UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF INDUSTRIAL AIR POLLUTION MONITORING SYSTEM FOR SAFETY AND HEALTH ENHANCEMENT AND SUSTAINABLE WORK ENVIRONMENT IN SMALL AND MEDIUM INDUSTRIES (SMI's)

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Thesis submitted in fulfillment of a requirement
For the degree of
Doctor of Philosophy

Faculty of Mechanical Engineering

February 2011

ABSTRACT

The study is focused on the development of Industrial Air Pollution Monitoring System (IAPMOS) for small and medium industries application. The objectives of the study are to develop a system with special configuration on wireless data communications and able to analyze hazard and risk especially in welding process. The Quality Function Deployment (QFD) was used as a tool in the design the system. Questionnaires were distributed to the relevant personnel in manufacturing industries. Case study was carried out in two manufacturing companies located in Shah Alam, Selangor. Another case study on wireless data communication was conducted in the Walk-in Stability Chamber (WiSC) at Universiti Tun Hussein Onn Malaysia (UTHM). The system analyzed the data after save file and it is used the Hazard Risk Index (HRI) approach and the result on risk level were used Risk Classification Matrix (RCM) approach. The system features has warning sign (by colour) and buzzer to ensure the safety and health personnel gives attention to the outcome toxic gas data collection. The system can reach 150m length for accurate wireless data transfer. The IAPMOS can be used by the industries to create safe, healthy and sustainable work environment and reduce occupational diseases.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, the background of the research problem was explained. The introduction to safety and health issues in industries were identified and related activities discussed. Initially, it looks into major related economic development activities, social, and policy issues in the Malaysia scenario and how these issues are related to the safety and health problems. This chapter will discuss the problem statement for the study, based on the background provided, as well as the resulting research questions, objectives, limitations and the significance of the study. This chapter also highlighted the management of the whole thesis.

1.2 Background of the Problem

Malaysia is one of the developing countries with a population of 28.6 millions (Department of Statistics Malaysia). Malaysia's population in 1996 was 12.2 millions and having a labour force of 8.641 millions. The labour force growth was 4.6% and GDP growth was 10.00%, but in 2000 the population increased to 23.3 millions and

labour force increased to 9.573 millions, a growth close to 4.3% with 8.3% of GDP growth. Table 1.1 below shows Key Malaysian Economic Data from 1996 to 2005 extracted from the Malaysian economic report 2001/2002 and 2005/2006. (Department of Statistics Malaysia, 2005)

