality of the design and construction phases and, eventually, the quality of the facilities built (Waje, 2012). Drawing is the only builder document showing the design

concept, size, and scope of work. It is important to have clear, concise and uniform drawings and specifications. In addition, the feasibility of design can be improved as it affects the quality of the design. (H. Mallawaarachch, 2015). For reliability and compliance with customer requirements, including early and postoperative operations, the design should be updated. It is also important to evaluate the feasibility of the initial design and the complete functional model.

Providing quality training to oil and gas related professionals involved in construction can also affect project quality (Arditi, 1997). Here, understanding and training of aspects of quality management relevant to entire phases is important. In addition, both stakeholders will work together as a team to meet those performance targets in the quality management system (Atkinson, 1999). Partnership arrangements between these parties will improve the overall quality.

Figure 2.2 shows the importance of improving the quality of the project for the success of the TAM / SM project where drawing, standards, designability, management commitment, training and awareness and teamwork of all stakeholders in the construction process can lead to improvements in the quality of the construction project. (H. Mallawaarachch, 2015). It can also reduce unnecessary quality costs when meeting project specifications to the satisfaction of all involved in the construction process (Rodchua, 2006).

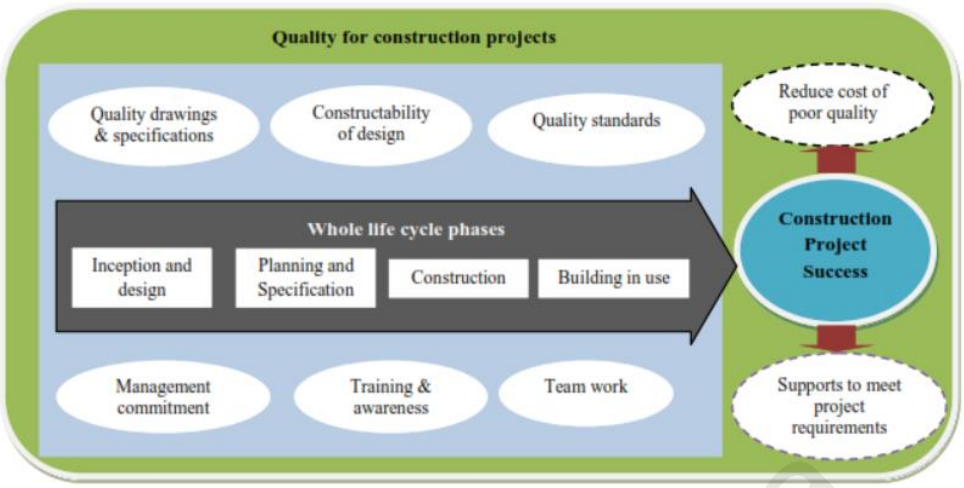

Figure 2.2: Framework of quality for construction project success (Source: H. Mallawaarachch, 2015) pg.88

2.10 Reputation or Customer Satisfaction in Project

It's not enough to make sure the project done on time and under budget. The project delivery needs to be made the right outcome to suit stakeholders' needs (D.Ashokkumar, 2014). Quality means making sure that meeting the project objective and specification by perform it efficiently. And that means trying not to make too many mistakes and always keeping the project working toward the goal (Ahmed, 1995).

Everyone "knows" which quality it is. Yet in daily life the way the word is used is somewhat different from how it is used in project management. Just like the triple constraint (scope, cost and schedule), by setting goals and taking measurements, managing quality on a project. That is why the need to understand stakeholders' quality levels is considered acceptable and ensure that the project meets those objectives, just as it needs to meet its budget and timetable goals (D.Ashokkumar, 2014).

Customer satisfaction is about ensuring that the customers who pay for the finished product are satisfied with what they are receiving. As the team collects the design

specifications, they seek to write down all the features the customers want in the product, so the contractor knows how to fulfil their specifications. Any specifications can be left undetermined (H. Mallawaarachch, 2015). Those are the ones that are implied by the customer's explicit needs. For example, some requirements are just common sense (e.g., a product that people hold can't be made from toxic chemicals that may kill them). It might not be stated, but it's definitely a requirement.

Quality assurance is about making sure that the project delivery has meet the possible customer's needs. Which would you choose: a product that's beautifully designed, well-constructed, solidly built, and all around pleasant to look at but does not do what meet it need and objective, or a product that does meet the need and objective despite being ugly and hard to use? The product that fits needs, even if it's seriously limited most of the time is priorities. That's why it's important that the project both does what it is supposed to do and does it well (Karna, 2004).

Conformance to requirements is the core of both customer satisfaction and assurance to use, and is a measure of how well the project intend. Above all, the project needs to do as per requirements document. The requirements should take into account what will satisfy the customer and the best design possible for the job. That means conforming to both stated and implied requirements.

Customer satisfaction is one of the key elements in total quality management (TQM), an approach that emphasises overall satisfaction through the continuous improvement of products (Kärnä, 2004). Construction firms follow TQM to improve their efficiency. However, construction has lagged behind other industries in introducing comprehensive quality control due to its inability to reliably define customer requirements and turn these

requirements into completed facilities (Ahmed, 1995). Furthermore, there is a lot of difference between manufacturing and building, so TQM techniques have to be tailored to the construction industry. Understanding the requirements of the customer is necessary in order to ensure customer service and the demand for the construction product must be measured in relation to the planned use of the facility. (Ahmed, 1995) suggest that customer orientation, communication skills and response to complaints all play an important role in the overall satisfaction of the customer in the construction industry.

The advantages of quality that attracts customers while at the same time enhancing credibility as a quality contractor are the sort that boosts productivity and creates a stable company, because you encourage the following (Ahmed, 1995):

- Fewer project headaches stemming from rework and claims
- More new customers
- Increased business with existing customers
- Losing fewer customers
- Better resistance to other companies that are competing based on price
- Increased profits and market share

The delivery of quality which exceeds the expectations of the customer is the cornerstone of maintaining the best reputation. Customer satisfaction is very complicated, since different customers have different definitions (Ahmed, 1995). That's why customer satisfaction often goes beyond standards and specifications, and instead is measured more by customer perceptions (Kärnä, 2004). If the project meets the positive expectations of a client, or don't meet the negative expectations of a client, it is the same thing. Customer

service is high. Differentiating the company from the sea of others by providing reasonable customer satisfaction is very difficult.

2.11 Summary

This chapter summarizes quality topics from various researchers which are related to project management. This chapter presented in the literature review is about the definition of quality management and its implementation benefits toward the project. This chapter also investigate some of barrier related to quality management and its affect toward customer satisfaction.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter deals with the methods used to attain the research objective. This chapter will provide the research design, population, sample size, data collection approaches, and data analysis. This chapter also describes the design of questionnaires, pilot test, validity and reliability of research.

The study will use questionnaire survey which will be conducted among practitioners in the oil and gas industry involved in managing a TAM/SM project. The data will be gathered from the Project Management Team of TAM/SM project, that cover both the client and contractors. For the purpose of the pilot survey, a representative from the top management such as the project manager and QAQC practitioner that experience in the project will be distributed to. It is close ended questionnaire survey. The data was collected and recorded using the SPSS version 22 for analysis.

3.2 Research Methodology – Quantitative

The aim of this research is to identify the barrier and benefit of the oil and gas turnaround/shutdown project quality management. In this study, a quantitative analysis method was adopted since quantitative research follows a deductive methodology relating to the theory and concern with the nature and sampling of measurements (Dudovskiy, 2016). Questionnaire survey was chosen because it is suitable to be used to gather information from a large number of respondents within a short period of time in a more convenient and inexpensive way (Peter Hoonakker, 2010). In order to create the questionnaires survey, a set of close ended questions is being used in this research because it limits the respondents to the set of alternatives offered in the questionnaires

(S.G.Naoum, 2007). Close-ended questions will allow the respondent to respond in a faster manner . It can prevent the variety of responses provided by the various respondents. Although the closing questionnaire will be more difficult to develop, the data collection, processing and analysis will be more efficient (Bourque, 2003). The questionnaire survey has been widely used to collect data for descriptive survey (Ridenour, 1998)

A research is defined as a set of assumptions into research and guiding the researcher to adopt an appropriate research approach (Kumar, 2014). Research method is divided into qualitative and quantitative. Qualitative research methods design to help researcher to study social and cultural phenomena (Kumar, 2014) Whereas quantitative methods of analysis are developed for researching natural phenomena in the natural sciences. The main distinction between qualitative and quantitative study is that quantitative analysis with a few (quantifiable) variables is focused on a few cases and primary qualitative variables. (Louis Cohen, 2007).

