

FACTORS INFLUENCING SAFETY MANAGEMENT SYSTEMS IN PETROCHEMICAL PROCESSING PLANTS

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ABSTRACT

The accident rate in the Malaysian construction industry is among the highest compared to other developing countries. The Malaysian government has recommended the self-regulation of safety management systems (SMS) for construction projects with the hope of improving the situation; however, the readiness of the local contractors to implement SMS is questionable. Based on the critical review of literature, this research intends to uncover the factors influencing SMS implementation and development among Malaysian contractors working in processing plants. Additionally, this paper highlights studies on the systemic issues of the contractors, during the development and implementation of SMS in construction industry during project execution in the processing plants. From the review of literature, this paper has uncovered interrelated obstacles encountered by contractors, namely cultural factors, working conditions and the organizational processes. The next step of the research aims to identify the most influencing factors on SMS development and implementation among Malaysian contractors as identified in this paper.

KEYWORDS: *Safety management systems, contractors, processing plants, construction supply chain*

I. INTRODUCTION

The growth of petrochemical processing plants (hereafter referred to as processing plants) has benefited various industries, especially the construction industry. The construction industry plays a major role in processing plants; as many construction activities are carry out to meet the high demands of development. One important role of the construction industry is to provide civil and mechanical maintenance tasks.

The use of contractors for maintenance tasks in processing plants is necessary to cope with the large scale of work and engineering problems (Mueller et al., 1996). Contractors play a significant role during maintenance tasks due to the amount of work to be accomplished in a short time (Duffuaa and Daya, 2004). Other reasons for using contractors include: experience and professionalism; specialization in certain areas; productivity, cost and efficiency (Lenahan, 2006; Duffuaa and Daya, 2004).

Despite its important contribution to processing plant development, the Malaysian construction industry is still saddled with serious safety problems. For instance, there have been 700 negligence cases in the construction industry since 2002, which include high-profile incidents (Basri and Kumar, 2006; The Star, 2006). The construction industry continues to contribute towards the high fatal accident rate in Malaysia (DOSH, 2011; MOHR, 2008; Berita Harian, 2007; Kong, 2001).

This research focuses on the factors influencing safety management systems (SMS) development and implementation faced by Malaysian contractors working in petrochemical processing plants. It is intended that the findings of the study contributes towards better implementation of safety management systems (SMS) in processing plants.

II. SAFETY MANAGEMENT SYSTEMS IN THE CONSTRUCTION INDUSTRY

Safety Management Systems

Safety management systems (SMS) have emerged from the “industrial accident causation theories” introduced by H. W. Heinrich in 1931, and function as comprehensive, integrated systems for managing safety. The principal aim of SMS is to impede the causation process that leads to accidents and incidents (Booth and Lee, 1995). SMS is fundamental to successful accident prevention (Grayham and Rosario, 1997), and has become a matter for concern in recent years (Hale et al., 1997).

A series of catastrophic incidents have occurred in the past (Hale et al., 1997; Kirchsteiger, 2002; Mitchison and Papadakis, 1999; Summers, 2007), which led to the development of safety regulations (Gun, 1993; Hale et al., 1997) and emphasized the need for SMS (Osborne, 1993). These major incidents involved Flixborough (1974), Seveso (1976), Mexico City (1984), Bhopal (1984), Chernobyl (1987) and Piper Alpha (1988) (Summers, 2007; Santos-Reyes and Beard, 2008).

Since then, SMS is used widely in various industries as an accident prevention mechanism. In the processing plant industry, the possibility of fire, explosions and toxic emissions is frequent, which could potentially kill a large number of people, including employees, processing plant contractors and the population, as well as causing catastrophic damage to the environment (Huat, 1997; Fernandez-Muniz et al., 2007). As a result, the use of SMS in processing plants is more extensive, and is where the development and publication of safety standards or guidelines and good engineering practices started (Knegtering, 2002).

Construction Supply Chain

Past studies have discovered that the successful development and implementation of sms can help to prevent accidents in the construction industry (Baxendale and Jones, 2000; Wilson and Koehn, 2000; Tam et al., 2001; Hinze and Gambatese, 2003). However, the use of sms reached a plateau (Tam et al., 2001). Despite adopting sms, contractors remain poor in the development and implementation of safety on worksites. As an organic type of organisation (Wilson, 1989), construction offers a flexible working environment. Construction involves human interaction and complex activity and aligns individual objectives into one process, which is always difficult in practice, especially for large projects. Projects are complex in nature, as they involve technical, procedural, organisational and human elements in an integrated manner (Ruuska and Vartiainen, 2003).