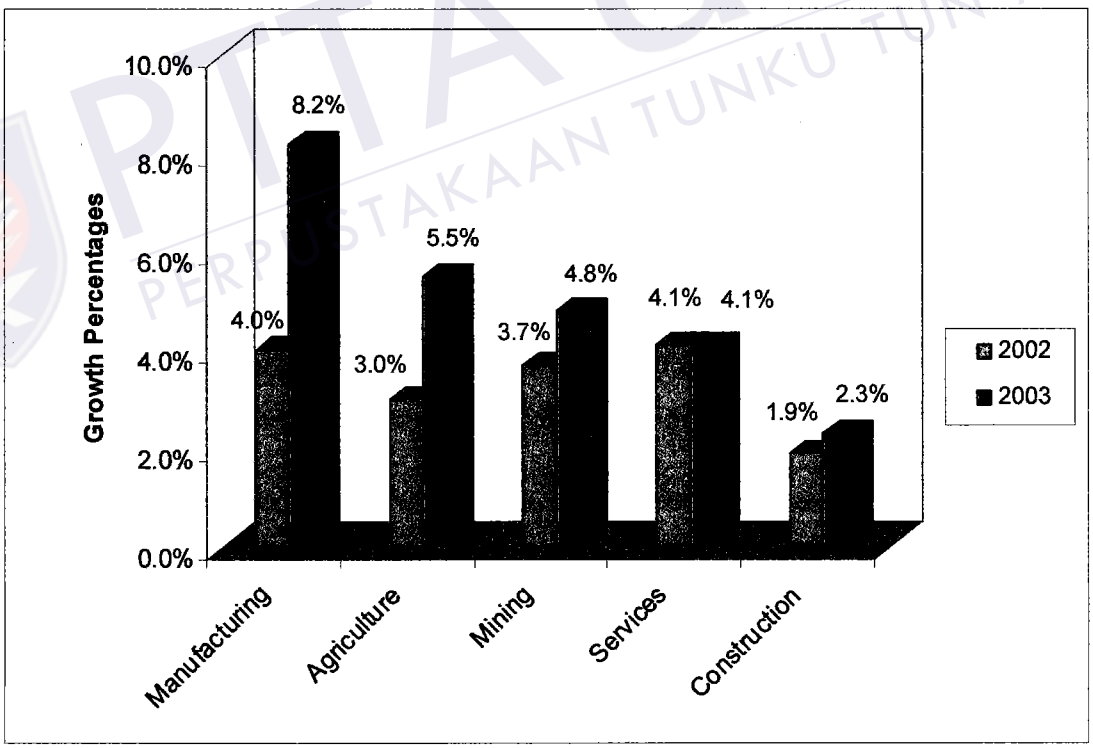
Table 1.1: Key Economic Data 1996-2005

Year	Population (million)	Real GDP (%)	Labour Force (thousand)	Labour force Growth (%)	Employment (thousand)	Employment Growth (%)	Unemployment (%)
1996	21.1	10.0	8,641.4	4.6	8,426.5	5.3	2.5
1997	21.7	7.3	9,038.2	4.6	8,818.8	4.7	2.4
1998	22.2	-7.4	8,880.9	-1.7	8,564.1	-2.9	3.2
1999	22.7	6.1	9,178.0	1.5	8,862.1	3.5	3.4
2000	23.3	8.3	9,573.0	4.3	9,271.2	4.6	3.1
2001	24.0	0.3	9,699.4	1.3	9,348.1	0.8	3.6
2002	24.5	4.4	9,886.2	1.9	9,542.1	2.1	3.5
2003	25.0	5.4	10,239.0	3.6	9,866.7	3.4	3.6
2004	25.5	7.1	10,587.7	3.4	10,222.0	3.6	3.5
2005	26.1	5.0	10,926.5	3.2	10,547.5	3.2	3.5

Source: Economic report 2001/2002
Economic report 2005/2006

From the report data, manufacturing sector formed the largest single component of Malaysia's economy. The sales value of the manufacturing sector had increased by 11.8% or RM 4.1 billion to 38.7 billion in July, 2005 compared to RM 34.6 billion registered in the comparative period from previous year (DOS, 2005). The demand on manufacturing sector has increased consistently due to the effort of Malaysia to be an industrialized country by 2020. As mentioned by the Governor of the Central Bank of Malaysia, manufacturing sector has recorded the highest growth of 8.2% followed by agriculture (5.5%), mining (4.8%), services (4.1%) and construction (1.9%) (DOS, 2005).

According to Small and Medium Industries Development Corporation (SMIDEC), majority of the Small and Medium Industries (SMIs) involved mainly in several industrial sectors such as manufacturing, agriculture, mining, services and construction (SMIDEC, 2002). The statistics showed that the manufacturing sector has high potential in developing Malaysia's economy. Small and Medium Industries (SMIs) is one of the parties which contributed to the growth of the manufacturing sector. Currently, the SMIs constitute approximately 84% of the manufacturing establishments in Malaysia (Halim I.2006). SMIDEC also reported that the growth of manufacturing sector in Malaysian SMIs was 4.0% in 2002 and increased to 8.2% in 2003 (SMIDEC, 2005). Figure 1.1 shows the growth percentages of the manufacturing and other sectors in Malaysian SMIs for the year 2002 and 2003.



Source:SMIDEC, 2005

Figure 1.1: Growth Percentages of Industrial Sectors in Malaysian SMIs for the Year 2002 and 2003

Although Malaysian industries growth are rapid and their expansion are fast, they still face challenges that influence their competitiveness. The current scenario, depicts the Malaysian industries are now facing challenges on safety and health awareness at workplace. This could be evident from number of industrial accidents occurrences and the unconducive work environment reported (SOCSO 2007).

1.2.1 Safety and Health Awareness in Workplace

The occupational safety and health policy is to provide a conducive working environment to safety and health in the workplace. Reasonable precautionary steps are taken so as to ensure that workers are prevented from injury or health hazard due to work activities being carried out (DOSH,2009). Managing occupational safety and health at the work place is no different than managing other aspect of business. The exception is that it requires the commitment of the proprietor or owner to ensure the following three conditions at workplace (OSHA 1994) exist. These are:

i. Should have a policy statement on occupational safety and health;
ii. Should have a plan for the implementation of hazard identification, risk assessment and risk control (HIRARC) including training and auditing and;
iii. Should take remedial action for any improvements to be made.

If safety and health awareness in workplace are improved, the number of accidents can be reduced or decreased (Nicholas and Wangel, 1991). This must be done through department influence which continuously operates on daily routine basis at workplace that can be implemented through:

i. Training to improve knowledge, attitude, and management that can result in good work practice and safety procedures. It is apparent that industries need the above three conditions to achieve ideal safety and health in workplace;
ii. Defining clear responsibilities and work ethics;
iii. Identifying and introducing practical solutions to the problem related to safety and health.

The implications for safety and health practice, the formulation of legislation and its enforcement in a global economy are considerable. Tools, machine, processes, raw materials, plant, buildings and the management system will have to be designed so that they are intrinsically safe and non-hazardous for the users. Safety and health will have to be integrated as part of the production process with its own quality assurance system. (Brune et. al., 1997, ISO 9001:2008). This will require managers and supervisors to be highly trained in the management and administration of safety and health system and programs. As legislation continues to develop for the recognition, assessment and control of risks in the workplace; at the planning stage and at the design stage for products and equipments, the knowledge and skills of those involved will also have to be developed. To meet these demands, the training education on safety and health will eventually become a new industry that will be closely associated with engineering and assist in identifying cost-effective ways of achieving control of risks.