Quantitative research defined as numerical representation and manipulation of observation to describe and explain the phenomena that reflect the observation. (Louis Cohen, 2007) added that the quantitative research is social research that uses empirical methods and empirical statement. Empirical statement is the descriptive statement of what the case is and the reality, rather than what the case should be. The empirical argument articulated in numerical terms and the empirical assessment applies. (Neubauer, 2019) Later, more specifically describing quantitative analysis as a form of study that describes the phenomenon by collecting numerical data analysed using mathematical or statistical methods. Quantitative research focuses on assessing social reality and analysis is looking for quantities in which to numerically define the analysis. Quantitative analysis is

objective in nature and composed of variables based on theory or hypothesis (Louis Cohen, 2007). The common data collection techniques used for quantitative research is questionnaires, existing databases and test and it will be emphasising on quantification (S.G.Naoum, 2007). In addition, this form of research perceives the environment as a fact that can be objectively evaluated so that the linear method of data collection and analysis is important. There are several kinds of quantitative research which can be categorized as qualitative research, correlation research, experimental research, and causal-comparative research where each kind has its own characteristic.

This work is quantitative descriptive non-experimental work because it is difficult to modify the variable attributes such as behaviour, personal characteristics and behaviours, and communication styles. The respondents cannot be put in randomly different categories as they have their characteristics that are already existing. Survey research helps researchers to identify the population that fits their research, reflecting a variety of perspectives, occupations and expertise in various attitudes, characteristics and values. This is chosen because the information is also collected from a wide number of members requiring a specific set of questions to answer. This is also a good way to get information on a wide variety of topics when there is no need for in-depth answers and even for summative and formative purposes. This showed that quantitative study findings within reasonable error limits can be generalized to a broader population (Walliman, 2011).

The questionnaire methodology is also the most appropriate for this research as the methodology involved data collection from a group of large respondents and it resulted in generalization to assess the population's experience in implementing quality control in the TAM / SM oil and gas sector. The questionnaire survey also designed to objective

and systematically collect the information from the population. The statistical analysis must explain the straightforward result that makes it strong and easy to understand.

3.3 Data Collection

A questionnaire was developed to get the survey from the professionals in the TAM / SM project, based on the research goals.

There are two forms of analysis, namely inferential and descriptive. A descriptive statistic consists of gathering, summarizing, arranging and presenting data, while inferential statistics consist of generalizing observations to populations, testing hypotheses, estimating, predicting, and deciding the relationship between variables. Descriptive statistical methods allow the data to be analysed, summarized and properly represented by means of numerical statistics (including median, mode and mean) and in the form of a graph or chart while inferential statistics are about parameter estimation and statistical hypothesis testing.

There are two main data collection methods in this research which is primary data and secondary data. It is necessary to examine the method and research strategy that is suitable for data collection.

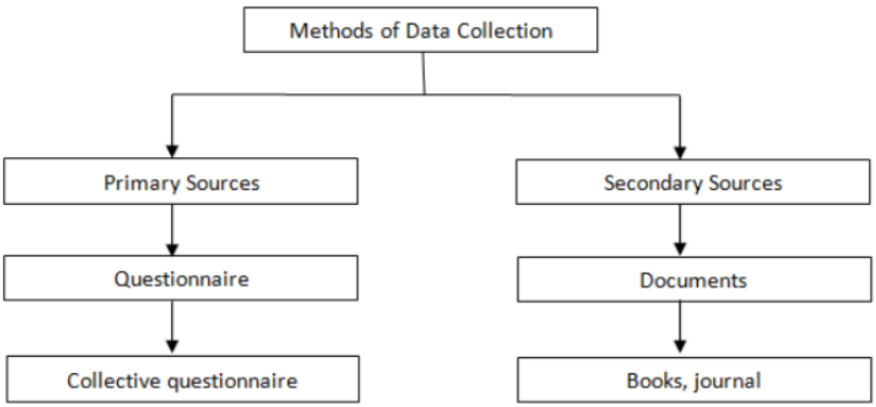

Figure 3.1: Methods of Data Collection (Source: Kumar,2014)

3.3.1 Primary Data

Primary data is the information that a researcher collects specifically for the research report. It is called primary data, since the data has not been written or collected.

3.3.1.1 Questionnaire survey

Survey is one of the common data collection methods for gathering large-group information and also for use where standardization is relevant. In a few cases, the surveys can be built and typically consist of two components of questions and responses, namely 'open ended' and 'close-ended.' Open ended allows the respondent to address the survey in a narrative style of free flow, while close ended survey allows the respondent to choose from a selection of predetermined responses.

3.3.1.2 Developing the questionnaire

A questionnaire survey is designed to provide additional information to support the study goals. The challenges of identifying quality in the oil and gas industry are planned, possible benefits of quality implementation are explored and obstacles to quality implementation in the oil and gas industry are looked at. The questionnaire survey is designed based on the literature review elaborated in Chapter 2.

i. Consist of general information on the respondent’s profile and demographic information.
ii. Respondents’ define understanding of quality in oil and gas industry. This section aims to determine the respondents’ awareness of quality

performance, barrier and best measure/indicator of quality in the oil and gas industry.

iii. Respondents will be given multiple choices questions to choose the importance of improvement and effect quality. This section is to identify the benefits of implementing quality in oil and gas industry.

3.3.2 Secondary Data

Secondary data is information of the studied objects which characteristics coded in variables that consist of a range of possible values (Kumar, 2014). The data that that researchers have obtained and analysed in the past and the use of data for this study will become secondary data. It is usually available in electronic formats, in writing and in types. Secondary data are data that include paper journal, online journal, library books, and sources from the internet. This is used to gain insight into problem studies. The secondary data is often used for literature review references, and it has been mentioned in this research's list of references.

3.4 Pilot study

A pilot study is a questionnaire survey trial run or preliminary test which involves testing the wording of the questionnaire, defining the questions and also testing the data collection technique. Used for questionnaire assessment. The questionnaire was distributed from client, contractor and other representatives to 3 representatives in the oil and gas sector. The respondents have 5 to 10 years of experience in the construction field. Their experiences are sufficient and suitable to be indicated for pilot study. The aim of the pilot study is to identify any difficulty in interpreting the contents of the questionnaire, and to determine whether these questions asked can be comprehend by the respondents.

3.5 Instrument Reliability

Reliability of instruments is defined as the degree to which an instrument reliably calculates what it is supposed to achieve. The reliability of a measure indicates the degree to which it is bias-free (error-free) and thus ensures accurate measurement over time and across the different elements in the instrument (ekaran, 2016). In other words, a measure's reliability is an indicator of the accuracy and precision with which the instrument calculates the definition, and helps to determine a measure's "goodness." A criterion of internal consistency is implemented in these questionnaires when only one type of the test is available, or to ensure that the items are homogeneous or all measure the same model. The reliability of interitem consistency is a test of the consistency of respondents ' answers to all of the items in a measure (ekaran, 2016). To the degree that items are independent measures of the same concept, they will be correlated with one another. The most popular test of interitem consistency reliability is Cronbach's coefficient alpha (Cronbach, 1946), which is used for multipoint- called items, and the Kuder–Richardson formulas (Kuder & Richardson, 1937), used for dichotomous items. The higher the coefficients, the better the measuring instrument.

3.5.1 Cronbach's Alpha

The alpha of Cronbach is a measure of inner continuity, that is, how closely connected a set of things is as a group. This is used as a test of efficiency in size. A "strong" alpha value doesn't mean the test is one-dimensional. If you wish to provide evidence that the scale in question is unidimensional, in addition to measuring internal consistency, additional analyses may be carried out. One method of testing dimensionality is the exploratory factor analysis. Technically speaking, the alpha of Cronbach is not a statistical test-it is a reliability coefficient (or consistency) (Dennick, 2011).

