EFFECTIVENESS OF SAFETY, HEALTH AND ENVIRONMENT PRACTICE IN MANUFACTURING INDUSTRIES: A CASE STUDY OF SPRAY BOOTH AREA AT SELECTED COMPANY IN KOTA DAMANSARA, SELANGOR

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SUBMITTED IN PARTIAL FULLFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ENGINEERING

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Field of Study: **Environmental Management**

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ABSTRACT

These days, accident and health diseases related to work become well known as a major concerned to the industries involved in Malaysia. This problem normally happened to manufacturing industry's workers. The total number of organizations increased worldwide accommodate to this requirements of Occupational Health and Safety Management Systems (OHSMS). In Malaysia, the Occupational Safety and Health Act (OSHA, 1994) was made and the Occupational health and safety regulations enforce a punishment related to the unsafe working condition to the employer's non-compliance with the standards. Painting industries, the effectiveness of Occupational Safety and Health practice in Malaysia is generally lacking and needs to be strengthen. One way to measure its effectiveness is by conducting audit checklist and questionnaire in the selected company referring to the OSHA 1994. Therefore, this research aim to observe the effectiveness of safety, health and environment practice by using a set of audit sheet, analyse the waste water and identify the awareness level of worker on through a set of questionnaires. Initially this organization measure effectiveness total of 71% complied with Occupational Safety and Health Act 1994. The waste water is fulfilled the minimum Environmental Requirement of Department of Environment (DOE), Malaysia with temperature (24.5 ^{o}C), pH (6.8), Biological Oxygen Demand (6.8mg/L), Chemical Oxygen Demand (8.9mg/L) and suspended Solids (ND < 1.0mg/L). Unfortunately, there is a room for improvement on the awareness aspect when a moderate correlation between the knowledge and attitudes (Correlation = 0.419, n=50, P= < 0.002).

Abstrak

Pada masa kini, kemalangan dan penyakit kesihatan yang berkaitan dengan pekerjaan menjadi keutamaan di dalam industri yang berlaku di Malaysia. Masalah ini biasanya berlaku kepada pekerja industri perkilangan. Jumlah organisasi meningkat di seluruh dunia yang menggunakan Sistem Pengurusan Kesihatan dan Keselamatan Pekerjaan (OHSMS) ini. Di Malaysia, Akta Keselamatan dan Kesihatan Pekerjaan (OSHA, 1994) telah dibuat dan peraturan-peraturan kesihatan dan keselamatan Pekerjaan menguatkuasakan hukuman yang berkaitan dengan keadaan kerja yang tidak selamat kepada ketidakpatuhan majikan terhadap piawaian. Industri spray, keberkesanan amalan Keselamatan dan Kesihatan Pekerjaan di Malaysia pada amnya kurang dan perlu dikukuhkan. Salah satu cara untuk mengukur keberkesanannya adalah dengan menjalankan senarai semak audit dan soal selidik di syarikat terpilih yang merujuk kepada OSHA 1994. Oleh itu, penyelidikan ini bertujuan untuk mengamati keberkesanan keselamatan, kesihatan dan amalan alam sekitar dengan menggunakan set lembaran audit, menganalisis air sisa dan mengenal pasti tahap kesedaran pekerja melalui satu set soal selidik. Pada awalnya organisasi ini mengukur keberkesanan sebanyak 71% mematuhi Akta Keselamatan dan Kesihatan Pekerjaan 1994. Air sisa memenuhi keperluan minimum dari Jabatan Alam Sekitar (DOE), Malaysia dengan suhu (24.5 oC), pH (6.8), Oksigen Biologi Permintaan (6.8mg / L), Permintaan Oksigen Kimia (8.9mg / L) dan Pepejal yang digantung (ND <1.0mg / L). Malangnya, ada ruang untuk memperbaiki aspek kesedaran apabila ada hubungan yang sederhana antara pengetahuan dan sikap (Korelasi = 0.419, n = 50, P = <0.002).

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LIST OF SYMBOLS AND ABBREVIATIONS

BOD:	Biochemical Oxygen Demand
COD:	Chemical Oxygen Demand
CO:	Carbon Dioxide
DOSH:	Department of Safety and Health
EAP:	Emergency Action plan
ND:	Non-Detected
OSH:	Occupational Safety and Health
OHSMS:	Occupational Health and Safety Management Systems
OHS:	Occupational Health and Safety
OHSAS:	Occupational Health and Safety Assessment Series
PPE:	Personal Protective Equipment
PSM:	Process Safety Management
SDS:	Safety Data Sheet
SPSS:	Statistical Package for the Social Sciences
TOSHMS:	Taiwan Occupational Safety Health Management System
TSS:	Total Suspended Solid
VOC:	Volatile Organic Compounds

CHAPTER 1: INTRODUCTION

1.1 Background of the study

These days, accident and health diseases related to work become well known as a major concerned to the industries involved in Malaysia. This problem normally happened to manufacturing industry's workers including paint industries that involved in different kind operation of production equipment and handling machine that is very much associated with the issue of the safety and health awareness.

As we all know, the paint manufacturing is the most hazardous industries as the workers are exposes to paint hazards. There are a lot of hazardous and volatile chemicals used such as alcohols, pigments, lead, fatty acids and ethers. As mention by Aras (2002), the risk in chemical process industries for example fire and explosion, ergonomic hazards and toxic chemicals exposure and dispersion also take place in the paint industries. In an effort to encourage the development of safety and health workplace as an endeavour by the organization, workers need to perform their everyday operation in a safe and correct manner.

The total number of organizations increased worldwide accommodate to this requirements of Occupational Health and Safety Management Systems (OHSMS). These enterprises exploited OHSMSs because of anticipated affirmative effects of the systems on the performance of Occupational Health and Safety (OHS) (Frick, 2011). Since its publication in 1999, the Occupational Health and Safety Assessment Series (OHSAS) 18001 standard known as Occupational Health and Safety Management System (OHSMS) and has derive substantial effects of the system acceptance worldwide (Chang, 2009). However, a huge number of organizations are acquired the requirements of OHSMSs, their effectiveness is still no clear general agreement (Goh, 2013). Statement from (Ma, 2001) stated that safety management system implementation like Process

Safety Management (PSM), OHSAS 18001 or Taiwan Occupational Safety Health Management System (TOSHMS) toward the organized and prospering management of safety work as the first step, yet no change in safety problems. Many organization blindly prosecute the certification yet neglect to carry on the audit or measure the performance nicely.