1.2.2 Industrial Accidents Occurrence

Overall, the number of industrial accident occurrence is the major indicator for evaluation of the occupational safety and health (OSH) program. The numbers of industrial accident for 2006 of were 21,609 of which 3,700 were permanents disability and 188 deaths. In 2007 the number was decreased to 19,607 with 3,622 permanent disability and 164 deaths (SOCSO, 2007). The number of occupational accidents reported declined by 1,982 cases or 3.4% to 56,339 as compared to 58,321 cases in 2006. The decrease in number of cases may be due to several initiatives implemented by the industries such as seminars, campaigns, periodic inspection and enforcements, collaborations with government bodies, employer association and workers unions to increase awareness on safety and health at the workplace. From the total number of accidents reported in 2007, 38,657 cases were due to industrial accidents, including cases of occupational diseases, while the total of commuting accidents stood at 17,682 cases. Employers and employees really need to combine their efforts to reduce the number of accidents in industry specifically at the workplace.

1.2.3 Unconducive Work Environment

There are many questions about the safety and health aspect of the working environment, and workers. Workers who spend about a quarter of their lives in the workplace must be aware of this situation (Brune et al., 1997). Ensuring a safe and healthy workplace require a joint effort with input from management and employees. While undoubtedly a win-win proposition, it is certainly not easy to ensure a safe and healthy workplace (Pingle, 2009). SOCSO categorized the work environment into

three categories that are outdoor, indoor and underground. Table 1.2 shows the number of accident cases that are related to work environment.

Table 1.2: The statistic for accident causes related to work environment in 2006 and 2007.

Accident Causes	**Year 2007**			**Year 2006**		
Work Environment	**CR**	**PDCS**	**DCS**	**CR**	**PDCS**	**DCS**
Outdoor						
-Weather	12	3	10	10	0	2
-Traffic and working surfaces	2,296	363	1,990	2,818	378	29
-Water	42	3	39	61	2	4
-Others	2,148	302	1,641	1,835	246	15
Indoor						
-Floors	944	147	828	1,155	120	4
-Confined quarters	638	19	492	11	1	0
-Stairs	904	101	763	590	90	0
-Others traffic and working surfaces	2,556	399	2,946	4,215	339	8
-Floor opening and wall openings	871	57	696	185	23	0
-Environmental factor(lighting, ventilation, temperatures, noise, ets)	221	4	149	98	14	0
Others	7,615	1,308	6,814	9,416	1,459	31
Underground						
-Roofs& faces of mine roads& tunnel	23	0	23	12	0	1
-Floors or mine roads and tunnels,etc	5	1	4	6	2	1
-working faces of mines, tunnels,etc	7	2	12	2	14	0
-Mine shafts	39	0	15	0	0	0
-Fire	31	3	27	16	0	1
-Water	21	2	15	0	0	0
-Others	22	4	20	0	0	0

Note: CR – Cases Reported
PDCS- Permanent Disability Cases Settled
CS- Death Cases Settled

From the SOCSO report, there are significant problems concerning working environment (i.e environmental factors: Lighting, ventilation, temperatures and noise). A total of 98 cases were reported in 2006 and 221 in 2007. The number of industrial accidents by causing agent (i.e: dusts, gases, liquids and chemicals) excluding explosives recorded 569 cases in 2006 and 617 in 2007. The data has increased from year to year. The air borne contamination is one of the hazards that is

associated in work environment. Failure to properly monitor, measure and report hazardous airborne emission can cost a manufacturing company considerable amount of money to pay the associated fines as reported in Danbury, Connecticut, the United States of America. A company was fined $218,000 in levied reported in the Environmental Protection Agency (Goetsch, 2008).

From the unconducive work environment, there are grown related issues on the workers safety and health. Sickness absenteeism is a significant problem both for employees and for employers (Martimo, 2006). As preventive measures, it is important to recognize the situation and factors that can cause psychological overload at work. Rapid workforce, pressure from employer, continuous changes at work are often listed as a stress factor (Rantanen and Lethinen, 1999). The health status of workers in small companies has been noted to be relatively poor (Yamataki et al, 2006). However in large organizations, safe behavior programs are currently a popular strategy for improving safety (Hopkins, 2006). Sometimes the discussions on safety and health is more directed towards the economic consequences rather than individual suffering caused by disabling diseases (Martimo, 2006). Another aspect that may be contributed to unconducive work environment is indoor air quality. Increased awareness of the poor quality of indoor air compared to the outdoor air has resulted in a significant amount of research on the adverse health effects and mechanism of action of indoor air pollutants (Susan and Meryl, 1996).