The construction industry consists of various parties such as client/owner, designer, consultants, general contractor, subcontractors and suppliers which are known as multi-organization process. Construction is also a multi-stage process as it includes conceptual, design, construction, maintenance, replacement and decommission. The multi-organization and multi-stage process is also known as construction supply chain (CSC). The CSC has been characterised with fragmentation and poor coordination among project participants for a long time, and there are many inter-organization problems, such as interdependency, inaccurate information transfer and wrong deliveries which resulted in poor performance (Xue et al., 2007; Vrijhoef and Koskela, 1999). This complexity clearly demands efficient and effective implementation of SMS as an accident prevention mechanism.

Construction Safety In Processing Plants

In the case of contractors working in processing plants, apart from the complexity of construction working condition, contractors face a

greater risk during maintenance tasks (Kim et al., 2002). Contractors could be exposed to a number of inevitable hazards: large numbers of workers - mostly employed by the contractors who are unfamiliar with the plant in a confined space; the presence of hazardous materials; large number of tasks performed under high pressure, and in various weather conditions (Ahmadun et al., 2003). The number of workers involved in a processing plant maintenance shutdown can be anywhere between 700 and 3000 at peak time (Ahmadun et al., 2003).

Due to the hazards and risks present in processing plants, the clients set high safety requirements and effective approaches to monitor and control the safety of contractors (Jannadi and Bu-Khamsin, 2002). However, accidents among contractors still happen (Kong, 2001; Mohd-Salleh, 2002; New Straits Times, 2002; Shaluf and Ahmadun, 2006; Zainudin et al., 2006). Fatalities and injuries are commonplace among contractors due to the heavy physical activities necessary during maintenance tasks and the presence of a large number of workers (Hale et al., 1998; Ahmadun et al., 2003; Duffaa and Daya, 2004). The number of accidents involving contractors is often more than five times higher than those involving the processing plants' own personnel (as cited in Hale et al., 1998).

Malaysian Construction Safety

The concepts of sms are relatively new in malaysia. The occupational safety and health act 1994 (Osha 1994) is quite comprehensive with improvements over earlier pieces of legislation however, the level of awareness and practicability of such regulations within the construction industry are generally lower than expected (rampal and nizam, 2006). In addition, sms in malaysia is still under self-regulation without nationally applied models (Kogi, 2002). Hence the number of malaysian companies subscribing to sms is still small compared to the total number of industries in the country (thye, 2001). A study by the malaysian trade union congress (MTUC) (2001) affirmed that the implementation of safety in malaysia is poor in the workplace. Furthermore, there are currently no specific guidelines or a master plan for the implementation of sms programmes to help the construction industry players to improve their performance (CIDB, 2008).

Industrial accidents happen mainly due to non-compliance of OSHA 1994 by employers (New Straits Times, 2002). However, in the case of contractors working in processing plants, safety is a requirement of the clients. Many clients have introduced various safety approaches to improve the safety performance of contractors (Simon and Piquard,

1991; Ibrahim et al., 2002). It is compulsory to include a safety plan in the tender documentation during the bidding process (Kong, 2001). However, previous researches (Fitts, 1996; Smallwood, 1998; Yule and Mearns, 2004; Abraham et al., 2004) confirm that contractors adopt SMS just for the sake of the tender requirements and to satisfy the clients during the bidding process. Hence the implementation of safety is still lacking (Fitts, 1996). In the context of Malaysia, according to Husin et al. (2008), the current SMS practices do have sound features and characteristics, but lacks mission, vision, objective and awareness due to the over-emphasis on productivity. SMS is under self-regulation and it requires more constructive and practical ideas for implementation (Husin et al., 2008). Furthermore, occupational safety is still in the early development stage in Malaysia (Husin et al., 2008).

Some important examples of accidents in Malaysian processing plants are the Tiram Kimia Depot chemical explosion (1992), the Shell Bintulu explosion (1997), the Petronas Gas Berhad fire and explosion (2002), the Petronas LNG Complex Bintulu fire incident (2003), the refinery fire in West Malaysia (1999), the Fatty Chemicals methanol blast (2006) and the Petronas LNG Complex Bintulu gas leakage (2009) (Mohd-Salleh, 2002; Shaluf and Ahmadun, 2006; Ismail and Stuart, 2005; Utusan Malaysia Online, 2009). Fatalities involving contractors is the worst consequences due to processing plants accidents. Some examples are three fatalities in the Petronas Gas Berhad explosion in 2002 (New Straits Times, 2005; Shaluf and Ahmadun, 2006) and two fatalities in the Fatty Chemicals Methanol blasts in 2006.

There are many issues involved in developing and implementing SMS. Failures are still common despite advances in the SMS approach. Little has been written on the views of contractors in processing plants about the issue they have with SMS development and implementation. Therefore, an investigation of SMS development and implementation can help to identify the problems encountered by contractors.