In Malaysia, the Occupational Safety and Health Act (OSHA, 1994) was made by considering the fact that the Factories and Machinery Act (FMA) 1967 that only covered the work related to safety and health in manufacturing, construction, quarrying, and mining industries, through others industries were not covered. The OSHA 1994 scope covers all works in both private and public sectors exception of the board ships and military forces. The Occupational health and safety regulations enforce a punishment related to the unsafe working condition to the employer's non-compliance with the standards.

To protect and ensure the occupational health and safety of the workers working in the unsafety and danger area, the objectives of OSHA 1994 are to secure workers at the workplace against risk, to promote an occupational safe environment for the employee which adapt to their physiological and psychological needs and to provide the means whereby the associated occupational safety and health legislations can be gradually change by a system of regulations and endorsed industry code of practice.

1.2 Problem Statement

Based on previous study by Das (2008), stated that the industrial accidents are closely related to the type of material, prevailing work environment and task given. Accident-causing factors which is most important are (1) prevailing environment (chemical exposure, dust, poor lighting and noisy), (2) nature of work (shift work, repetitive, physical workload and fatigue). (3) handling machine, manual and postural stress). (4) ergonomics (repetitive motions and work design), (5) machine (operator-pace, machine-pace, machines and dangerous tools, (6) training (on-the job training and formal training), (7) maintenance (culture, poor housekeeping, poor maintenance, lack of supervision and psychosocial environment) (8) plant layout (machine organization and work flow), and (10) safety climate (safety system and management commitment) and the risk posed by each these factors may different from each factory.

Surveys conducted during the spray painting process found that large number of population experience headaches and feeling of lethargy, eye and respiratory irritation in industrial area of painting process with low indoor air quality (Kim, 2000). Thus, standard and regulations are required to control the organic vapour pollutants in air, wastewater and environmental aspect, standards and regulations are required to limit and control the vapour emissions. Referring to Jamal (2006), ignorant attitudes and behaviour from the employer and employees contribute to increase the behavioural safety non-compliance.

Currently, in painting industries, the effectiveness of Occupational Safety and Health practice in Malaysia is generally lacking and needs to be strengthen. One way to measure its effectiveness is by conducting audit checklist and questionnaire in the selected company referring to the OSHA 1994.

1.3 Aims and Objectives of the study

The research aims to examine the procedure of spray booth in selected manufacturing company in Kota Damansara. In realising this aim, three objectives were decided as listed below;

1. To observe the effectiveness of Safety, health and environment practice by using a set of audit sheet focussing in spray booth area.

2. To analyse the waste water quality in spray booth by measuring the parameter of pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Suspended Solid (TSS).

3. To identify the awareness level of workers on through a set of questionnaires to prepare recommendations to improve any weakness or non-compliance.

1.4 Scope of the study

This research was conducted in a selected manufacturing companies in Kota Damansara to examine the effectiveness of Occupational Safety, Health and Environment followed procedure and compliance to standard and regulation at the specific spray booth area. Major task is focussing on the analysis of audit checklist, water analysis and identify the awareness level of workers at the workplace based on questionnaires.

CHAPTER 2: LITERATURE REVIEW

2.1 Case study In Malaysia: Safety in Occupational Safety, Health and Environment in Malaysia

Accident occurred at their workplace by unsafe performance, hence good attitudes is very important controlled by every individual to demonstrate safety behaviour (Mullen, 2004). Referring to Table 2.1, total number of accidents and types of accident in Malaysia recorded from year 2012 to 2016. Total number of accident significant increase by 24.90% from year 2012 to year 2016. Also total number of death and non-permanent disability showed significant increase recorded for all sectors. For total number of permanent disability recorded significant decrease 43.7% in 2012 to 2016 for all sectors. (DOSH, 2016).

Table 2.1: Total number of accident and types of accident reported

(Department of Safety and Health, 2016)

Years	Total Accident Reported	Death	Permanent Disability	Non-Permanent Disability
2012	2780	191	207	2382
2013	2826	185	165	2476
2014	2805	204	145	2456
2015	3344	213	122	3009
2016	3702	240	144	3348

The highest number of accident in manufacturing sector has been recorded from 2012 to 2016 increase by 26.2% as shown in Table 2.2.

Table 2.2: The total accident reported in all sectors

(Department of Safety and Health, 2016)

Sector	**2012**	**2013**	**2014**	**2015**	**2016**
Manufacturing	1722	1655	1667	2040	2333
Agriculture, Forestry, Logging and Fishery	446	535	492	480	471
Construction	177	164	172	237	233
Transport, Storage and Communication	95	93	102	131	130
Utility	94	108	70	96	75
Wholesale and Retail Trade	73	78	83	108	109
Financial, Insurance, Real Estate and Business Service	62	71	74	119	126
Public Services and Statutory Bodies	54	67	26	32	110
Mining and Quarrying	42	35	62	39	25
Hotel and Restaurant	15	20	57	62	90
Grand Total	2780	2826	2805	3344	3702

This shows that manufacturing area are presented to high possibility accidental danger compare to other sector. Also, this table pattern can be concluded that accident reports varies compared from one sector to another sector, reflecting the different hazard crosswise over all sector.

2.2 Factors contributing to practices of safety culture in organizing in risk and hazard

According to Cox, (1998) there are three characteristics that define great safety culture which is rules and norms handling with risk; safety attitudes and reflexivity. It can be explained as usual practice in managing risk and hazards, which different according to people attitude and organizational importance towards safety (Chauvin, 2007). Several assessment tools for various sectors for factors contributing to the safety practice. Refer to Table 2.3 shows that various tools that have been used in petrochemical, oil and gas, nuclear power industries and also railway (Health and Safety Executive, 2005). In the study of Occupational Health and Safety Practices in the Petrochemical Industries of Malaysia, has used as Malaysian Safety Tool Kit (MSTK) (Isha, 2012). To assess the join of individuals attitudes, work environment and perception towards management commitment, this MSTK has been used. These factors model has contributed to Occupational Health Safety (OHS) analysis and practice substantiating its constancy as an instrument. Safety priority, management, involvement, safety management personal views and supportive environment as influential factors of safety practices in Malaysian construction and manufacturing sectors (Ramli, 2014).