1.3 The Problem Statement

Air pollution in the past has not been regarded as serious problems in Malaysia. However, since the shift in the nation's development strategy from agriculture to manufacturing and heavy industries, there has been an increase in the generation of pollutants and industrial waste thus resulting in the deterioration of the country's air quality. This has become a serious concern particularly when the climate in this part of the world has shown to have a high potential of air pollution. This is evident from a study carried out for long term observation on the trends of major air pollutants in Malaysia which includes Nitrogen Dioxide, Carbon Monoxide, ground level Ozone, total suspended particulate (particularly PM_{10}) and Sulphur Dioxide emitted from industrial and urban areas from early 1970s (Latif et. al, 2006). The data showed that the state of atmospheric environment in Malaysia, particularly within industrialized areas were caused both by emissions from local and transboundry. Local emissions are the pollutants that come from local activities and transboundry emissions are from the neighboring countries like Indonesia, Thailand and Philipines (Ibrahim et. al., 2006). Among the example activities that generate the pollutants from industry are welding process (ACGIH 1998).

A.M Leman (2008c) have conducted the monitoring on toxic gases emissions in industries. From the study, it is evident that welding process was one of the source of air pollution. The hazard from the welding process can be categorized into three groups; that are mechanical, ergonomic and chemical. These hazards need to be identified, assessed and controlled in the workplace (CCH, 2001). The Malaysian Government has introduced a guideline on monitoring of airborne contaminants for chemicals hazardous to health (DOSH Malaysia 2002). However from the

observations and case studies conducted, it was noticed that monitoring process has not been given priority due to insufficient of measuring equipments, hence the toxic gases were not measured in the work place (A.M Leman et. al., 2006b, 2008c and 2009b). In providing solutions to the above problems, it is necessary to conduct a monitoring and support system for sustainable work environment, in order to create healthy working condition in Malaysian SMIs. The introduction of Industrial Air Pollution Monitoring System (IPAMOS) approach will promotes the occupational health awareness among the workers in Malaysian SMIs.

1.4 Research Question

Hence the primary research questions being investigated in this research are:

(a) Does the indoor air pollution of Malaysian SMIs affect the occupational safety and health among the workers in the manufacturing industries?

(b) Does the introduction of measurements and monitoring system able to improve the occupational safety and health factor in manufacturing industry?

1.5 Research objectives and goals

The main objectives of the research work reported in this thesis are as follows:

(a) To identify the occupational risk factors that contributed to occupational safety and health in Malaysian SMIs. Occupational safety and health risk factors are regarded as a main contributor to occupational diseases and give a negative impact to workers' health. These efforts are crucial in order to prevent

occupational risk factors continuously contributing to occupational safety and health to workers.

(b) To identify the effectiveness of occupational safety and health management system (OSHMS) in reducing the occupational risk factor. Establish the documentation and approach factors of workers such as working instruction, safe operation procedure, risk available are observed and analyzed using assessment tools to determine the effect

(c) To develop a decision support monitoring system that provides decision support for the safety management system. The system includes the guideline on mechanical work or process, the advice and recommended solution for working indoor environment quality improvement.

1.6 Significance of the Study

The study is anticipated to provide benefits three sectors. (i.e; industry (employer and employees), the government and the education sector.

1.6.1 Industry (Employer and employees)

Some related industries would benefit from the outcome of the study. The employers' awareness will increase in establishing their safety and health management system in terms of monitoring the work environment. At the same time the employer would comply with section 15, Occupational Safety and Health Act 1994. Also the outcome of the study would influence on the workers productivity.

The direct impact to employees is the conducive work environment. The system that will be developed will be able to monitor the toxic gases exposed to the worker and at

the same time will be able to analyze the data to ensure the adequate ventilation provided to the workers and protect the workers from adverse health problems. The traditional technique used in Industrial hygiene will be improved and more monitoring process, will became easier.

1.6.2 Government

The government will get direct benefit from this study. As the awareness from the industries increases, it will become easier to establish the occupational safety and health policy as required in section 16 OSHA that is the duty to formulate safety and health policy. The government also would be able to reduce the amount of insurance claimed through SOCSO, and this savings can be allocated to the other sectors for economic development. With this allocation, the government can produce and place emphasis on foreign direct investment (FDI) to Malaysia. At the same time, the government can benefit through the available established Malaysian Standard. These standards provide guidelines to the employer to develop their capabilities on ensuring they follow the Malaysian Standard for their competitiveness in borderless world and global market. Malaysia through government agencies like the Department of Occupational Safety and Health (DOSH) will be able to compile relevant data and it can be a resource in developing the regulation and enforcement activities.

1.6.3 Education Sector

Education and training sector can benefit from the study through the system developed. The system will become the starting point to the other researches that are

related with the working environment. Through the system development, the training agency such as National Institute of Occupational Safety and Health (NIOSH) can take advantages from the system to improve the course curricula that have been developed. The training will be conducted internally or externally (abroad). From the outcome of this study, the guidelines on mechanical work or process will be established. The technique on data capture and analysis will become more appropriate due to working environment quality improvement.

1.7 Limitations

The studies are limited to the activities involved in manufacturing industry. The companies that are involved in this study were the Malaysians SMIs based in Shah Alam. Nevertheless, the implementation proposed solution depends on company's willingness to deploy the solution. Moreover, the research work has no direct access and authority to enforce the proposed solution to the company even though the case study was carried out at the designated industries. For this study only a few toxic gases were identified these gases include Carbon Monoxide (CO), Carbon Dioxide (CO_2), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2) and Ozone (O_3) . The nature of the study is focus on safety and health enhancements in the working environment, the development process and the related activities like data collection in selected industries. The processes that were involved in the manufacturing company was welding and assembly. The key point is to monitor the pollutants in the working environment that include the level of toxic gases that posed health effects.