The Cronbach alpha can be written as a function of the number of test items and the inter-correlation between the items on average. Below we present the formula for the Cronbach alpha for practical purposes:

$$a = \frac{\mathrm{N}\bar{\mathrm{c}}}{\mathrm{v} + (\mathrm{N} - 1)\bar{\mathrm{c}}}$$

Here N is equal to the number of items, $\bar{c}$ is the average inter-item covariance among the items and $\bar{v}$ equals the average variance. One can see from this formula that if you increase the number of items, you increase Cronbach's alpha. Additionally, if the average inter-item correlation is low, alpha will be low. As the average inter-item correlation increases, Cronbach's alpha increases as well (holding the number of items constant).

3.5.2 Rule of Thumb for Results

A rule of thumb for interpreting alpha for dichotomous questions (i.e. questions with two possible answers) or Likert scale questions is (George & Mallery, 2007):

Table 1.1: Cronbach's Alpha Result Scale. Source: Sekaran (2013)

Cronbach's alpha	Internal consistency
α ≥ 0.9	Excellent
0.9 > α ≥ 0.8	Good
0.8 > α ≥ 0.7	Acceptable
0.7 > α ≥ 0.6	Questionable
0.6 > α ≥ 0.5	Poor
0.5 > α	Unacceptable

In general, a score of more than 0.7 is usually acceptable. However, some authors suggest higher values of 0.90 to 0.95 (Dennick, 2011).

3.6 Design of Research Sample

This research would discuss the oil and gas experience of both the client and the contractor. Data will be obtained from the Project Management Team for the TAM / SM project in the oil and gas sector, covering both the client and contractor location, under this report. The purpose of the research sample is to obtain the population information by observing a small proportion i.e. the sample size (Peter Hoonakker, 2010). For the purpose of the survey, priority will be given to a top management representative such as the project manager and QAQC engineer, who will have experience in the project. All these staff were selected based on their scope of employment and experience in the oil and gas industry with the TAM / SM project. These individuals have to be specifically involved directly with the implementation of the project. That is the justification for target group selection.

The non-probability sampling technique is used specifically to identify the key respondents used in this study. As stated by Neuman (2007), by using this approach the researcher can select specific cases or data sources that are particularly informative; selected groups of highly specialized and difficult to reach population groups.

3.6.1 Population

The population for this study is focus on the project management team of the oil and gas professionals in the industry in Malaysia from both client and contractor which involved with the TAM/SM that comprised of Project Managers, Project Engineer, QA/QC Engineer, Maintenance / End User, and others. According to the

Overall population of personnel engaged in oil & gas industry Malaysia 36,776 (Department of Statistic Malaysia, 2019). The number of populations is too large and the Human Resource organization rules in most of the companies that did not allow the information of their list of registered employees to be collected. After considering the rules of the organization, the snowball and convenience sampling was used to determine the sample size to be distributed to 100 respondents from the clients and contractors. This method had been done by (Ismail et. al, 2013) when the researcher was not allowed to have get the information access for the respondents and not able to choose respondents randomly. This was done to suit the period of the study, information limitations.

3.6.2 Sampling Technique Used

Figure 3.2: Sampling technique used

In this research, the non-probability sampling techniques were used because the population element cannot be identified or known for the purpose of the survey. (Sekaran, 2003). The convenience and snowball sampling were chosen because it comes under the class of non-probability sampling techniques (Arditi, 1997). The elements of the study were defined by convenience (friends and colleagues) and by comparison networking. Of the four types of non-probability sampling techniques in total, the snowball and convenience sampling techniques were used because they were ideal when the population was too large, enable the researcher to conveniently collect information from the respondents and are chosen when it is impossible to

include any respondent for the study (Convenience Sampling, 2009).

Snowball sampling is characterized as a non-probability sampling technique used by researchers to identify potential subjects in studies where the subjects are difficult to locate and use when the sample is limited to a small or very rare population subgroup for the analysis. The snowball sampling techniques were initially used to contact multiple possible respondents who were then asked to classify their organization's respondents and obtain the number of respondents for the study with the barrier and the advantage of quality control as listed for the sample size. The questionnaire surveys were distributed through the friends and networking and they distributed it to their friends of the quality management who were working

3.6.3 Sample Size Obtained

From the sampling method, approximately 100 sets of questionnaires were distributed through online google form to the oil and gas practitioners who had experience in the TAM/SM project across Malaysia. According to (Roscoe, 1975) A first thumb rule was introduced for choosing the correct sample size for a research study that is greater than 30 and less than 500 for most research studies. If the samples were greater than 30 the researchers need not reach 10 percent of the standard deviation to ensure the sample error. Online survey uses were also used to ease the collection of data. Respondents were given two weeks of time to return their survey questionnaire. The members have been approached by contacting business mates and networking and they help to distribute the surveys to their colleagues. Most of the respondent took about one (1) to two (2) weeks to return back the questionnaire surveys.

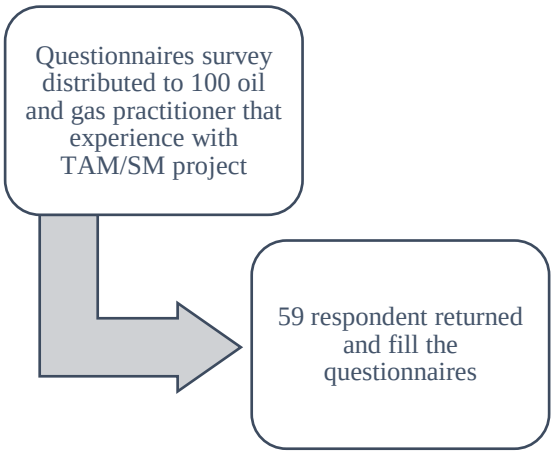

Figure 3.3: Distribution and collection of questionnaire surveys

There are several approaches to determine the sample size (Atkinson, 1999) Which include the use of small populations, mimic the sample size of similar studies, use published tables and apply sample size formula. For this research the sample size was determined using the small population and formula to calculate a sample size.

3.7 Data Analysis

3.7.1 Relative Importance Index (RII) Method

The primary data collected from the second part of the questionnaire was analysed from the perspective of clients, consultants and contractors. The five-point Likert scale to indicate the relative importance of each cause were then transformed into RII perceived by all respondents using the formula below.

$$RII = \frac{\Sigma W}{\mathrm{A}\, x\, \mathrm{N}}$$

Where: W – scale for rating a factor (ranges from 1 to 5); A – is the highest weight in the scale; N – is the total number of respondents.

The result were ranked based on RII values according to overall ranking and group category. From the ranking assigned to each cause of benefit and barrier of quality management, the study able to identify the most important/agree factors or causes of benefit and barrier of quality management in oil and gas industry.

3.7.2 SPSS version 22

The type of data calculation needs to be understood in order to choose suitable method for data analysis. The nominal scale, ordinal scale, and central tendency were used for method of analysis in this research. This analysis was quantitative, and statistically analysed the results. Descriptive analysis was used in data analysis since it can show the variable's percentage distribution, frequency, min score, and rank. The Statistical Package for Social Sciences (SPSS) program is used to evaluate the data from the survey questionnaire. SPSS was chosen because it is specifically made to analyse statistical data and also an effective data management system that allow the researcher to analyse quicker. SPSS was design to separate the out from data and the result was stored in separate file. It is also allowed researcher to analyse in more detail.

Table 3.2: Analysis according to question

Research Objectives	Type of Question	Analysis method
To defining quality implementation in oil and gas industry.	Nominal data	Percentage distribution
To examine the barrier and benefit in quality implementation in oil and gas industry project.	Nominal data	Percentage distribution
To provide recommendation on area that can be overcome in the barrier of quality implementation in oil and gas projects.	Nominal data	Percentage distribution

3.8 Summary

The work was carried out using a process that meets the needs of scientific science to ensure the findings are accurate and reliable. Weighted assessment item creation was focused on accurate secondary data, and the process of obtaining primary data was conducted through survey and interview. The following chapter is summary of the findings of the data review.

CHAPTER 4: DATA COLLECTION AND ANALYSIS

4.1 Introduction

This chapter consists of finding and analysis from the study. The results here are an overview of the collective fieldwork data, focused on the research objective and research questions. For this research the data analysis consists of many steps. The analytical stages are separated accordingly to the various data themes.

4.2 Part One: Respondents' Demographic Background

The questionnaire surveys were distributed to 100 respondents using the chosen sampling method and 59 respondents returned and completed the survey at a response rate of 59%.

4.2.1 Respondents' Profile

About 23 respondents (39.0%) from Client, 32 respondents (54.2%) from contractors, 4 respondents (6.8%) from other firms were received and analysed.

