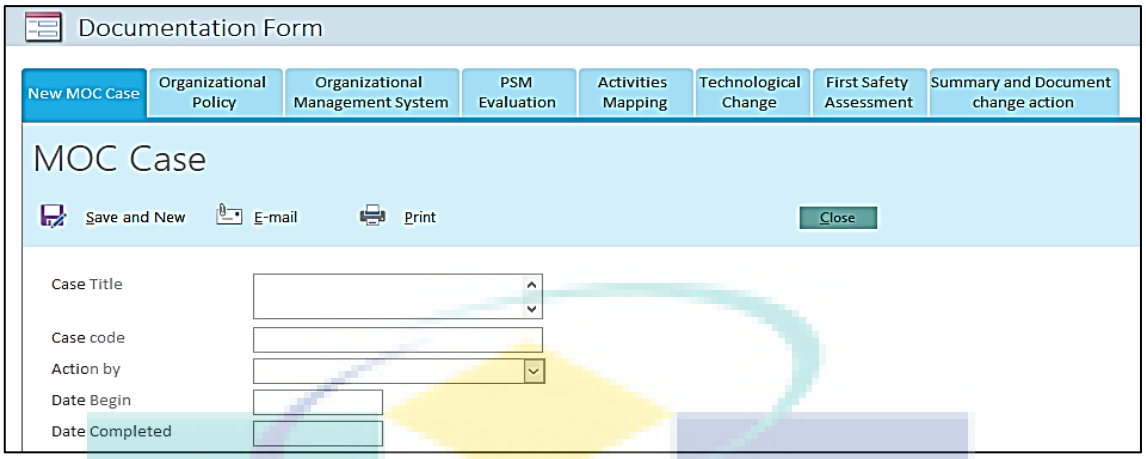

Investigation of Management of Change (MOC) Requirements for Framework Intervention Compliance with Process Safety Management Standard

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ABSTRACT

Changes and modifications in chemical, oil, and gas plants process are essential for survival in the dynamic process industry. These changes and modifications are needed for a variety of reasons such as yield of improvement, compensation for unavailable equipment, production increases, safety improvements and pollution prevention. However, a number of catastrophic incidents such as Flixborough have been attributed to improperly handled process changes. One of the established standards that addressed the above issue is Process Safety Management (PSM) by OSHA US. The PSM standard contains 14 elements, including Management of Change (MOC) 29 CFR 1910.119(l). MOC has excellent requirements that could and should prevent accidents due the changes if plants follow the regulation as intended. MOC element has been established with interrelated PSM elements such as process safety information, process hazard analysis, operating procedures, training, Emergency Planning and Response and incident investigation that define the management principles to control process hazards and protect the workplace. Less consideration of interrelations between the PSM elements leading to poor data sharing, energy and document intensive which complicates the updating process safety data and knowledge transfer that could contribute to safety and regulation implication. MOC with an integrated risk analysis is an important Process Safety Management (PSM) elements involved in planning and controlling risks and hazards that comes with the proposed change. However, lacking of systematic technique for easy adoption of this element had delayed its application in plant. Corresponding to these weaknesses, an integrated MOC management system is presented in this study. Results of this study comprises of MOC process framework and MOC management system (MOCMS) which acts as a guidance and documentation inventory tool. Other associated frameworks and systems also developed to ease the MOC program. Implementation of this technique and system at the selected plant as a case study shows is examined and discussed. The system is beneficial to industries to manage underlying risks in temporary and emergency change which ease the tracking of MOC case inventory as to improve risk controls in changes.

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CHAPTER 1

1.1 INTRODUCTION

Nowadays, highly hazardous industries grow rapidly due to increasing demand towards petroleum made products. Technologies, manufacturing process in these industries is getting complex to improve productivity to meet market demand. Increasing complexity of manufacturing process cause difficulty to acquire a comprehensive view on safety perspective of the entire complex processes, equipment and personnel. Potential of disastrous events may significantly increase following the growing complexity and expanding operation process (Bert Knegtering, 2002). Process Safety Management (PSM) is a safety management approach which introduced to highly hazardous industries in ensuring safety level in the premise. Every element in PSM are interlinked and integrated to cover all aspects in manufacturing process. PSM is not only system but the result of this approach may beyond safety in terms of process safety and eventually create a sustainable operation of facility. This system can be modified into business system and practice in every layer of the organization (Centre For Chemical Process Safety, 2016).