1.8 Organization of the thesis

The thesis is organized into seven chapters. Figure 1.2 illustrates the overall organization of the thesis sequence and establish the interaction between chapters. **Chapter 1** has outlined the background of the problem, economic development, safety and health awareness in workplace, industrial accidents occurrence, unconducive work environment, the problem statement, objective, significance of the study and potential benefits that could be exploited from the study.

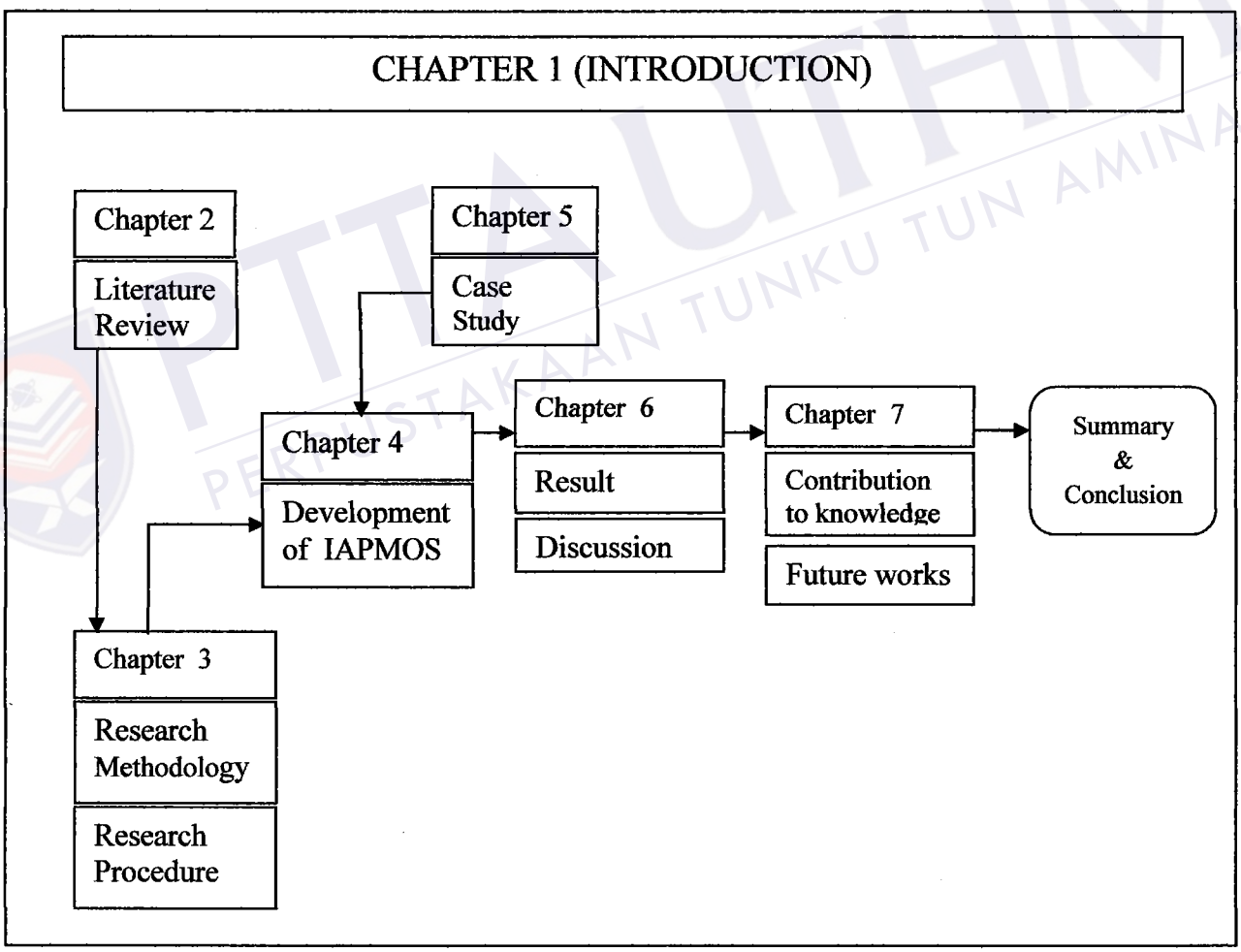


Figure 1.2: The Structure of the Thesis

Chapter 2 reviews the literature on Maslow theory, safety, health and environment theory. It describes the trend of current research on safety and health and highlights the work environment issues. Furthermore the chapter also looks into the current International and Malaysian standards regarding on safety, health and environment. An understanding about the work environment that associated with the welding process, the hazard and the risk assessment were taken into consideration during discussion this topic. This chapter also investigates the utilization of Quality Function Deployment (QFD) as a tool on product design process.