Table 4.1: Percentage of respondent's organisations

Specified field				
	Frequency	Percent	Valid Percent	Cumulative Percent
Client	23	39.0	39.0	39.0
Contractor	32	54.2	54.2	93.2
Others	4	6.8	6.8	100.0
Total	59	100.0	100.0	

4.2.2 Respondents' Position

Table 4.2 shows the frequency and percentage of the respondent's roles in their organisation that are 20.3% project manager, 28.8% project engineer, 15.3% QAQC engineer, 16.9% maintenance/end user, and 18.6 % others. From the table, the result shows that the respondents were from different project skills and experiences and often need to communicate and deal with each other to deliver the project.

Table 4.2: Frequency and percentage of position of the respondents

Specialization				
	Frequency	Percent	Valid Percent	Cumulative Percent
Project Manager	12	20.3	20.3	20.3
Project Engineer	17	28.8	28.8	49.2
QAQC Engineer	9	15.3	15.3	64.4
Maintenance/End User	10	16.9	16.9	81.4
Others	11	18.6	18.6	100.0
Total	59	100.0	100.0	

4.2.3 Experience Years of The Respondents

The concept of experience is generally the observation of knowledge or skills gained through the participation or exposure of an event (Neubauer, 2019).

Table 4.3: Experience years of respondents

Years of experience in Oil and Gas Industry especially Turnaround/Shutdown Maintenance Project				
	Frequency	Percent	Valid Percent	Cumulative Percent
1 to 5 Years	3	5.1	5.1	5.1
6 to 10 years	29	49.2	49.2	54.2
11 to 20 years	18	30.5	30.5	84.7
More than 20 years	9	15.3	15.3	100.0
Total	59	100.0	100.0	

Table 4.3 shows that 5.1% of the respondents have experience less than 5 years in the Oil and Gas Industry especially Turnaround/Shutdown Maintenance Project, 49.2% of the respondents have experience between 6 to 10 years and 30.5% of the respondents have experience 11 to 20 years and 15.3% more than 20 years respectively. Based on the table, the respondents were mostly having 5 to 10 years' and 11 to 20 years of experience.

4.3 Reliability Test

Table 4.4 below shows the total number of items measured in this study. The value of Cronbach's alpha on the variables includes all of the variable is within the 0.7 <0.9 margin. Hence, the scored of all variable is excellent which results reported the acceptable values of Cronbach's alpha.

Table 2.4 Reliability Test Result

No	Variables	No of Item	Cronbach's alpha
1	how to measure quality performance	**5**	**.702**
2	how to improve quality performance	**8**	**.764**
3	what are the barriers to quality?	**9**	**.856**
4	what do you consider the best measure/indicator of quality in the oil and gas industry	**10**	**.819**
5	Contractor/Client definition of quality	**7**	**.784**
6	Perception of safety and quality in the oil and gas industry	**2**	**.898**
7	Aspects that are important for improving quality.	**17**	**.861**
8	benefits of improving quality	**12**	**.870**
9	barriers to the improvement of quality	**10**	**.881**

4.4 Part Two: Finding of Questionnaires

Questionnaires Survey 1: To defining perception of quality management implementation in oil and gas industry.

Table 4.4: Contractor/Client definition of quality (on a score 1–5)?

Computed values, given the 5 frequency entries:

Rank	Contractor/Client definition of quality	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Do it right the first time, zero leakage and zero LTI	**59**	**210**	**0.712**	**3.559**
2	On time, on budget and on scope	**59**	**205**	**0.695**	**3.475**
3	Meets all customer's expectations or demands for the finished product	**59**	**203**	**0.688**	**3.441**
4	Meets specification or requirements, minimal call-backs or rework needed	**59**	**101**	**0.342**	**1.712**
5	Able to guarantee the finished product will not fail or have problems	**59**	**76**	**0.258**	**1.288**
6	Do not use a definition for quality, or not applicable to our work	**59**	**30**	**0.102**	**0.508**
7	Others	**59**	**18**	**0.061**	**0.305**

* Please rank from 1 (Strongly Disagree) to 5 (Strongly agree).

With descriptive statistics, the mean and standard deviation data received from the respondents have been analysed. The highest mean showed the respondents selected the highest rank factor as tabulated in table.

Results show that contractors' and client own perceptions of quality and to do it right the first time, zero leakage and zero lost time injury (LTI) and to deliver on time, on budget and on scope a part from customer satisfaction are the aspects most often associated with quality specifically in TAM/SM project. Meeting technical specification and warranties are less agree (Table 4.4). This result aligns with PETRONAS quality campaign for this specific project also as in the overall perception in quality.

Table 4.5: Quality Programme Awareness

Item	Quality Programme Awareness	Yes	No
1	Aware of quality programmes	100%	
2	Not aware of such programmes		100%
3	Their company has a quality programme	100%	
4	No quality programme in their company		100%

All of the respondents said that they were aware of quality programmes in the oil and gas industry and none of them are not aware of such programmes. Similarly, all of the respondents rated that their company has a quality programme; while none said that this was not the case.

Table 4.6: How to measure quality performance? on a score 1–5.
Computed values, given the 5 frequency entries:

Rank	How to measure quality performance?	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Reputation or customer satisfaction	59	255	0.864	4.322
2	Experience Contractors	59	211	0.715	3.576
3	Customer loyalty and repeat business	59	201	0.681	3.407
4	Quality management programmed	59	143	0.485	2.424
5	Unable, the industry favours low tender/Bidder	59	75	0.254	1.271

* Please rank from 1 (Strongly Disagree) to 5 (Strongly agree).

The respondents indicated that the primary measure of quality performance in the oil and gas industry was a contractor's reputation on the street or the satisfaction expressed by customers (4.32 mean). Follow by, mean of 3.57 and mean of 3.4 respectively rated that experience contractor and getting continued business or work for clients was a measure for quality performance. This result show that, as the companies face increasing competition, greater attention continues to be given to customer relationships and satisfied customers. Companies use various approaches to customer satisfaction in developing and

monitoring product/service offerings in order to manage and improve customer relationships and quality (Kärnä, 2004). Measuring customer satisfaction also has several benefits for organisations, for example, in improving communication between parties, enabling mutual agreement, evaluating progress towards the goal, and monitoring accomplished results and changes (Ahmed, 1995).

Table 4.7: What do you consider the best measure/indicator of quality in the oil and gas industry?

Computed values, given the 5 frequency entries:

Rank	What do you consider the best measure/indicator of quality in the oil and gas industry?	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Overall customer satisfaction	**59**	**257**	**0.871**	**4.356**
2	Management commitment to quality	**59**	**194**	**0.658**	**3.288**
3	General oil and gas standards, such as (PTS, IEC, ASME, BSI and etc)	**59**	**157**	**0.532**	**2.661**
4	Skilled work force	**59**	**152**	**0.515**	**2.576**
5	Certified quality programmes such as the ISO 9000 series	**59**	**152**	**0.515**	**2.576**
6	Being asked to come back to do more work (return business)	**59**	**148**	**0.502**	**2.508**
7	Training and education	**59**	**136**	**0.461**	**2.305**
8	The amount of punchlist/rework	**59**	**126**	**0.427**	**2.136**
9	Quality Awards	**59**	**111**	**0.376**	**1.881**
10	Regular inspections	**59**	**107**	**0.363**	**1.814**

* Please rank from 0 (least important) to 5 (most important).

Results as per table 4.7 shows that the respondents consider customer satisfaction (mean of 4.35), management commitment to quality (mean of 3.3), Official standards (PTS, IEC, ASME, BSI and etc) with mean of 2.6 and skilled work forces the best measures of quality (mean of 2.5), quality awards and regular inspections are considered far less important in the best measure/indicator of quality in the oil and gas industry. Management unnecessary layers can frequently contribute to duplication of tasks and obligations. This has made an organization's lower employees leave the quality implementation to the job of a management (Davis, 2016). In addition, in the oil and gas

industry in important that the official standard of practice is apply and follow in order to prevent any downfall that disturb the process plant and safety issues (Ismail, Behaviour Based Approach for Quality and Safety Environment Improvement: Malaysian Experience in the Oil and Gas Industry, 2012). There a deference in finding by (Peter Hoonakker, 2010) whereby the important of the company being recognize by certification body in compliance with the QMS standard such as ISO. The result shows that Certified quality programmes such as the ISO 9000 series is important in consider the best measure/indicator of quality in the oil and gas industry. That is because the requirements of the quality management system for the petroleum, petrochemical, and natural gas industries. Its key objective is to increase customer trust and confidence in day-to-day operations by implementing the program effectively, as well as continuous improvement processes, compliance monitoring and regulatory requirements (Shardy Abdullah, 2013).