We are living in an ever-changing world, changes occur fast in a flash at any time. What happened today might be changed tomorrow. An organization shall manage to adapt to changes quickly to ensure sustainability and competitiveness in the market (Harmon, 2007). However, changes shall be well planned to ensure the changes will not bring negative consequences to the organization. Managing changes in a complex manufacturing process is challenging as industry safety practitioner shall able to foresee and manage all possible consequences brought by the changes (Koivupalo, Sulasalmi, Rodrigo, & Väyrynen, 2015). MOC is the element which worth for employer to pay attention with. This can be seen from statistics made by previous studies in which 9.1% of process safety accidents in contributed by poor MOC (Piong et al., 2017) and 19% (Ye, Xia, & LI, 2012). Gambetti et al. (2013) addressed that approximately 80% of major accidents were traced and discovered MOC failure is the root cause. In every 1000 work tasks, there would be 5-10% of tasks required MOC while there might be 5 to 10 changes are high risk.

MOC in PSM emphasized on evaluating, analyzing and preparing a company to potential consequences brought by changes in manufacturing process. However, current MOC element is proved to be one of the insignificant in terms of effectiveness in effort on improving process safety (Naicker, 2014). Current MOC approach is having flaws and weaknesses that shall be eliminated to ensure effectiveness of this system and to regain industry practitioners' confident towards MOC system. Changes in a process plant could be temporary or permanent based. MOC procedure is supposed applied to both situation of changes. However, short-term changes always treated negligently by applying changes without complete risk assessment. The consequences of neglecting temporary changes is well displayed from Flixborough incident. There was a temporary change on the reactor to complete maintenance of corrosion. This temporary change was not well controlled and contributed to the happening of explosion (Piong et al., 2017).

In this study, an integrated MOC system is proposed to minimize these limitations. Introduction of technology factor in MOC system also included in this study to enhance the effectiveness of MOC system. A framework of MOC process is established which complied to PSM regulation yet covering every criterion stated in legal requirements. Meanwhile, a MOC management system is developed to aids in MOC procedure on standards compliance and database of MOC reports. This management system is integrated as it covers from the beginning to the end of the MOC.

1.2 PROBLEM STATEMENT

As complexity of operation process increasing, the work of managing safety level is getting difficult if relying solely using manual method. Managing change is challenging as it shall be fast and disseminate knowledge and information to address hazards. Reporting and reviewing task may be complicated as more paper work required. Moreover, applying changes on operation process are a complex procedure and relatively challenging which requires assessing need of improvements and training of personnel, potential challenges and so on (Koivupalo et al., 2015; Zwetsloot, Gort, Steijger, & Moonen, 2007). French et al., (2011) stated the same opinion which human behavior are merely impossible to perform characterization of risk and reliability test on

complex environment which may restrict personnel from entering during operation. Integrated system on MOC which is well-developed and planned may be minimize the burden on process safety related personnel in planning work on implementation of changes in operation process and thus improving production efficiency and customer satisfaction (Centre For Chemical Process Safety, 2016).

MOC is one of the elements under PSM which functioned to evaluate, anticipate and manage all possible consequences that may bring after implementing change in manufacturing process. Based on the findings by Naicker (2014), MOC is one of the insignificant element in PSM implementation in several case studies. It is believed that these companies focus more towards Mechanical Integrity and Emergency Response & Control elements instead of MOC. Besides, there are many more research studies are not recognizing MOC as part of important elements in safety management. This is addressed by Koivupalo et al (2015) as current MOC approach is applied after changes instead of before. The actual function of MOC is wrongly translated. This is one of the reasons which causes industry to ignore the importance of MOC. Moreover, weaknesses in storing of many MOC related data is causing a burden to industry practitioner to practice MOC due to non-systematic and inadequate procedure and system (Bakar et al., 2017; Piong et al., 2017).

According to Zwetsloot et al., (2007), previous proposed approach on MOC in organization are practicing time-motion based method. This method has limited operators to perform work within the timeframe given which leads to systematic bias in performing work task. For example, an operator may be given only '5 minutes to check on safety valve and pressure gauge' before firing a boiler. This may cause the operator to focus only looking on safety valve and pressure gauge during checking which may cause the operator neglected to observe any unusual condition on the other parts of the boiler during safety check. Another drawback of time-motion based MOC approach is less to predict possible consequences on changes made on the process. Previous time-motion based approach are strictly followed on the time allocated on each actions item given in the framework. This approach has overlooked some essential supporting action items which could be one of the underlying weakness of current MOC framework in detecting consequences and error. Current MOC framework are focusing too much on performing task within period given and hence performing work using checklist with underlying error and weaknesses.