Chapter 3 explains the research methodology and procedure. It defines the formulation of research design. Apart from that the research flow was discussed. The research's needs and requirements was develop by using the QFD technique and the voice of customer and questionnaires were used in the data collection methods. This chapter also relates the necessary tools required to accomplish the research objectives described in chapter 1 and discusses the focus of this research.

Chapter 4 elaborates the development of IAPMOS. The development phase and flow diagram was established is clearly discussed. In this chapter the overview of the system creation and laboratory testing was explained. The experimental set-up and data communication flow was developed from first stage until the end. The Walk-in Stability Chamber (WiSC) testing was done during the development process.

The case study was done to get the information from the selected industries. In **Chapter 5**, the case study set-up and industrial visit was discussed. From the basic information, the questionnaires were given to the occupants and the data was analyzed to be med in the system development. Also from the case study the data collection method and data gathering were explain in detail. The equipment for data collection and software that is used in the study was mentioned in chapter 5. Hence chapter 5 describes the data information and the situation based on the selected industries.

In the **chapter 6** the findings from the study were discussed. Also the discussions from every angle are taken into consideration and present the outcome from the research study. The system development and the discussion on every part of the study were explained.

Chapter 7 elaborates the conclusion and recommendation for the further work. The author critically assesses the merits of the research and suggests possible and further research work. Finally, key issues described in the thesis pertaining to the development of IAPMOS were summarized and also provide conclusion for overall research work.

1.9 Summary

In this chapter, the Malaysia key economic data was mentioned. Manufacturing sector and the challenges in safety and health issues is the main topic to show the evidence and the needs of the system to be developed. The industrial accidents and occupational diseases effected from the workplace and the work environment must be assessed and monitored from time to time to ensure a safe and healthy workplace.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The background information will be summarized and made references to the extensive literature search documented in chapter 2. This review includes findings from recently published studies on topics related to the research questions for this thesis. The chapter also highlighted how the current study is related to and adds to the existing knowledge.

2.2 Occupational Safety and Health in General

Occupational Safety and Health (OSH) is concerned with preserving and protecting human and facility resources in the workplace (Friend and Khon, 2007). OSH is also a field wherein professionals attempt to prevent catastrophic losses. Economically, morally, and legally, OSH has become an important issue. Companies are attempting to remain profitable in an ever competitive global economy. For companies, addressing safety, health and environment programs may actually mean survival. In reality the amount of production required to cover costs associated with accidents in the workplace can be substantial and may far outweigh the expense of providing a safe and healthful working environment.

OSH started 2,000 years ago. Early Historical of OSH is based on Ancient Greek and Roman Physicians (Goetsch, 2010, Reese, 2009, Friend and Khon, 2007). Figure 2.1 below illustrate evolution on OSH .