The oil and gas industry requires systematic, rigorous controls and any negligence could result in massive, irreparable losses. It is crucial to have a Quality Management System in place that facilitates the monitoring of every operational procedure within the organization (Fayek & Robinson, 2014). The certification, therefore, is the path that ensures the desired quality in your organization. Furthermore, for contractor to be involve in TAM/SM project one of evaluation criteria for pre-qualification is the company need to be certified with QMS body.

Questionnaires Survey 2: To examine the barrier and benefit in quality management implementation in oil and gas industry project.

Table 4.8: What are barriers to quality? on a score 1-5.

Computed values, given the 5 frequency entries:

Rank	What are the barriers to quality?	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Worker attitude or 'bad seed' effect	**59**	**254**	**0.861**	**4.305**
2	Lack of skilled workers	**59**	**199**	**0.675**	**3.373**
3	Product problems	**59**	**163**	**0.553**	**2.763**
4	Wrong identification of processes	**59**	**135**	**0.458**	**2.288**
5	Turnover in company	**59**	**112**	**0.380**	**1.898**
6	Lack of proper equipment	**59**	**94**	**0.319**	**1.593**
7	Lack of supervision	**59**	**95**	**0.322**	**1.610**
8	Lack of experience	**59**	**91**	**0.308**	**1.542**
9	Tight TM/SM windows (schedule)	**59**	**93**	**0.315**	**1.576**

* Please rank from 1 (Strongly Disagree) to 5 (Strongly agree).

With reference to table 4.8 the two highest factor with mean of 4.3 and 3.3 rated that worker attitude or 'bad seed' effect lack of skilled workers respectively this is related to the issues of personnel preference. The competitive environment, poor practices in management and a general lack of higher expectations contributed to unproductive and unhealthy attitudes. Such views are also reflected in common sayings like "It's not my work" and "If I'm not broken, don't repair it. Such attitudes stem from the popular notion that management is always correct and therefore employees should only implement management decisions without questioning (Davis, 2016). Lethargy is further propagated through management's failure to train employees on quality fundamentals that build better attitudes by involving them in teams that identify and solve problems.

Table 4.9: How to improve quality performance? on a score 1-5.

Computed values, given the 5 frequency entries:

Rank	How to improve quality performance?	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Education and training	**59**	**248**	**0.841**	**4.203**
2	Experience/specialised personnel	**59**	**248**	**0.841**	**4.203**
3	Improvement of testing and commissioning method	**59**	**194**	**0.658**	**3.288**
4	Better workmanship	**59**	**185**	**0.627**	**3.136**
5	Proper Supply Chain Management Procedure	**59**	**131**	**0.444**	**2.220**
6	Improve management-worker relations	**59**	**115**	**0.390**	**1.949**
7	Stronger pre-qualification and bonding criteria	**57**	**84**	**0.295**	**1.474**
8	Compliance with contract and require quality	**59**	**76**	**0.258**	**1.288**

* Please rank from 1 (Strongly Disagree) to 5 (Strongly agree).

Table 4.9 shows that the perceptions of how the oil and gas industry could improve its quality performance varied from education and training (4.2 mean) to stronger pre-qualification and bonding criteria (1.4 mean), and compliance with contract and require quality (1.2 mean). Table 4.5 shows the respondents' answers to questions concerning their perception of the oil and gas industry's quality performance. According to clause 6.2.2 from ISO 9001 refers to competencies and training, relating it to quality of products and services. Its summaries that in order to produce a quality product/service, the need for people who are competent to conduct the required activities. That means there a need to train people.

Table 4.10: Perception of safety and quality in the oil and gas industry quality (on a score 1–5)?

Item	Perception of safety and quality in the oil and gas industry.	Very Serious Problem	Serious Problem	Neural	Minor Problem	No Problem at All
		5	4	3	2	1
1	Overall safety record of the oil and gas industry	23	22	10	4	0
2	Overall quality record of the oil and gas industry	24	22	9	4	0

Computed values, given the 5 frequency entries:

Item	Perception of safety and quality in the oil and gas industry.	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Overall safety record of the oil and gas industry	59	205	0.695	3.475
2	Overall quality record of the oil and gas industry	59	208	0.705	3.525

* Please rank from 1 (Very Serious Problem) to 5 (No Problem at All).

76% of the respondents consider the lack of quality a serious problem to the overall quality record of the oil and gas industry. We asked the same question about the safety record of the oil and gas industry (Table 4.10). Results show that both client and contractors see the lack of quality as a slightly less important problem than safety. Workplace injuries and accidents contribute to loss of production time, damage to machinery and the injured workers' absence. Many approaches were developed for the appropriate selection and implementation, which gave the company or organization benefits (Ismail, Hashim, Ismail, Kamarudin, & Baharom., 2011).

Table 4.11: What Company characteristic aspects are important for improving?

Computed values, given the 5 frequency entries:

Rank	What aspects are important for improving quality	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Management and leadership commitment	**59**	**238**	**0.807**	**4.034**
2	Employee involvement	**59**	**222**	**0.753**	**3.763**
3	Skilled workforce	**59**	**210**	**0.712**	**3.559**
4	Communication between managers and employees	**59**	**166**	**0.563**	**2.814**
5	Project Quality Plan and Quality Policy	**59**	**159**	**0.539**	**2.695**
6	Criteria used in pre-qualification in bidding process	**59**	**136**	**0.461**	**2.305**
7	Documentation	**59**	**134**	**0.454**	**2.271**
8	Training and education	**59**	**130**	**0.441**	**2.203**
9	Organisational culture	**59**	**128**	**0.434**	**2.169**
10	Clearly defined goals and objectives	**59**	**123**	**0.417**	**2.085**
11	Subcontractors involvement	**59**	**123**	**0.417**	**2.085**
12	Well-defined roles and responsibilities	**59**	**119**	**0.403**	**2.017**
13	Incentives for good performance	**59**	**104**	**0.353**	**1.763**
14	Certified programme or award	**59**	**103**	**0.349**	**1.746**
15	Regular inspections and audits	**59**	**99**	**0.336**	**1.678**
16	Review/analysis used to improve performance	**59**	**91**	**0.308**	**1.542**
17	Regular meetings	**59**	**68**	**0.231**	**1.153**

* Please rank from 1 (least important) to 5 (most important).

With reference to the results shown at table 4.11 find that management commitment (mean 4.0), employee involvement (mean 3.7), a skilled work force (mean 3.5) and a good communication between managers and employees (mean 2.8) are considered important characteristics for improving quality. In TAM/SM project, contractor do require to prepare Project Quality Plan and Quality Policy as compulsory document for client to review and approved so contractor is well prepared execute the project base on the result shown this aspect are important for improving quality. Regular meetings or Review/analysis used to improve performance are considered far less important. The results are nearly identical to the results of questionnaire survey 1 (see table 4.8).

Table 4.12: Which elements are important and which are effective for quality work performance quality (on a score 1–5)?

Computed values, given the 5 frequency entries:

Rank	Which elements are important and which are effective for quality work performance?	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Training and education of both management and employees	**59**	**259**	**0.878**	**4.390**
2	Clearly defined guidelines for customer satisfaction	**59**	**213**	**0.722**	**3.610**
3	Means and methods for ensuring continuous improvement	**59**	**176**	**0.597**	**2.983**
4	Clearly defined goals relating to quality work performance	**59**	**147**	**0.498**	**2.492**
5	Systems for collecting and tracking data for ensuring quality objectives	**59**	**105**	**0.356**	**1.780**
6	A review/analysis process for identifying errors in the system	**59**	**65**	**0.220**	**1.102**

* Please rank from 1 (least important) to 5 (most important).

Results show in table 4.12 find that the elements considered the most important and effective for quality improvement are training and education (mean 4.4) and clearly defined guidelines for customer satisfaction (mean 3.6). Systems for collecting and tracking data and data analysis are not considered effective at all.

Table 4.13: Parties involved in quality improvement.