Apart from time motion based, MOC is having limitation in time constrain and urgency to resume operation which contributes to failure. Simplification on risk assessment, absent of updating operating procedure and so on were causes that neglected in MOC due to urgency (Piong et al., 2017). Gambetti et al.(2013) mentioned that MOC process actually requires long lead times due to several factors. Meeting shall be conducted with affected departments and specialist to address control measure on potential risk in the change. Documents which related to process hazard analysis (PHA), process safety information (PSI) and other elements are required to review to evaluate the change. Lastly, documentation for all related work task and risk assessment is required for both temporary and permanent changes. This is obviously time consuming to perform all the steps especially for temporary MOC changes.

One of the key factors in success of MOC program is that each related element such as PHA, PSI, operating procedure (OP) and risk assessment come as component in integrated MOC program. Although various kind of integrated safety management system or MOC systems (CSChE, 2004; Sphera, 2016) have been introduced, direct integration system, each between MOC procedures, time prediction and organizational risk assessment were not extensively being studied. The present studies addressed these shortcomings of MOC system that leading to poor MOC implementation program. Therefore, new framework and management system are proposed to minimize on limitation in time prediction, prioritization of risk and make record logging and storage comes into a more convenient yet less burdensome way.

1.3 OBJECTIVES

To develop an integrated management of change system based on Process Safety management.

Specific Objectives:

i. To construct framework to be carried out to implement management of change based on Process Safety Management.

ii. To develop MOC system that aids in process of managing change.

iii. To validate developed MOC system through case studies.

1.4 SCOPE OF STUDY

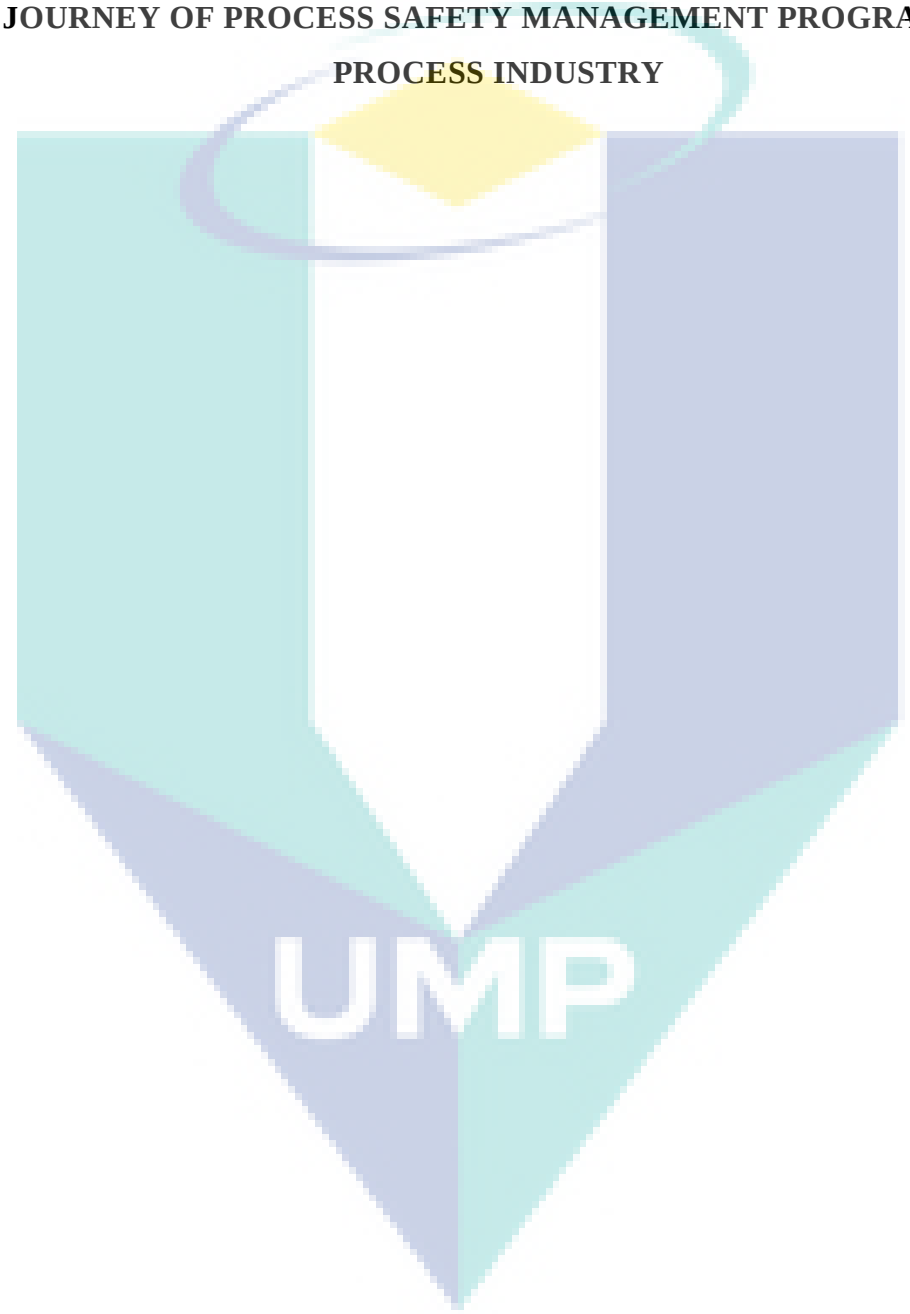
- In order to achieve the mentioned objectives, the following scopes are drawn:
- The requirement of PSM US, UK, RBPS, Korea and Singapore legislation is referred as body of knowledge.
- Framework of MOC and other associated elements have been constructed based on the above legislations.
- MOC system has been developed using Microsoft Access and Microsoft Excel environment.
- Reliability of developed framework and management system is verified via process safety expert feedback and case studies at two companies in petrochemical and petroleum processing sector that involve with review and data testing on MOC system.