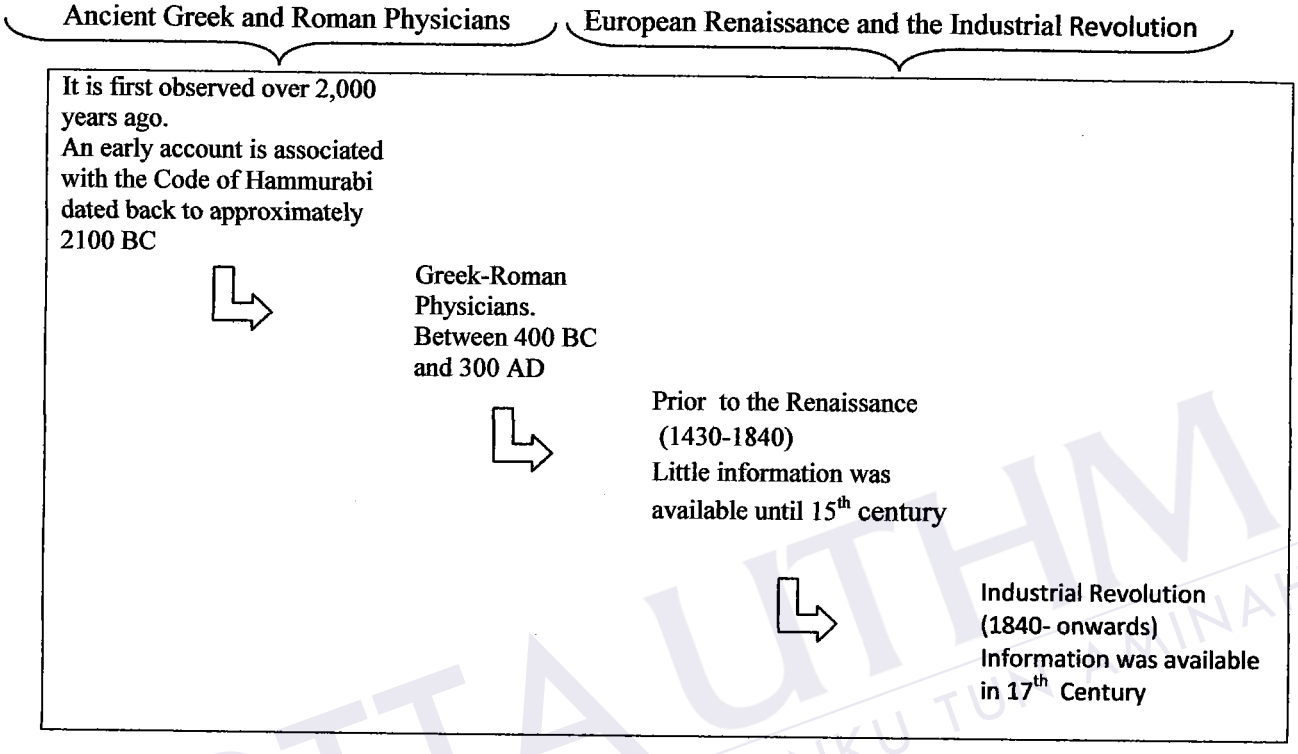


Figure 2.1: The Evolution on OSH (Goetsch, 2010)

The field of OSH has undergone significant change over the past two decades. Some of the reasons include the following: technological changes that have introduced new hazards in the workplace; proliferation of safety and health legislation and corresponding regulation; increase pressure from regulatory agencies; realization by executives that workers in a safe and healthy workplace are typically more productive; increased pressure from environmental groups; corporate social responsibility and increased pressure from labor organizations and employees in general (Goetsch, 2010, Reese, 2009).

2.3 OSH Management Worldwide

Organization worldwide strives to develop their management system for business functions, ranging from quality and environment to safety, information security and social responsibility. For the latest decade a considerable amount of these efforts has been concentrated on introducing and applying standards such as the ISO 9001 and ISO14001 (Eriksson and Hansson, 2006). Numerous manufacturing and service organization are considering integrating their respective occupational and safety management and audit systems into the International Organization for Standardization (ISO) based audit driven quality management system (ISO 9000) or environmental management system (ISO 14000) models (Dyjack et al, AIHA, 1998). The need for Integrated Management System (IMS) often arises as a result of decisions to implement Environmental Management System (EMS) and occupational safety and health management system in addition to a Quality Management System (QMS). Thus the development of standard from various sources emerged. A good example is the series of the OSHAS 18001: 2007 and OSHAS 18002:2008. The OSHAS 18001 is compatible with ISO 9001:2000 (Quality) and the ISO 14001:1996 (Environmental) management system standards, that can facilitate the integration of quality, and environment OSH management system individual organization (BSI, OHSAS 18001:1999). Malaysia has also introduced the Malaysian standard and the latest is MS ISO 9001: 2008 and MS 1722: 2003. Malaysian Standard also emphasize on the employer understanding and take the opportunity to improve on the quality aspect.

People worldwide face occupational safety and health hazards daily. Over the years, the global occupational hygiene community has worked diligently to develop ways to protect workers, in workplaces of all types and sizes. Standards and guidelines were developed to help the employers and employees to develop their OSH Management system. A standard is an agreed, relatable way of doing something. It is published document that contains a technical specification or other precise criteria designed to be used consistently as a rule, guideline, and definition. Standards help to make life simpler and increase the reliability and the effectiveness of many goods and services. It is created by bringing together the experience and the expertise of all interested parties such as the producers, sellers, buyers, users and the regulators of particular material, product, process or service. Standards are designed for voluntary use. However, laws and regulations may refer to certain standards and make compliance with them compulsory (British Standard, 2009). In this study certain standards were referred based on the Malaysian standard requirements. MS 1722: Part 1: 2005, Occupational Safety and Health Management Systems-Part 1: Requirements was establish to guide the company on safety and health aspect. MS 1722: Part 2: 2003, OSH Managements Systems-Part 2: Guidelines was developed to give the understanding to the company and guidance to employer to build up the Occupational Management System. From the environment aspect, the study also will look at the MS ISO 14001: 2004, Environment Management System (EMS) Requirements with Guidance for use.

2.4 OSH Malaysian Perspective

OSH provides a working environment which is conducive to workers. Reasonable precautionary steps are taken so as to ensure that workers are prevented from injury or health hazard due to work activities being carried out. Occupational safety and health (OSH) was first implemented in Malaysia some 130 years ago towards the end of the 19th century (DOSH 2007). In 1953 initially, the formation of the OSH was managed by Factories and Machineries Department. Its main activities were to ensure machinery safety and also the safety and health of workers in the manufacturing sector. With the rapid growth of technology and the economic development of the country, the department no longer focused solely on the manufacturing sectors, but also other occupational sectors. Hence, the Factories and Machineries Department was upgraded to the Department of Occupational Safety and Health (DOSH) in 1994, where its main focus is to ensure the safety, health and welfare of people at workplace and to protect others from the danger arising from occupational activities. Thus, DOSH is the only government agency responsible for administrating, managing and enforcing legislation pertaining to OSH in the country with the vision of making all occupations safe and healthy while enhancing the quality of working life (OSHA, 1994).

From the DOSH report, the industrial accident statistic was tabulated in Table 2.1. The data describes the number of industrial accidents occurred by sector from year 2005 to 2009. It shows that the number of industrial accident is quite high especially for manufacturing sector and Table 2.2 presents a total number of investigation cases of occupational diseases and poisoning.