Item	Description	Yes (%)
1	Are your employees involved in efforts to improve quality?	95%
2	Do you promote partnering on your projects?	68%
3	Do you require vendors and subcontractors to use a Quality Programme?	66%
4	Does an employee quality training programme exist at the company?	59%

Table 4.14: Which of the following are quantified/measured in your company in an effort to improve quality?

Item	Description	Yes (%)
1	Change orders	8%
2	Rework	47%
3	Customer satisfaction	95%
4	Complaints to suppliers (delivery, quality)	25%
5	Complaints to sub-contractors (delivery, quality)	15%

Results show that employees of the company are often involved in quality improvement (see Table 4.13). However, a formal quality training programme exists in only 59% of the respondents. Suppliers and subcontractors are also positively involved in quality improvement. Results show that most of the companies do have some kind of quality improvement programme in place (see Table 4.14). Quality improvement is indeed a systematic, formal approach to performance analysis and enhancement efforts in practice. Understanding and proper implementation of quality improvement is essential for a well-functioning practice and is necessary for any practice that aims to improve efficiency, safety or delivery results (D.Ashokkumar, 2014).

Table 4.15: Benefits of improving quality on a score 1 (none)–5 (great).

Rank	Benefits of improving quality	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Customers Trust	**59**	**257**	**0.871**	**4.356**
2	Reduced rework/punch list	**59**	**241**	**0.817**	**4.085**
3	Improved employee job satisfaction	**59**	**196**	**0.664**	**3.322**
4	Improved relationships with architects/engineers	**58**	**163**	**0.562**	**2.810**
5	Improved schedule performance	**59**	**148**	**0.502**	**2.508**
6	Higher productivity	**59**	**148**	**0.502**	**2.508**
7	Reduced claims	**59**	**118**	**0.400**	**2.000**
8	Lower employee turnover	**59**	**115**	**0.390**	**1.949**
9	Improved safety	**59**	**91**	**0.308**	**1.542**
10	Improved relationships with subcontractors	**59**	**89**	**0.302**	**1.508**
11	Better chances in bidding process with pre-qualification	**59**	**59**	**0.200**	**1.000**
12	Reduced change orders	**59**	**55**	**0.186**	**0.932**

* Please rank from 1 (None) to 5 (Great).

Table 4.15 indicates the result that the benefit of quality enhancement is seen by the respondent. More repeat customers, less rework and better job satisfaction are considered significant benefits. Improved protection, scheduling efficiency, relationships with subcontractors, improved bidding opportunities and reduced change orders are considered less significant, but more than half of the companies still see advantages in these areas. Results show that according to the respondents, the highest rank of most important barriers to quality improvement in oil and gas industry are the lack of skilled workers, leadership, not knowing the definition of quality and the low bid mindset in awarding contracts (see Table 4.16).

Table 4.16: Barriers to the improvement of quality on a score 1–5.

Rank	Barriers to the improvement of quality	Total Respondents (N)	Weighted Total	RII	Item Mean
1	Lack of skilled workers	**59**	**215**	**0.729**	**3.644**
2	Lack of Leadership	**59**	**235**	**0.797**	**3.983**
3	Not Knowing the definition of quality	**59**	**169**	**0.573**	**2.864**
4	Awarding of contracts to the lowest bidder (low bid mindset)	**59**	**132**	**0.447**	**2.237**
5	Lack of effective teams and/or team building skills	**59**	**118**	**0.400**	**2.000**
6	Use of adversary contracts	**59**	**84**	**0.285**	**1.424**
7	Union environment	**59**	**69**	**0.234**	**1.169**
8	Owners/contractors rely heavy on the litigation process to settle disputes	**59**	**55**	**0.186**	**0.932**
9	litigation process to settle disputes	**59**	**43**	**0.146**	**0.729**
10	Use of EPCC contracts on a negotiated basis	**59**	**51**	**0.173**	**0.864**

* Please rank from 1 (Strongly Disagree) to 5 (Strongly agree).

4.5 Summary

The data collected and its result provided much useful information about the oil and gas industry. This chapter had analysed the data collected and organized in groups and related topics. There were three sections of questions asked to the research respondents and the answers are satisfactory for this study. The data were analysed according to the themes of this study.

CHAPTER 5: DISCUSSIONS OF RESEARCH FINDINGS

5.1 Introduction

This chapter will look in to the summary of findings, the discussion and appropriate recommendation. discuss the problems of defining quality in the oil and gas industry, examine possible benefits of implementing quality, and look at barriers to quality implementation in oil and gas industry. This was done to find the problems with defining and measuring quality in oil and gas. Then, by exploring the both barrier and benefits of Quality. Challenge to improve quality and how to overcome the barriers to quality improvement in the Oil and Gas industry. This chapter will summarize the findings and general recommendation was suggested.

5.2 Discussion

When looking at the seven main elements of quality management that are used as the Malcolm Baldridge Award criteria: leadership, human resources, customer attention and satisfaction, strategic planning, process management, evaluation and analysis, and business performance, the oil and gas companies have recognized the significance of the first three factors (Peter Hoonakker, 2010). They are ranked at the top of Tables 4.11 and 4.12. However, the importance of the last four factors is lacking in understanding. Strategic planning (setting targets for service improvement, developing a long-term strategy and a quality improvement plan) ranks only 10 in Table 4.11 and is not considered to be very effective in improving quality (see Table 4.12).). At the bottom of Tables 4.11 and 4.12, process management, evaluation and analysis (collection and use of a wide variety of data and knowledge on the quality of goods and services) rank. Business results (examination of the success and development of the company in its core business areas: customer satisfaction, financial and market success, human resources,

supplier and partner performance, organizational efficiency) are also deemed not relevant (see Tables 4.11, 4.12 and 4.15).

5.2.1 Problems with Defining and Measuring Quality in Oil and Gas Industry

The results of this study have shown that it is the respondent is well aware of the defining quality in the oil and gas industry. However, some of the respondent often have an attitude of 'looks good, feels good' (see Table 4.4). This type of quality is hard to quantify, and that is also one of the main results of the study: it is hard to find a quantifiable outcome measure of quality in oil and gas. It has become clear throughout the research that a necessary first step is to specifically define quality, and then quantify it. Customer satisfaction is an obvious indicator of the result but this indicator is still not properly quantified in the oil and gas industry. Contractors are more than willing to show references from satisfied clients, but a standardized outcome measure would be welcome (Peter Hoonakker, 2010). For example, if all oil and gas contractors were to use a standardized questionnaire on customer satisfaction, it would be possible to compare contractors' quality records (benchmarking) and examine which factors lead to high customer satisfaction and high quality. Efforts were being made to create such a questionnaire. Even if contractors collect customer satisfaction data, however, they often fail to analyse the data. Results of this study showed that although more than half of the respondents in the survey report collect data on a variety of measures (Table 4.14), they do not understand that analysing the data is crucial to improving quality (refer Table 4.11 and 4.12).

The triple constraint of project management that is time, budget and specifications feature in many definitions of project management success (PMI,

2017). However, time, budget and scope are not sufficient to measure project management success as dimensions such as the quality of the project management process and the satisfaction of the expectations of project stakeholders also need to be considered (Chin Keng & Hamzah, 2011). Therefore, extending the traditional triangle to include the quality of the management process and stakeholder's satisfaction provides a more complete view of project management success.

5.2.2 Benefits of Quality

Clients and contractors see clear benefits of improving the price. Higher repeat clients and less rework are two of the advantages cited most. The study by (Mcintyre & Kirschenman, 2000) found similar results. Overall, contractors who use TQM reported higher customer satisfaction, improved schedule performance, improved relationships with architect/engineering firms and reduced rework (Mcintyre & Kirschenman, 2000). (Love, 1999) It was found that the costs associated with rework (reconstruction due to bad workmanship or change of plan) were as high as 12 % of total project costs and required as much as 11% of total project work hours.

5.2.3 Challenge to improve quality in the Oil and Gas industry

The primary obstacle to successful implementation of the management system appears to be the complexity of the project not just in oil and gas but often in the construction process: the projects are often very big, labour intensive and located in the same location; the workforce seems to be transient; and demand fluctuates, according to the client's view of the importance of the building project. (Sommerville, 1994) (Fayek & Robinson, 2014). TAM / SM project's 'nature' in oil and gas is a complex system in which several participants are brought together, each

with their own perspectives and interests, to complete a project plan that typically changes several times during construction, while each tries to minimize the effects of weather, occupational hazards, scheduling delays and building defects. The many changes can lead to construction project completion delays, quality issues, and rework, which in turn can lead to more delays, and so on. In short, the industry is characterised by confrontational instead of cooperative relationships between the different parties involved, with claims by the different parties as a result (Ismail, Hashim, Ismail, Kamarudin, & Baharom., 2011).