Table 2.3: Assessment tool of factors contributing to the safety culture practices

(Health and Safety Executive, 2005)

Tool	Factors	Sectors	References
Aberdeen University Offshore Safety Questionnaire (OSQ99)	-Communication -Safety behaviour -Involvement in safety -Attitudes to safety -Satisfaction with safety activities	Offshore, gas, as well as power generating industries. Other industries also applicable	Health and Safety Executive (1999)
HSE Health and Safety Climate Survey Tool (CST)	-Organisational commitment and communication -Line management commitment -Personal role -Workmate's influence -Supervisor's role -Competence -Risk taking behaviour and some contributory influences -Permit-to-work system -Reporting of accidents and near misses	Industry sectors, including oil and gas companies. It is used to assess managers, supervisors and the workforce.	Rail Safety and Standards Board (2003)
Safety Climate Assessment Toolkit	-Communication -Management Commitment -Safety rules -Priority of safety -Personal priorities and need for safety -Supportive Environment -Personal appreciation of Risk -Involvement -Work Environment	Offshore environment	Cox (2000)
Malaysia Safety Tool Kit, 2012	-Safety management & environment -Involvement -Safety priority -Management Commitment -Personal Views -Supportive Environment & Communication	Malaysia petrochemical	Isha (2012)
Serco Assurance Safety Culture Assessment Tool	-Management & Organizational Factors -Individual Factors -Enabling Activities	UK Nuclear, Eastern European Nuclear, Railway, Oil and Gas Industries	Rail Safety and Standards Board (2003)

2.3 Effective Safety Management System

In the growth of firms in manufacturing sector, the safety management system plays an important role because many firms conclude that the effective safety management system implementation can improve safety performance. According to Makin (2008) who support this idea stated that the critical success factors of an effective safety management system can be explained as the best ways which both the firms and their employees attempt safety activities in all key processes. Table 2.4 shows 6 critical success factors for the effectiveness safety management system.

Table 2.4: Critical success factors

Critical success factors	Description	Reference
Management Commitment	High commitment from manager should be showed through attitudes and practice involving the safety operation, so their employees can see clearly.	Neal (2002)
Employee Involvement	Organizations should endorse employee's safety and health activity such as accident review, self-inspection, worksite analysis, training and hazard training & control.	Punnett (2009)
Safety communication	Two way communication by coverage and impact of communication approached is accustom, can lead to high behavioural personally.	Vinodkumar (2010)

Safety training	Effective safety management system that provides means to make good workplace more foreseeable.	Vinodkumar (2010)
Safety Champion	Main role of a safety champion in the implementation of safety management system is to establish a positive safety culture that helps promote employee involvement at all levels of the organization.	Flynn (2011)
Government Regulation	Government regulations and their enforcement through internal control management can improve safety behaviour of workers and result in accident rate reduction and working days lost	Vinodkumar (2010)

2.4 Environment Impact on painting process

By referring to Table 2.1, total of four main ingredients consists in the traditional automobile paints are carrier, resin, additives and pigment (Frye, 1997). The carrier could be either water or solvent transform it into two most used paint types in automobile industry which are waterborne and solvent borne respectively. Solvent borne paints carrier are; epoxies, urethenes, acrylics and polyester (Frye, 1997). On the other hand, waterborne paints used mutual solvent carrier of acrylic and polyester. Primary resin used in waterborne paints include epoxies, acrylics, polyurethanes, alkyds/polyesters, and alkyd emulsions (Busato, 2002). However, color and additives are from the pigments, e.g thinners. For fast drying properties, solvents are used as carriers and its formulations are

the main source of stiff smell and main source of VOC emissions. Development have been done for waterborne paints as another option with lower VOC emissions but waterbourne formulations still contains up to 15% solvents (Geldermann, 2007).

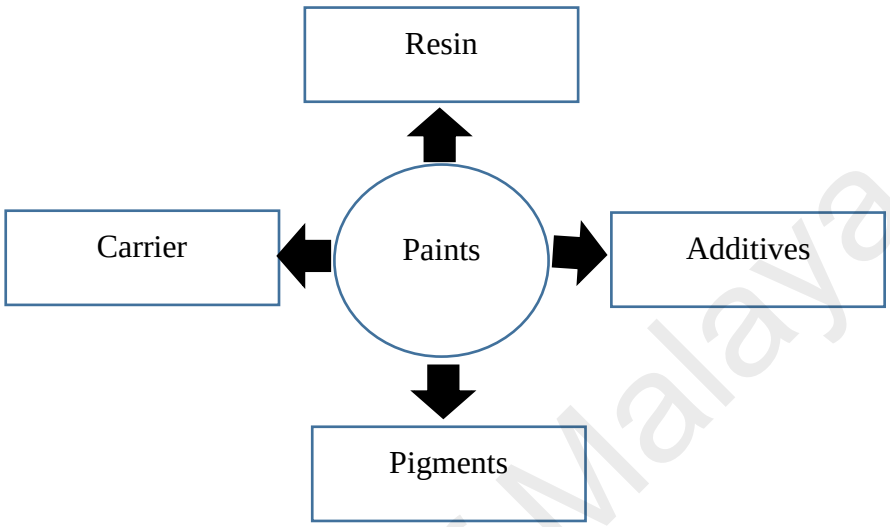

Figure 2.1: Main components of automobiles paint

The painting phase is the most affected because of the stricter regulations in automobile industry for the emission of the volatile organic compounds (VOCs). According to Papasavva (2001) the superlative environmental burden among all the phase an automobile is the printing process. Emission from automobile manufacturing, almost 80% to 90% has been related with painting phase (Geffen, 2000).

Additionally, the emission of VOC from the printing activities that cause environmental impact consists; PM, NOx, CO2, VOCs, CO including the liquid waste and solid waste (Pappasavva, 2001).