Table 2.1: Industrial Accidents Statistics by sector from 2005-2009

Sector /Year	Year 2005			Year 2006			Year 2007			Year 2008			Year 2009		
	D	PD	NPD	D	PD	NPD	D	PD	NPD	D	PD	NPD	D	PD	NPD
Manufacturing	65	93	2058	66	116	2752	63	133	2094	76	134	1564	63	90	1419
Mining and Quarrying	3	4	107	2	1	22	9	1	5	6	0	4	3	1	2
Construction	87	36	246	81	25	365	95	10	76	72	2	55	71	6	38
Agriculture and Forestry	18	23	614	32	19	1014	30	14	712	42	7	365	44	8	440
Utility	2	20	177	5	6	66	10	4	51	19	12	82	23	3	116
Transport & Communication	14	0	145	10	1	47	2	0	7	8	1	18	18	0	21
Wholesale and retail	2	3	53	0	1	13	3	1	11	0	0	2	0	0	0
Hotel and restaurant	3	1	27	0	0	7	0	2	11	1	1	13	0	0	18
Financial & Real Estate	0	0	10	4	2	18	4	0	25	4	1	2	1	0	0
Public Services	2	2	22	9	3	44	3	3	16	2	1	3	1	0	0
Total	196	182	3459	209	174	4348	219	168	3008	230	159	2108	224	108	2054

Source: DOSH annual report 2007, 2008 and 2009.
Legend: D -Death
PD -Permanent Disability
NPD -Non-Permanent Disability

Table 2.2: Total Number of Investigation Cases of Occupational Diseases and Poisoning from 2005 to 2009

No.	Types of Disease	2005	2006	2007	2008	2009
1.	Occupational Lung disease (OLD)	51	38	50	56	57
2.	Occupational Skin Disease (OSD)	57	30	192	70	53
3.	Occupational Noise Hearing Loss (NIHL)	190	106	120	169	427
4.	Occupational Muscular Skeletal Disorder (OMD)	10	22	18	31	57
5.	Disease caused by chemical agent (poisoning)	139	116	117	41	61
6.	Disease caused by biological agent	0	3	1	2	3
7.	Occupational Cancer	0	2	1	3	2
8.	Other and Non- Occupational Disease	4	45	47	81	2
TOTAL		451	362	546	453	669

For the occupational disease, The Occupational Health Division monitors and analyses the data received. For each case of occupational disease and poisoning that is investigated, the department advises the industries to take corrective measures to prevent from recurrence. To ensure the safety, health and welfare of workers are taken care; DOSH work towards making sure that the occurrence of industrial accidents in Malaysia is low, by introducing the OSH Master Plan 2015. This plan provides the direction of OSH in the country, and function as a guide for working cohesively with stakeholders and social partner, including government agencies, local authorities, labor unions, employer associations, academic institutions and other non-governmental organization. Small and Medium Industries (SMI) sector has been identified as the major source of accidents in the manufacturing industry. New strategies had therefore been introduced to reduce the accidents and to increase the level of awareness for the compliance with the Factories and Machinery Act, 1967 and Occupational Safety and Health Act, 1994. The strategies that had been adopted by the DOSH's Strategic Management Group (SMG) are:

i) Having an effective inspection and audit program for the occupational safety and health system;

ii) Preparing the OSH-MS (MS 1722) – the OSH Malaysia Standard as the guideline for managing the occupational safety and health system; and

iii)Rewarding SMI companies implementing good OSH management systems with an Occupational Safety and Health Award.

In addition, DOSH also carried out the SMI occupational safety and health audits. It is the department's hope that with these new strategies would help to reduce accidents in this sector. The rapid development of the country in various industrial sectors,

2.4 OSH Malaysian Perspective

OSH provides a working environment which is conducive to workers. Reasonable precautionary steps are taken so as to ensure that workers are prevented from injury or health hazard due to work activities being carried out. Occupational safety and health (OSH) was first implemented in Malaysia some 130 years ago towards the end of the 19th century (DOSH 2007). In 1953 initially, the formation of the OSH was managed by Factories and Machineries Department. Its main activities were to ensure machinery safety and also the safety and health of workers in the manufacturing sector. With the rapid growth of technology and the economic development of the country, the department no longer focused solely on the manufacturing sectors, but also other occupational sectors. Hence, the Factories and Machineries Department was upgraded to the Department of Occupational Safety and Health (DOSH) in 1994, where its main focus is to ensure the safety, health and welfare of people at workplace and to protect others from the danger arising from occupational activities. Thus, DOSH is the only government agency responsible for administrating, managing and enforcing legislation pertaining to OSH in the country with the vision of making all occupations safe and healthy while enhancing the quality of working life (OSHA, 1994).

From the DOSH report, the industrial accident statistic was tabulated in Table 2.1. The data describes the number of industrial accidents occurred by sector from year 2005 to 2009. It shows that the number of industrial accident is quite high especially for manufacturing sector and Table 2.2 presents a total number of investigation cases of occupational diseases and poisoning.

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