The second challenge to achieving quality is the multiple actors involved in the construction process who are all seeking to protect their own interests. The oil and gas industry traditionally consist of three main participants: the owner (or client), the consultant or OEM / engineer and the (general) contractor. The basic construction process takes place like this: the owner hires an architect / engineering company to design the project and submit the project to contractors (in a competitive bidding process) and the contractors do the actual construction work. Even though a common project goal is shared (completion of the plan), participants differ in what they hope to gain from the construction process. The typical owner would probably agree that they would like to spend as little as possible to get their desired project completed. Designers are in business to provide a service to the owner; however, their relationship with the contractors is often unclear. The contractors attempt to provide the product as drawn by the designer as efficiently as possible, in order to maximise their profit. Apart from the three primary participants, there are many other parties involved in the construction process: a variety of sub-contractors and suppliers. The many sub-contractors (Fabrication, instrumentation, electricians, lifting, mechanical piping) are a particularly

important factor, and company size is a related factor that explains the difficulty in implementing quality. Contractors companies vary greatly in size. General contractor companies are mostly large, but sub-contractor companies are often very small.

Failure to apply standardisation is a third barrier to quality implementation. General contractors want to ensure consistency in the entire project throughout the design of the TAM / SM. However, according to (Jiao, 2008), the oil and gas industry is characterised by its standardisation. Products are very often one-offs, and the production processes differ to some extent from each other. Therefore, no universal standard or specification can be applied to the product which leads to quality assurance difficulties. Changes in project design specifics are often common, and can be regular during the construction process. Quality is often at risk when a plan is changed during construction.

The bidding process is one final and important barrier to the implementation and management of quality. The typical oil and gas bidding process begins with the issuance by contractors of a project description for public review. Project specifics can vary, but usually specify sufficient detail that experienced contractors can build a reasonably reliable job bid. Some contract bids are only open to general contractors, who are required to hire subcontractors after the contract has been awarded (Peter Hoonakker, 2010). Contractors as well as researchers are concerned about 'competitive bidding' for projects. For example, to retain a healthy profit margin for the job, a contractor can seek to reduce allocated resources towards safety or quality management. In the event of injuries during the project, efforts to minimize participation in protection and/or quality management can be very

expensive for a contractor. For many reasons, they may also experience delays in the schedule: weather, labour shortages, late delivery of equipment or materials and other events beyond the contractor 's control (Shurbagi, 2012).

5.2.4 How to Overcome the Barriers to Quality Improvement in the Oil and Gas Industry

There are several possibilities to overcome the barriers to quality improvement in oil and gas TAM/SM project: partnering, standardisation, using pre-qualification in the bidding process and last, but not least, changing the culture of the oil and gas industry.

5.2.4.1 Overcoming conflict between actors in the oil and gas process: Partnering

Partnership is one of the most promising possibilities and can take the form of either a single project agreement or a long-term or strategic agreement covering a number of projects (sometimes expressed as a framework agreement) (Meng, 2012). (Kanji, 1998) defined project partnering in construction this also similar with the other industry that having a similar nature with the construction industry including oil and gas are as follows: 'Project partnership is a synergy – a cooperative, collaborative effort between contracting parties and related parties to complete a project in the most efficient , cost-effective way possible, by setting common goals, keeping communication lines open and resolving issues together when they arise.' This definition also been support by (Ali Hosseini, 2016) cite that partnering is defined as a collaborative procurement form, focusing on integration of the project design and delivery

by weighting collaboration and coordination between involved parties. The principle in both project partnering and strategic partnering is that the parties try to work as much as they can as if they were a single organisation. Different partnerships can be established between, for example, architects/engineers/designers and contractors, between contractors and subcontractors and between contractors and suppliers (Peter Hoonakker, 2010). Partnership requires commitment, real mutual trust and discipline to be successful. Some authors consider partnering to be one of the major changes in recent decades and one of the greatest opportunities for change (Meng, 2012). Partnering is claimed to have a positive impact on project performance (time, cost and quality), as well as on improved customer satisfaction, safety and reduced litigation (Meng, 2012) (Ali Hosseini, 2016). Although most of the literature supports the positive effects of partnering, much of the evidence is descriptive and largely based on case studies. However, some empirical studies have also been conducted (T. Roger Manley, 2007) (Ali Hosseini, 2016) and this literature also favours the advantages of partnership. Partnership requires some of the same elements as quality implementation: commitment to management , human resources (teambuilding), customer focus and satisfaction, strategic planning, process management, measurement and analysis and, last but not least, culture change (Bresnen, 2000)

Despite the many successes reported as a result of partnering, there are also reports about mediocre or failed partnering projects. There are three (internal) barriers against partnering: organisational culture, organisational climate, and organisational structure (Bresnen, 2000). It is no coincidence

that these three barriers resemble the barriers against the implementation of quality management. Partners in the oil and gas industry must begin to realize that organizational change is not an easy process: it requires cultural change that is a long-term process and difficult to achieve; climate change (the thoughts, feelings and behaviours of all members of an organization); and change in the organization's structure (formal patterns of activity and decision-making within an organization or organization). All this needs a great deal of effort. The partnering demands high levels of investment of resources and risk taking in decision making, especially from staff and middle management, but in return oil and gas companies can achieve higher levels of performance (Adnan Hamimah, 2009). And it is not easy to handle a successful partnering. Risk analysis and risk management measures need to be considered in order to improve the partnering performance. Nevertheless, partnership offers a greater chance of improvement. As a result, most of those who have had partnering experience are able to participate again because of the positive results of partnership (Adnan Hamimah, 2009). Partnering in a wide sense has been regarded to have the capability of improving the procurement approach of the industry.

5.2.4.2 Standardisation

Standardised equipment specifications are been develop through collaboration of subject matter experts from the participating operators with the independent engineering consultancy's technical leads during the engineering phase of the project (Zafarani, 2011). For example, the delivered standardised equipment specifications for procurement of low voltage switchgears, ball valves, and piping and valve materials. These

specifications are based on industry and international standards, as well as operators' experience and expertise and also incorporate feedback from suppliers (Obiajunwa, 2012).

Many authors point out that non-standardisation is one of the main barriers of implementation of quality programmes in oil and gas industry (Obiajunwa, 2012) (Mohammad & Price, 2004) (Øien & Knut, 2016). Many TAM/SM projects are unique and even similar projects are not usually identical. The end product is not repetitive like in manufacturing and, therefore, the TAM/SM project process cannot start with the same highly defined planning (Karim, 2006). This problem is in itself not easy to solve, but the different stages in the engineering, procurement, construction and commissioning (EPCC) process in the TAM/SM project have many issues on their own. Instead of over-emphasising the uniqueness of each EPCC process, contractors and clients should focus on the similarities and make more use of standardisation, prefabrication and system-configuration (Fayek & Robinson, 2014). Standardisation is defined as: 'The extensive use of processes or procedures, products or components, in which there is regularity, repetition and a record of successful practice' (Gibb & Isack, 2001). Standardization in the oil and gas industry means cost savings on projects, while operators across the oil and gas industry look at standardization as a way to simplify processes from design and construction to installation and start-up, in order to create safer, more predictable and reliable facilities that start on time and stay up (Amendola, Depool, & Artacho, 2010).

Same of the benefit in standardization in this project it can reduce bespoke design. although individual companies in the oil and gas industry have been improving standardisation within their own businesses, the industry as a whole lag behind others, such as automotive and aviation sectors, and erodes value by creating bespoke components in each project (Al-Turki, Duffuaa, & Bendaya, 2019). In a research by (Naiyeju, Ogedengbe, & Aderoba, 2013) it also helps in simplify procurement phase. The standardization of equipment and bulk materials as these are the building blocks that make up the packages and the components that shape a whole project. At this point though, there are savings to be made. Equipment specifications (including technical requirements, quality requirements, and documentation requirements) are provided to a manufacturer of equipment to receive a suitable bid during the procurement process. If these requirements are standardized, the manufacturing process will be more streamlined and the delivered products will be easier to verify and maintain. (Naiyeju, Ogedengbe, & Aderoba, 2013). (Naiyeju, Ogedengbe, & Aderoba, 2013) also indicate that a reduce bid-evaluation time. Furthermore, simpler bid processes and more standard production lines for fabrication and testing can lead to improved supplier efficiency. For example, one of the participating operators has reduced its bid-evaluation period for major rotating equipment from more than a year to six months as a result of standardised internal specifications (Naiyeju, Ogedengbe, & Aderoba, 2013).