There are several methods done by researcher to investigate and predict the expose of paint solvent. For example, a multivariate regression models method to predict solvent exposure during bridge painting (Qian, 2010). By using survey and experimental analysis of hexavalent chromium, Kim (2011) determined that 46 years old man who have been

15 years working at a bumper spray painter in automobile shop formed a lung cancer and cater the exposure analysis result to determine the lung cancer carcinogen.

2.5 Safety Training

An effective safety training is crucial to demonstrate employees on how to prevent accidents, potential accidents and hazards related to their work task. The education program and training show a powerful role to enhance safety in construction while increase the level of safety awareness (Ghani, 2010). Moreover, change the behaviour of employees on safety (Wong, 2000).

Normal root cause of accidents are lack of education, knowledge and skills to identify the potential hazards at site is because of inadequate safety training (Toole, 2002).

2.6 Personal Protective Equipment (PPE)

There are many types of PPE used in industries. The employer need to supervise their employee to ensure the compliance of activities with the rules and regulations. A respirator is one of the personal protective equipment (PPE) to protect the workers from accident and hazards. Study done by Lombardi (2009), shows most of the problems associate with PPE is lack of fit and comfort when 62% of respondent feel uncomfortable due to the shape and size. Hence, different kind of respirators should be design and available for the workers to choose. Facial fitting related to shape and size of the face was a problem. Study by Zhuang (2010b) have conducted a face and head anthropometric survey to identify the facial variability component to civilian respirator.

2.7 Water quality

Industries always find ways to decrease or treat their waste water in their financial allowable because of the demanding environmental regulation to attain permissible discharge levels. According to Chacon-Torres, (2002), water quality are define as physical biological and chemical characteristic of water that measure through the parameter. The level of water quality is influence by man-made sources and natural causes which include geographic factors, geologic formation and vegetation. Understanding of the factor that affect water quality parameter by the analysis from data collected over-time are essential (Smith, 2004). Some of the parameter to measure at the affected area because of inefficient discharge are pH, temperature, BOD, COD, suspended Solids, Chromium hexavalent, manganese, copper and etc.

Water Quality Parameters

Various parameter pertains to the water quality parameter required by Department of Environment (DOE) in Malaysia, was define to get the level of pollution that contain pH, Biological Oxygen Demand (BOD), Chemical Oxygen Demand, Total suspended solid (TSS), Ammoniac Nitrogen (NH3-N), Chemical Oxygen Demand (COD) and others parameter.

pH

The main role for biological life is pH to guarantee they survived or not in the water bodies. Acidity and alkalinity of the water normally affected by the present of mineral salt which is phosphate, chloride and sulphate (Chipman, 1934). In addition, Train (1979) conclude that the normal range for the water in rivers should between 6.4 and 8.3, and also acceptable range for most aquatic species survived. In general, pH 7 value are neutral.

Temperature

To control of the rate of reproductive and metabolic activities in aquatic life, temperature plays a very important factor. Wastewater discharge, agricultural discharge, water flow rates and sunlight are the factors that affect the temperature (Kozar, 1996).

Chemical Oxygen Demand (COD)

COD is the parameter to determine the quantity of organic and inorganic oxidizable compound in water. It can also measure the capacity of water that used oxygen during the oxidation of inorganic chemical and decomposition of organic matter. High COD concentration in the wastewater can stimulate considerable change to aquatic live. This COD test only takes 150 minutes to complete the test as the main benefits compare to BOD that need at least 5-days to complete.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter will explain methods used for completing this research. It includes the site visit to the area of study and collection of qualitative and quantitative data. For the qualitative data are based on observation of the area and interview workers face to face method for ease of the audit checklist construction. For the quantitative data including the conduction audit and distribute the questionnaire. Also, laboratory analysis to analyse the waste water compliance to the Environmental Quality (Sewage) Regulation 2009.

3.2 Audit Checklist

An essential step to observe the effectiveness of Safety, Health and Environment practice at the manufacturing company is by using a set of audit sheet. By performing the Safety, Health and Environment (SHE) audit, it is a good idea to identify all the possible pitfalls and area need to be improve.

A walk-through survey has been done at selected manufacturing company with the purpose investigating the process flow, company layout and observed the daily routine of process at the company. A checklist has been developed based on the findings of the walk-through survey by referring to the requirement listed in OSHA 1994, adapt from Lay (2006). (Appendix A).

There are three main components and under each component there is sub-component;

1. General facility Component;

    a) Housekeeping / work environment

    b) Emergency safety health information

    c) Fire emergency and fire prevention

2. Environmental Component;

    a) Clean Air Act Compliance

    b) Clean Water Act Compliance

    c) Hazardous / Non-Hazardous Waste

3. Safety Component;

    a) Employee work practice

    b) Electrical equipment

    c) Ergonomics

    d) Forklift/Industrial trucks

    e) Emergency health and safety equipment

    f) Personal protective equipment

Observation and audit by using a set of audit sheet conducted to all the workers based on compliance to Law of Malaysia Act 514; OSHA 1994 and Environmental Quality (Clean Air) Regulations 2014 or any related Malaysia Act and Regulation. Result from the audit findings being analyse further to obtain the percentage of compliance to the standard and level of effectiveness towards safety, health and environment to the organization.

3.3 Water Quality

The water samples were collected randomly from the spray booth 2, at Plant No 2 as illustrated in layout Figure 3.1 during daily production process. These water samples taken for three replications to prevent an error reading from the water sample, taken at the final discharge of spray booth as shown in Figure 3.2.