III. FACTORS INFLUENCING SMS DEVELOPMENT AND IMPLEMENTATION

For this research, a literature review has surveyed the scenario of the CSC as well as enabling an understanding of its impact on SMS development and implementation during project execution in the processing plants. A literature review was undertaken to identify factors that influenced SMS development and implementation among contractors in processing plant.

It is evident that many obstacles encountered by contractors during SMS development and implementation including cultural factors, working conditions and the organizational processes are interrelated (Othman, 2010). These factors have formed the underlying factors of ineffective SMS development and implementation - the misperception of safety responsibility. The misperception of safety responsibilities occurs by the parties involved in the CSC. However, this study explains only relationship between clients and contractors, clients and contract workers and contractor and contract workers. Based on the literature review, the barriers to effective SMS implementation can be divided into external factors (clients) and internal factors (contractors and contract workers). Several distinct misperceptions of safety responsibility between clients, contractors and contract workers emerged from these barriers that will be discussed further in the following sections.

Reliance Culture Of Safety Management Systems

The research indicates that a reliance culture does exist between contractors and client, and between contractors and parents company/headquarters. Several factors have contributed to this condition. Obviously, safety performance is being taken into consideration prior to contract approval. This has led to contractors disregarding safety measures in order to gain contract approval. Generally, SMS policy and procedure, which was drawn by the parents company/headquarters was included in the tender documents as a standard image of company's safety implementation.

Subsequently, contractors rely on headquarters in organizing the safety measures to be utilized. As a result, contractors are in a vulnerable situation as they need to work in an environment, location and condition that they are not familiar with. In order to familiarize with the in-house safety requirements set by headquarters, contractors are required to collaborate with clients. However, the different levels of responsibilities between contractors and clients in the alliance have led to misperceptions in the process of developing and implementing SMS. The reliance culture leaves the contractor in a vulnerable position due to different environment, location and condition between the entities.

The Uncertainty Of Organic Types Of Organisation

The development and implementation of SMS is highly influenced by the company's external environment such as the uncontrollable risk and uncertainty that is easily overlooked by contractor in the processing plant. Safety requirements and standards will vary based on

client's requirements such as work progress, datelines, and schedule. Consequently, safety enforcement is not standardized for contractors and clients when profit is placed as a higher priority compared to safety.

As contractors work under pressure to complete the task in a specified period, this study reveals the bureaucracy of safety procedures, which leads to ineffective SMS development and implementation, for example, the procedures for bringing in equipment; therefore contractors choose to take short cuts by using inappropriate equipment for the job.

Another issue which relates to the working conditions, is the physical environment. In this case, the physical environment refers to the geographical location and climate of the workplace. Santos-Reyes and Beard (2008; 2002) stated that the physical environment might affect some aspects of SMS. It is common that contractors will frequently change their working location, and therefore the working conditions also change (Laukkanen, 1999). Safety requirements become more stringent and more demanding according to the project and client. SMS development and implementation becomes tougher due to this type of physical environment.

Disintegration And Inconsistency Organisational Process

Organising is critical to ensure the effectiveness of SMS development and implementation and has a significant influence upon it (Fitts, 1996; Santos-Reyes and Beard, 2002; Rundmo et al., 1998; Basso et al., 2004; McDonald et al., 2000). Therefore, the development of safety department is crucial to cater safety issues in a company. However, contractors reluctant to do that as it can reduce the budget.

The main concern of a contractor is how to save money and reduce costs. Thus safety is usually considered a secondary priority in the company's plans. In this study, the interviewees' views indicate that it is common practice in Malaysia to discount safety purposely to win the tender. The clients who demand the lowest contract costs have influenced this scenario. As such, the contractors search for lower quality supplies and neglect safety issues. It is not surprising to find that the majority of contractors in this study do not encompass safety costs in their tenders. This seems to suggest that these contractors find it difficult to develop and implement the most effective safety during the construction phase of their projects.

The SMS development and implementation was also affected by the project and company size. Safety attention is higher on bigger projects compared to smaller projects. For a small size company, financial constrain is common which led to hiring temporary workers. This condition contributed to poor safety training and lack of qualified taskforce.

IV. CONCLUSION

The research indicates that misperception of safety responsibility issues has a strong influence on contractors' SMS implementation. This finding is an interesting one, as previous studies of SMS give little or no attention to this issue. Addressing this issue is essential to create awareness by the parties involved to improve SMS development and implementation.

This research has contributed to furthering the understanding of the main factors influencing safety development and implementation by Malaysian contractors working in processing plants. It has identified factors that are peculiar to, or exacerbated by, the internal and external environment of the companies. Factors such as financial constrictions, cultural dimensions and working conditions are prominent influences. Further step is to identify the most influencing factors on SMS development and implementation by distributing survey questionnaire to Malaysian contractors working in processing plants.

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