Following the standardization, will also add value and improve safety. Important savings in project cost and schedule can come from minimizing

preferred engineering; cost and work time are reduced by not updating equipment requirements for each project; (Ismail, Hashim, Ismail, Kamarudin, & Baharom., 2011). Eliminating inconsistencies and unnecessary requirements also leads to fewer fabrication defects, thereby enhancing equipment reliability, quality and safety (Ismail, Hashim, Ismail, Kamarudin, & Baharom., 2011).

According to Sabri, Rahim, Yew, & Ismail (2014), standardization improve industry learning. In addition to addressing inefficiencies, standardized specifications can also create a new global industry learning platform where lessons can be captured and fed back directly into future projects worldwide by updating the specifications. In addition, it also optimizes the engineering of projects in terms of mechanical, electrical and instrumentation engineering, the predictability offered by standardized equipment specifications is of great benefit in the onshore plant's front-end design phase and in the delivery of the relevant equipment packages (Fayek & Robinson, 2014). mechanical, electrical and instrumentation engineers are typically involved in technical bid evaluation and delivery of equipment packages in projects, for example lifting equipment such as winches (Mohammad & Price, 2004). Standardised specifications can help set clear expectations from the outset for the design of supporting structures, as well as supplier management. Engineering teams can then focus on optimising design rather than re-inventing the wheel or resolving technical issues which may arise from inconsistent or unclear requirements (Mohammad & Price, 2004).

In conclusion, the common objective for TAM/SM oil and gas projects globally is to deliver safe and economically viable facilities, which start-up on time and stay up. Standardisation has the potential to support this goal and industry-wide collaboration is needed to realise the full benefits.

5.2.4.3 The Competitive Bidding Process and Pre-Qualification

The competitive bidding process is often mentioned by parties involved in the EPCC TAM/SM project as one of the biggest barriers against quality implementation. The underlying assumption is often that low cost usually means low quality. Interestingly, in the UK until 20 years ago, the system of competitive bidding did not exist as it does today (Peter Hoonakker, 2010). Instead, they used a system of mandatory fee scales. Many parties involved in the EPCC TAM/SM project predicted that abolishing the mandatory fee scales would lead to lower quality. However, results of a study by (Hoxley, 2007) It demonstrated that the implementation of the competitive bidding mechanism was not resulting in poorer quality. Moreover, the results also showed that the quality of service was higher when care was taken with the pre-selection of contractors in the bidding process (Oyewole, 2018).

One of the option is pre-qualification to solve the problems created by the competitive bidding process. The use of pre-qualification criteria requires bidders to satisfy a minimum requirement for programs of experience, performance, safety or management implemented (Naiyeju, Ogedengbe, & Aderoba, 2013). Therefore, the owner or general contractor can reduce their risk of working with a poorly performing subcontractor by

requiring, for example, a maximum experience modification rating (generally indicating good safety performance in the recent past) or evidence of an implemented quality management system (that could indicate a more reliable work product) (Ismail, Hashim, Ismail, Kamarudin, & Baharom., 2011).

5.2.4.4 Changing the Culture in the Oil and Gas Industry

Organizational culture is a complex phenomenon. Organisational culture is embedded in behavioural norms, hidden assumptions and human nature, and consists of many levels (Watanabe, Nguyen, & Tsunemi, 2017). Lessons from the manufacturing and service industries have shown that the implementation of quality management systems involves a comprehensive understanding of the organizational culture and the improvements required to make quality a state of mind of the members of the company (Mosadeghrad A. , 2006).

Although organisational culture plays a crucial role in adapting TQM and other innovations, until recently organisational culture has hardly been examined in the context of oil and gas industry (Maleki Sadabad & Pathirage, 2017). A summary of the Competing Values Framework study by (Yong & Pheng, 2008) briefly, according to (Cameron & Quinn, 2011) four different organisational cultures can be distinguished. First, the clan culture, most common in family-type organisations, characterised by teamwork, employee-involvement programmes, and corporate commitment to employees. Organisations characterised by a clan culture treat their customers as partners and its employees as family. Second, the adhocracy

culture, most common in dynamic, entrepreneur, and creative organisations, where the goal is to foster adaptability, flexibility and creativity. Organizations characterized by culture of adhocracy easily adapt to change and the secret to success is creativity. Third, the market culture, which is most common in externally oriented organizations, focusing on transactions with suppliers, customers, etc. Competitiveness and productivity characterize this culture, obtained through a strong emphasis on external positioning and control. Fourthly, the culture of hierarchy, characterized by a formalized and organized workforce with consistency, predictability and effectiveness as its key focus (Cameron & Quinn, 2011). Several recent studies have shown that most, but not all, oil and gas and also construction companies are characterised by a clan culture (Oney-Yazic, Arditi, & Uwakweh, 2006) (Maleki Sadabad & Pathirage, 2017).

To identify what kind of organisational culture most oil and gas companies are characterised is by examining the effect of organisational culture on TQM implementation. TQM implementation strategy with a focus on modifying the culture to become more externally oriented and fortifying customer focus and satisfaction and process management fits the clan culture best (Yong & Pheng, 2008).

The impact of culture to a project team has received various answers first, it creates social standards to control behaviour; it conveys messages to both insiders and outsiders about the organisation objectives; it also assists in connecting people, organisational objectives and standards; and finally it

helps regulate, supervise, and develop views and activities in the organisation (Maleki Sadabad & Pathirage, 2017).

CHAPTER 6: CONCLUSION AND LIMITATION

6.1 Conclusion

What is the perception of quality management implementation in oil and gas industry? Data analysis for this study shows that the quality management has positive perception most of the respondent are well aware of the implementation of quality management this include it perception and awareness on existing quality programme in the oil and gas industry. Thus, defining the important of quality management implementation in oil and gas industry. The data also shows that Client satisfaction and education and training is the best measure to improve quality performance. Other than that top management commitment and leadership, standardization, empowerment & involvement, participation, recognition & reward, and skilled workforce are some of the key elements on the project quality management that are important and effective for quality work performance. The respondents' rated to questions concerning their perception of the oil and gas industry's quality performance. Results show that according to the respondents, quality is most often measured through customer satisfaction. The best way to improve quality is through education and training and the biggest barrier to quality is personnel.

These results will assist client and contractors to identifying the barrier and how to improve for it. Also benefit effects for the implementation of quality management on project performance. The data collected results assist to identifying how to overcome the barriers to quality improvement in the oil and gas industry, the find is: overcoming conflict between actors in the oil and gas process: Partnering, standardisation, competitive bidding process and pre-qualification and changing the culture in the oil and gas industry. The research also finds that the quality perception among the industry have evolved in term of the important of the company being recognize by certification body in compliance

with the QMS standard such as ISO. The result shows that Certified quality programmes such as the ISO 9000 series is important in consider the best measure/indicator of quality in the oil and gas industry.

6.2 Study limitations

In general, response rates are low in studies of oil and gas professional. The response rate in the first questionnaire survey (29.5%, 200 respondent) consequently, it is low but not below the average for research in this field, especially since it was the second round of data collection in a longitudinal study and only the original respondents were asked to participate. The results of this studies are similar (Tables 4.5 and 4.8), suggesting that the low response rate for the survey did not result in biased findings. Furthermore, most of the literature is based on construction industry. However, the construction industry has a similar nature with the oil and gas industry. Oil and gas construction workers perform tasks involving physical labour, whether that entails building well foundations, setting up a rig, welding pipelines, or building refinery infrastructure. They use hand tools, repair drilling equipment, and transport materials to and from sites.

It is possible for a future research to undertake the direction of this research to identify the perspective of the wider oil and gas project team population. This would enable a generalization of the research findings towards the target populations. Qualitative interview could be conducted for this approach that would enable data collection from a narrower range of participants.

It is desired that the model recommended in this research could be further explored for better acceptability in the industry. The model could be further improved in the future with more research data being available.

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