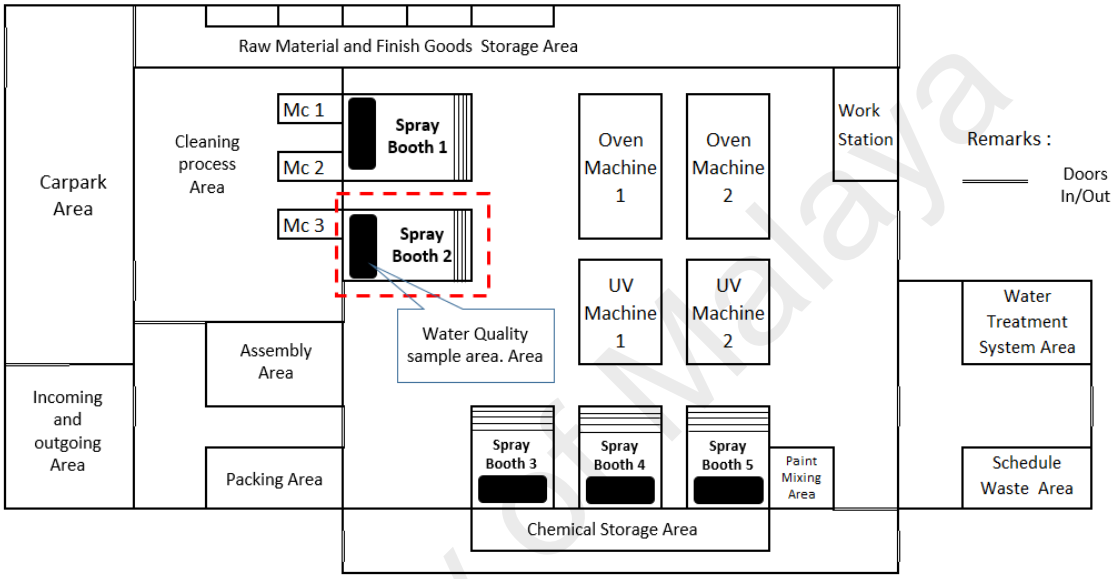

Figure 3.1: Floor plan of water sampling of spray booth 2 (Plant 2)

Figure 3.2: Location of water sampling of spray booth

About 1.5 to 2.0 litre of water samples were taken by using a clean container (polyethylene bottles) and immediately sent for tested in the laboratory for physico-

chemical parameter analysis as shown in Table 3.1. Temperature and pH values were tested on site with 3 replicates. The laboratory test was conducted to measure the Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Suspended Solid (TSS). All the test method or equipment follow the American Public Health Association (APHA) (2005). Details test are mention in Table 3.1;

Table 3.1: Water Analysis Test Parameter

Parameter	Unit	Spec	Method or Equipment Used
Temperature	^{o}C	40	APHA 2550 B (2005)
pH	-	5.5 – 9.0	APHA 4500 H+B (2005)
BOD	mg/L	50	APHA 5210 B & APHA 4500 – O G (2005)
COD	mg/L	200	APHA 5220 D (2005)
Suspended Solids	mg/L	100	APHA 2540 D (2005)

Based on the result in Table 3.1, the acceptable conditions of Sewage Discharge of Standard B were being compared with Environmental Quality (Sewage) Regulations 2009, Second schedule (Regulation 7) referring to Environmental Requirement of Department of Environment (2010).

3.3 Questionnaire

The questionnaire divided into two sections (Appendix B). Section A are data about demographics of respondents, and section B is about awareness level of Occupational Safety, Health and Environment cover three element which are knowledge, attitudes and practice. Each element consists of five questions. For section A, there is few answer that respondent can choose, whereas for section B, there are questionnaire need to answer by respondent based on Likert scale which is given 5 scales from scale 1 (strongly disagree) to scale 5 (strongly agree). This questionnaire will be handed out to 50 out of 200 respondents taken from the spray booth area only. Sampling method used in this research are based on systematic sampling techniques which is a form of random sampling. The questionnaire will be answer by respondent based on their level of experience, level of knowledge, attitudes and practice that can contribute to the effectiveness of the safety health and environment.

3.4 Data Analysis

Data acquired from the observation, interview and audit have been analysed to determine compliance to standards and regulation towards the effectiveness of Occupational Safety, Health Environment practice

All the collected data from the questionnaire have been analysed by using Statistical Package for the Social Sciences (SPSS) version 23. A descriptive analysis was taken together with non-parametric analysis. For section A, the determination of the demographics of the respondent, statistical method that will be used are frequency and percentage. For section B, the statistical comparison of average percentage of each element between agree and disagree will be analyse. Further, the determination of relationship between any two variables (Knowledge-Attitudes-Practice), correlation test will be tested.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1 Safety, Health and Environment audit result

Safety, Health and Environmental audit by using a set of check list has been conducted thoroughly at the spray booth area which involved technical manager and all workers. The audit checklist was categorized into three components and their sub-component which include the first, general facility component; housekeeping / work environment, emergency safety health information and fire emergency and fire prevention. Secondly, environmental component; Clean Air Act Compliance, Clean Water Act Compliance and Hazardous / Non-Hazardous Waste. And last component is safety; employee work practice, electrical equipment, ergonomics, forklift/Industrial trucks, emergency health and safety equipment and personal protective equipment.

4.1.1 General Facility Component

By referring to (Appendix A) under housekeeping / working environment component, there are seven questions were listed, 100% measures have been followed and complied. They implemented good housekeeping procedure at the organization. No any obstruction was found along their workplace and free from tripping hazard that can contribute to accident and unwanted accident. Canteen and locker were provided at the outside of the organization for the workers to eat and drink and stored their personal item.

Out of seven questions were listed under emergency, health and safety information, 85.7% measures have been complied. Only one item which are not complied where there is no Emergency Action plan (EAP) copy are available at the area for employees to read. It is very important during workplace emergencies happen to assist and organize workers action toward emergencies. For information, EAP is written document needed by particular OSHA standards. However, other information regarding hazard sign, fire sign for evacuation plan and routes are clearly visible and understandable

by all the workers. Clear safety explanation and practice were given by their supervisor to all the workers.

For the fire emergency & fire prevention measures, 100% have been followed according to the guideline and complied. Fire extinguisher are being charged and inspection updated every year and easy accessible if fire happened. The fire extinguisher and hoses hung followed the minimum standard clearance of 24 inch between the sprinkler head and material storage or position beneath them. Emergency lighting exit, fire doors and shutter are in good condition and fully functional. Also, "No Smoking" areas have been enforced at several areas especially at the spray booth area by providing a specific area for the workers to smoke. It is because some of the solvent used in the paint is flammable solvent and easy to ignite.