CHAPTER 2

COMPLIANCE TRACKING SYSTEM FOR TRAINING ELEMENT OF OSHA PROCESS SAFETY MANAGEMENT

CHAPTER 3

A JOURNEY OF PROCESS SAFETY MANAGEMENT PROGRAM FOR PROCESS INDUSTRY



CHAPTER 4

INTEGRATED CHEMICAL, TECHNOLOGY & EQUIPMENT PROCESS KNOWLEDGE MANAGEMENT SYSTEM BASED ON RISK BASED PROCESS SAFETY

CHAPTER 5

MANAGEMENT OF CHANGE SYSTEM WITH INTEGRATED RISK ANALYSIS FOR TEMPORARY AND EMERGENCY CASES

CHAPTER 6

COPYRIGHT (LY2018005805) - MECHANICAL INTEGRITY MANAGEMENT SYSTEM FOR HIGHLY HAZARDOUS OPERATIONS

CHAPTER 7

COPYRIGHT (LY2018005815) - PROCESS HAZARD ANALYSIS TRACKING SYSTEM

CHAPTER 8

COPYRIGHT (LY2019002352) - MANAGEMENT OF CHANGE MANAGEMENT SYSTEM

CHAPTER 9

COPYRIGHT (LY2018005816) - NOISE EXPOSURE MANAGEMENT SYSTEM

CHAPTER 10

COPYRIGHT (LY2019002347) - INCIDENT INVESTIGATION SYSTEM

CONCLUSIONS

The objectives of this research were to establish a MOC framework and management system based on PSM regulation, 29 CFR 1910.119. A PDCA cycle is established to provide an overview of MOC process and a MOC framework which highlights all the important action items and related risk assessment forms recommended for each action items. An MOC management system is established in which stores all related risk assessment forms, change proposal, also act as storage database for related documents.

Case studies have been conducted to validate management system developed to determine the reliability and applicability in real life operation process. It is proved that this management system able to ease the burden of documentation and yet proposing new approach in MOC management. Tracking of open MOC task and temporary case is additional features in the system. Time begin and completed field in the system is established to enhance time prediction in performing every risk assessment and period required for a whole MOC process.

RECOMMENDATIONS

Key factors in MOC management are complete risk assessment, mitigation measures and adequate follow-up actions. A longer research period is required to recommended to perform a continuous research on MOC to discover more significant features and action items to establish a lesser weakness and flawless MOC process. It is recommended that return of investment (ROI) and detail steps on follow up action to be added into MOC framework to expand the coverage of MOC in real lie practices. Adopted checklist could be improved by covering more detail in MOC issue. Management system software can be designed more perfectly with extra features to tackle more current issues in MOC.

In future research, it is recommended that this software to be made into centralized software which enable users to surf the system anywhere away from computer in office. Pilot testing can be implemented in further research to determine the reliability of risk assessment checklist and management system in real process plant.

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