4.1.2 Environmental Component

For the Clean Air Act Compliance and Clean Water Act Compliance measures, 100% have been complied respectively. There are no any solvent contaminated rags found lying about the workplace because they disposed correctly into the provided container. All open top solvent pump has been clearly removed from the workplace area and paint equipment including gun cleaning containers, solvent containers end empty containers are closed when not using it. The impact of paint to environment is various because of the paint materials and process itself can contribute to harmful effect to the environment. In addition, report of flue gas monitoring was conducted every three months by Environmental Science (M) Sdn Bhd. Results of dust particulate concentration recorded were 0.0006gm/m^3N and it is within the DOE License Approval Condition, 0.4 gm/m^3N.

The employees have been not to easily dump waste into the drains or sink without any authorization given. Also, no waste found outside the or in storm sewer or catch basin. However, there are still some unwanted rubbish found in the storm sewers. This

can contribute to the unsmooth water flow in the storm sewer. For the spray booth, waste water used were being recycle and ongoing treatment process before it is being discharge. Water curtain flow have been used to accumulate paint particulates from overspray. By filtering and separating paint sludge from this water curtain, they can reduce the need for purging chemicals, control cleaner fluid and dependable production by removing the manufacturing downtown.

The percentage of compliance for the hazardous / non-hazardous waste at the organization are only contribute 21.4% as there are not enough attention and followed the guidelines given to the storage area, identification, signage of chemical labels, controlled, segregation and disposal of the hazardous / non-hazardous waste correctly. The storage area was found available at the workplace. However, there is no clear identification of the storage area because of the no safety lock at the specific area for hazardous waste and non-hazardous waste. The area is easily to access by all workers at the workplace. Under Regulation 9(4) of the Environmental Quality (Schedule Wastes) Regulations 1989, the storage area of the container shall be design, constructed and maintained adequately. The reason for a good storage area is to avoid unnecessary direct exposure and also to avoid leakage or spillage of schedule wastes into the environment.

The controlling the hazardous waste were not properly managed and segregated. The waste was not properly stored on a pallet instead on the floor, no proper packaging was used for the waste. They used to recycle paint tin to store the waste for example sludge of paint from SW416 and recycle carton box for contaminated rags from SW410. It is best to used plastic clamp-lid drums for the inorganic solids sludge suggested packaging for the waste type in Malaysia.

Figure 4.1: No proper packaging of Hazardous and Non-Hazardous Storage

Under regulation 9(1) of the Environmental Quality (Schedule Wastes) Regulations 1989, stated that all scheduled wastes to be stored on container which are able to avoid spillage or leakage of the scheduled wastes into the environment. For the hazardous waste containers were not clearly identified, marked and label properly.

Figure 4.2: No proper marked and label of each box of waste

Based on interviews with the workers, the waste generated and method of disposal at the workplace are not familiar with them since no training regarding this hazardous waste were given and conducted. For the wasted removed within the schedule were not on time yet were delays for several weeks from the date given.

All the Safety Data Sheet (SDS) were available from the supplier. SDS is important component of occupational safety and health and product stewardship and also spill-handling procedures. However, the employees were not familiar with SDS since it is kept in the office and hard to refer when needed. Hence, they do not know how to read and used the SDS.

4.1.3 Safety Component

Employee work practice have been measures and the result shows in (Appendix A) 50% complied. The Job Safety Analysis (JSA) information for infrequently, high value or risk task have been done, yet there is no reference to refer to and clearly display to the workers. Hence, they do not know the basic step of the job to identify the potential hazards that could happen and recommend the safest way while doing their job. However, for the employee work practice, employee with long hair especially the female workers being tied up nicely to avoid any accident and defects to the products.

For the electrical equipment at the organization to operate the spray booth and other machines, there are only 60% measures have been complied. In term of the electrical equipment safety, the electrical panels and electrical cords across walkways were not fully protected and covered. The purpose of the protection system is to reduce the equipment damage, prevent electric shocked and injuries. The hazard can be related with electricity are electric shock, fire and flash. For others electrical equipment, no major hazard could be found. There is clear indicator and switch panel being marked, exposed wiring being repaired immediately and all operated equipment were grounded effectively. Based on

Ali (2009) that occupational injuries and accidents will raise due to ineffectiveness of safety training.

Safety ergonomics measures, 100% have been complied since there is no ergonomics problem at the workstation, lifting techniques available of mechanical lifting aids for awkward and heavy items. The workstation design of the spray booth were design ergonomically to fit the workers while doing spray process. For loading and unloading heavy items, a proper lifting techniques and mechanical lifting aids were available to the workers. However, need some improvement at the mixing paint area to provide a good ergonomic workstation including chair and table for the workers to do the mixing process.

Operation of the forklift or industrial trucks being measures that complied only 33.3%. This is because the records show that there is no qualification and licence Class F to drive the forklift by the competent operator. This can result to major accidence since they do not know how to handle, parking and controlling the forklift according to the rules and regulation. Also, they do not perform any daily inspection prior to first used and complete the log entry prior to their safety. It is recommended that the workers need to take licence Class F and attend course which will train the safety precaution, engineering and technology principle, operation rules and maintenance.

Almost 75% measure complied for the emergency, health and safety equipment. All the emergency equipment distinctly marked and labelled, spill kit and first aid kits available and reachable by the employee. However, the one of the most important equipment which is the emergency eyelash or shower station are not available at the spray booth area. This station is vital for every workplace that uses chemicals and hazardous substance needs to reduce workplace injury and avoid workers from dangers.

Only 25% which accounts for two out of eight questions were fulfilled for the personal protective equipment (PPE). There are available for the proper safety googles,

facemask and proper gloves (nitrile and leather). Unfortunately, there are no available for the safety hats, approved respirators provided for regular or using during working and emergency by the workers. They seem to not wearing a proper PPE such as safety googles, face masked and gloves while doing their spray process. If they wore a face mask or respirator properly, it helps to blocked large particle droplets splatter, splashes and spray from your mouth and nose. Also, PPE were not stored properly, cleaned and inspected before they used.

Overall for the compliance to the Environmental, Health and Safety audit results showed that this organization measure overall total of 71% effectiveness complied. For highest 100% complied of Occupational Safety, Health and Environment practice, were contribute from housekeeping, clean air act compliance and clean water act compliance. On the other hand, for the least compliance with Occupational Safety, Health and Environment practice is Hazardous / Non-Hazardous waste compliance (21,4%), safety personal protective equipment (25%) and on forklift / industrial trucks (33.3%).

4.2 Water Quality Result

The result of the water quality analysis was present as below Table 4.1. From the analysis we can conclude that all the parameters are within the minimum specification and requirement based on Environmental Quality (Sewage) Regulations 2009, Second schedule (Regulation 7) standard including temperature is normal at 24.5 ^{o}C, pH is neutral with 6.8, BOD and COD is lower with 2.8 mg/L and 8.9 mg/L respectively. However, for the suspended solids non-detected (ND) found in the final discharge waste water from the spray booth.

Table 4.1: Water Quality Analysis result

Test Description	Unit	Result(s)	Specification
Temperature	^{o}C	24.5	40
pH	-	6.8	5.5 – 9.0
BOD	mg/L	2.8	50
COD	mg/L	8.9	200
Suspended Solids	mg/L	ND < 1.0	100

Most important characteristic that determines the acceptable trends of charges in the water quality is temperature. It also important for the biochemical and chemical to react and it is one of the factors influence the water quality. When temperature increase, it can also affect the lower of oxygen content. Based on Department of Environment (DOE) standard is below 40^{o}C. Most major environmental factor of aquatic ecosystem at the interface of biological and physiochemical is pH. It represents an effective concentration of of hydrogen ion in water. For BOD parameter, it is used to determine the oxygen demand on the receiving waters from industrial discharge or municipal area. Based on Hooda, (2000) stated that the BOD will remain within the range natural water when there is no rainfall unless the effluents are discharged directly in to the stream. In addition, for the COD is an important signage of organic pollution and it can decrease the substance in surface water (Aoki, 2004). One of the parameters contain in water quality is Total Suspended Solid. It can be trace in the water column from its movement. The lower value of TSS can increase the light passage which can result the faster photosynthesis of plants in aquatic.

4.3 Questionnaire result

A total of 50 workers had successfully responded and completed the survey from the company. Table 4.2 shows that most of the workers were male (68%), around the age between 20 ~ 29 years old (46%) and married (58%). Highest workers education at least high school which is total of (52%) followed by diploma (32%) and degree (16%). Meanwhile, majority total of years of working in the organization between 1 ~ 5 years is (58%). Workers citizenship are (100%) Malaysian and only local workers.

Table 4.2: Demographic Characteristics of Respondents

No	Characteristic	Percentage (%)
A1	**Gender**	
	Male	68
	Female	32
	Total	100
A2	**Age**	
	< 20	8
	20 ~ 29	46
	30 ~ 39	28
	40 ~ 49	16
	> 50 years	2
	Total	100
A3	**Marital Status**	
	Single	42
	Married	58
	Total	100
A4	**Highest Education**	
	< High school	26
	High school	26
	Diploma	32
	Degree	16
	Others	0
	Total	100
A5	**Total years of work in your organization**	
	< 1	8
	1 ~ 5	58
	6 ~ 10	18
	> 10 years	16
	Total	100
A6	**Citizenship**	
	Malaysian	100
	Foreigner	0
	Others	0
	Total	100

Firstly, based on Table 4.3, summarize the responses of 5 question related to knowledge towards awareness level of Occupational Safety, Health and Environment. Total average knowledge (57%) that most of the workers agreed and thought they understand their roles and responsible towards safety, health and environment at their workplace (66%), know what to do and precaution while doing their work (60%), know what safety data sheet is (59.6%) and know how to read the sign and label of chemical used (66.7%). However only (33.3%) know the effect of pneumoconiosis (dusty lung) to their health.

Table 4.3: Knowledge towards Awareness level of Occupational Safety, Health and Environment

No	Statement	Agree (%)	Disagree (%)
1	I understand my roles and responsible towards safety, health and environment at my workplace.	66.0	33.0
2	I know what to do and precaution while doing my task.	60.0	40.0
3	I know what Safety Data Sheet is	59.6	40.4
4	I know how to read the sign and label of chemical used.	66.7	33.3
5	I know the effect of pneumoconiosis (dusty lung) to my health	33.3	66.7
	Average	55.1	42.6

Secondly, based on Table 4.4, summarize the responses of 5 question related to attitudes towards awareness level of Occupational Safety, Health and Environment. Total average attitudes (84%) agreed to take safety at their workplace seriously (84%), reports any workplace hazard that can't be fix to management (84%), will managed and segregate

schedule waste properly (72%), always used required personal protective equipment (PPE) (86%) and they don't dump and waste into the sink or drains (94%).

Table 4.4: Attitudes towards Awareness level of Occupational Safety, Health and Environment

No	Statement	Agree (%)	Disagree (%)
1	I take safety at my workplace seriously.	84.0	16.0
2	I will reports any workplace hazard that can't be fix to management	84.0	16.0
3	I will managed and segregate schedule waste properly	72.0	28.0
4	I always used required Personal Protective Equipment (PPE). Eg : Face mask, safety goggles, gloves etc	86.0	14.0
5	I don't dump any waste into the sink or drains	94.0	6.0
	Average	84.0	16.0

Thirdly, based on Table 4.5, summarize the responses of 5 question related to practice towards awareness level of Occupational Safety, Health and Environment. Total average practice (93%) agreed and practice that they always follow all the standard operation procedure (SOP) (86%), ensure all sources of ignition being eliminate (98%), do not smoke when spray painting in operation (100%), ensure any warning signal are in correct place (100%) and always practice good housekeeping at their workplace (80%).

Table 4.5: Practice towards Awareness level of Occupational Safety, Health and Environment

No	Statement	Agree (%)	Disagree (%)
1	I always follow all the Standard Operation Procedure (SOP).	86.0	14.0
2	I will make sure all sources of ignition being eliminate.	98.0	1.0
3	I do not smoke when spray painting in operation.	100.0	0.0
4	I will make sure any warning signal are in correct place.	100.0	0.0
5	I always practice good housekeeping at my workplace.	80.0	20.0
	Average	92.8	7.2

The significant Spearman correlation coefficient value of 0.419 confirms; is showed in Table 4.6 that correlation between the knowledge and attitudes are moderate. Hence, the medium value of knowledge is associated with medium attitudes values.

Thus, to determine the relationship between total 50 knowledge and attitudes values, a spearman's correlation was run. There was a moderate, positive monotonic correlation between the knowledge and attitudes (Correlation = 0.419, n=50, P= < 0.002).

Table 4.6: Correlation between Knowledge, Practice and Attitude

Domain		Knowledge	Attitude	Practice
Knowledge	Spearman's correlation	1.000	0.419**	-0.880
	Sig. (2-tailed)		0.002	0.543
	N	50	50	50
Attitudes	Spearman's correlation	0.419**	1.000	-0.143
	Sig. (2-tailed)	0.002		0.322
	N	50	50	50
Practice	Spearman's correlation	-0.088	-0.143	1.000
	Sig. (2-tailed)	0.543	0.322	
	N	50	50	50

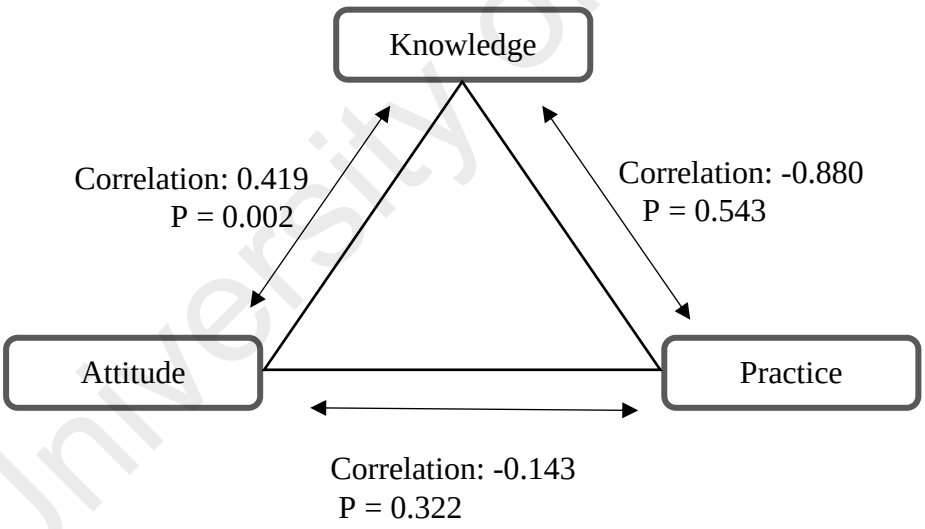

Figure 4.3: Summary of Correlation between knowledge, practice and attitudes

The significant Spearman correlation coefficient value of 0.-0.880 confirms; is showed that no correlation between the two variables. Hence, negative value of knowledge is associated with negative practice values.

Thus, to determine the relationship between total 50 respondent to the spray booth area only, knowledge and practice values, a spearman's correlation was run. There was a negative, no monotonic correlation between the knowledge and practice (Correlation = -0.880, n=50, P= < 0.543).

The significant Spearman correlation coefficient value of -0.143 confirms; is showed that no correlation between the two variables. Hence, negative value of attitude is associated with negative practice values.

Thus, to determine the relationship between total 50 attitude and practice values, a spearman's correlation was run. There was a negative, no monotonic correlation between the attitude and practice (Correlation = -0.143, n=50, P= < 0.322). All the summary of correlation between knowledge, practice and attitudes can be refer to Figure 4.2

Many organization take for granted for the safety and health practice issues referring to safe work environment as an important issues. This will lead to higher accident and occupational at workplace. While doing their works, all the employer need to have an excellent responsibility in handling their job. In manufacturing sector, important role in the growth of organization is the safety management because of many organization conclude that effective of safety management system implementation can increase their safety performance. The idea support by Makin (2008) that critical success factor of an effective safety management system can be conclude that the best ways in which company and employees include all the safety activities in all key process.

This study also to investigate the awareness and compliance with the Occupational Safety and health in selected group of workers in the manufacturing industry. Among the knowledge, attitudes and practice, the respondents are more concern about the good attitudes and practice and least concern about the knowledge awareness.

However, general awareness of occupational safety and health in employers was almost lacking although we are in economic development. Previous studies by Liu (1990), stated that, one of the main causes that cannot be control for occupational injuries in employers and employees is the limited knowledge and the importance of occupational safety and health.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Based on audit checklist analysis, all the general facilities are compliance with Occupational Safety and Health (OSHA, 1994). Result shows that the overall percentage of effectiveness is 71% complied with the regulation. From the audit result for each component for the general facility component found that overall 95% complied, environment component found overall 56% complied and safety component towards the safety elements are only complied 50%.

For the waste water analysis, all the parameters are within the minimum requirement of Sewage Discharge of Standard B were being compared with Environmental Quality (Sewage) Regulations 2009, Second schedule (Regulation 7) referring to Environmental Requirement of Department of Environment (2010). Result shows the temperature (24.5 ^{o}C), pH (6.8), Biological Oxygen Demand (6.8mg/L), Chemical Oxygen Demand (8.9mg/L) and suspended Solids (ND < 1.0mg/L).

There is a room for improvement when the awareness level of workers is acceptable between the knowledge, attitudes and practice. The results show there is medium value of knowledge are associated with medium attitudes values with the significant Spearman correlation coefficient value of 0.419. There was a moderate, positive monotonic correlation between the knowledge and attitudes (Correlation = 0.419, n=50, P= < 0.002). However, there are no correlation and negative values between the two variables knowledge are associated with negative practice values and also two variables attitudes and practice.

5.2 Recommendation

Several recommendation can be practice to improve effectiveness of occupational safety and health in the organization. The top management plays the important roles in the organization and need to put an extra effort to make more improvement and more effective. The role of top management is important to decreasing the accident or injuries to their workers while it is important also that the workers give full commitment to support the practice. The employer should conduct training frequently for example safety programs in order to decrease the workplace accidents and injuries by giving them briefing and introduction training about safety and health practice. To reduce the number of accidents in manufacturing company, employers should implement, follow and complied with all the procedure and guidance on safety and health at the workplace. Policy maker and government authorities should take efforts to implement Occupational Safety and Health management effectively challenge locally and globally,

For future work research can be continue by comparing the effectiveness of occupational safety and health practice to others industries such as electric and electronic industries, construction industries, food industries and many more. Also, this effectiveness can be compared with local and international industries to identify the difference and their similarity.

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