SECURING THE FUTURE

OCCUPATIONAL SAFETY AND HEALTH IN MALAYSIA

National Institute of Occupational Safety and Health (NIOSH)
Ministry of Human Resources Malaysia

OCCUPATIONAL SAFETY AND HEALTH IN MALAYSIA

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ABBREVIATION

PART I : OSH MANAGEMENT

AAS	Atomic absorption spectrophotometer
ADDIE	Analyze, Design, Develop, Implement and Evaluation
AIHA	American Industrial Hygiene Association
AOSHRI	Asian OSH Research Institute
BA	Breathing Apparatus
BOD	Board of Directors
CEO	Chief Executive Officer
CEP	Continuous Education Program
CHL	Chemical Hazardous Laboratory
CMCO	Conditional Movement Control Order
CoE	Center of Excellence
COVID-19	Coronavirus Disease 2019
CP	Competent Person
CRD	Consultancy, Research and Development
CS	Confined Space
DML	Dust Mask Laboratory
DOSH	Department of Occupational Safety and Health Malaysia
EEC	Ergonomics Excellence Centre
EEL	Environmental Ergonomics Laboratory
EMCO	Enhanced Movement Control Order
FEL	Forensic Engineering Laboratory
FMA	Factories and Machinery Act
FPETL	Fall Protection Equipment Testing Laboratory
GC	Gas Chromatography
GCL	Gas Detector Calibration Laboratory
GHS	Globally Harmonized System
HEAL	Human Ergonomics Assessment Laboratory
HIRARC	Hazard Identification, Risk Assessment and Risk Control
HPLC	High Performance Liquid Chromatography

HRL	Hydrostatic Testing Laboratory
IC	Ion Chromatography
ICOP	Industry Code of Practice
IH2C	Industrial Hygiene Catalyst Committee
IHAL	Industrial Hygiene Analytical Laboratory
IHLAP	Industrial Hygiene Laboratory Accreditation Program
IHT	Industrial Hygiene Technician
IKM	Institut Kimia Malaysia
ILO	International Labor Organization
IRPA	Intensive Research in Priority Areas
JICA	Japan International Cooperation Agency
JNIOSH	National Institute of Occupational Safety and Health, Japan
KOSHA	Korean Occupational Safety and Health Agency
KPI	Key Performance Indicators
LMM	Lumbar Motion Meter
MCO	Movement Control Order
MITI	Ministry of International Trade and Industry
MoA	Memorandum of Association
MOHR	Ministry of Human Resources
MTP	Development Action Council
NART	NIOSH Augmented Reality Simulation of Safety and Health Training
NCOSHN	National Council for Occupational Safety and Health
NGO	Non Government Organization
NIOSH	National Institute of Occupational Safety and Health
NSP	NIOSH Safety Passport
OH	Occupational Health
OHD	Occupational Health Doctor
OHL	Occupational Health Laboratory
OIC	Organization of Islamic Countries
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Act
OSHCIM	Occupational Safety and Health in Construction Industry (Management)
OSHECT	OSH Hazard Evaluation and Control Technology Centre
OSHMP 2020	Occupational Safety and Health Master Plan 2020

OSH-MS	Occupational Safety and Health Management System
OSHNet	Occupational Safety and Health Network
PCM	Phase Contrast Microscope
PEL	Permissible Exposure Limit
PPE	Personal Protective Equipment
PSL	PPE Simulation Laboratory
PT	Proficiency Testing
R & D	Research & Development
RMC	Research Management Center
RMCO	Recovery Movement Control Order
SAMM	Skim Akreditasi Makmal Malaysia
SDG	Sustainable Development Goals
SDG	Sustainable Development Goals
SECL	Scientific Equipment Calibration Laboratory
SHO	Safety and Health Officer
SiRAC	Simple Risk Assessment and Control for Chemicals
SIRIM	Standard and Industrial Research Institute of Malaysia
SMEs	Small and Medium Enterprises
SMI	Small and Medium Industries
SOCSO	Social Security Organisation
SOP	Standard Operating Procedure
TCTP	Third Countries Training Program
TWHP	Total Wellness and Health Promotion
UNDP	United Nation Development Program
USECHH	Use and Standard of Exposure of Chemicals Hazardous to Health
VOC	Volatile Organic Compound
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
XRD	X-ray diffractometer

PART II : OCCUPATIONAL SAFETY

BBS	Behaviour Based Safety
CIDB	Construction Industry Development Board
CP	Competent Person
CRDD	Consultation, Research and Development Department
CSRA	Confined Space Risk Assessment
CT	Customized Training
CF	Certificate of Fitness
DOSH	Department of Occupational Safety and Health
ECRL	East Coast Rail Link
ERT	Emergency Response Team
ETD	Education and Training Department
ETP	Economic Transformation Program
FAM	Football Association of Malaysia
FMA	Factories and Machinery Act 1967
GCL	Gas Calibration Laboratory
HCL	Hydrostatic & Corrosion Laboratory
HSR	High Speed Rail
I.R. 4.0	Industrial Revolution 4.0
ICOP CS 2010	Industrial Code of Practice for Safe Working In a Confined Space
KUSTEM	Kolej Universiti Sains dan Teknologi Malaysia
LC	Legal Compliance
LS	Laboratory Service
LRT	Light Rail Transit
MBAM	Master Builders Association Malaysia
MHLW	Ministry of Health, Labour and Welfare
MPC	Malaysian Productivity Council
MRT	Mass Rapid Transit
NCOSH	National Council for Occupational Safety and Health
NIOSH	National Institute of Occupational Safety and Health

NOP	Notice of Prohibition
OHS	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment Series
OS	OSH Solutions
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Act 1994
OSHMS	Occupational Safety and Health Management System
PDP	Project Delivery Partner
PLKN	National Service Training Programme
PMC	Project Management Consultant
PPE	Personal Protective Equipment
PTW	Permit to Work
R&D	Research and Development
RFO	Reconstituted Fuel Oil
SAMM	Skim Akreditasi Makmal Malaysia
SDS	Safety Data Sheet
SHO	Safety and Health Officer
SME	Small & Medium Enterprise
SOCSO	Social Security Organisation
SOP	Safe Operating Procedure
SSS	Site Safety Supervisor
UPSI	Universiti Pendidikan Sultan Idris
UPV	Unfired Pressure Vessel
USA	United State of America
WISE	Workplace Improvement for Small and Medium Enterprise

PART III : OCCUPATIONAL HEALTH

OH	Occupational Health
IH	Industrial Hygiene
OSHA	Occupational Safety and Health Act
FMA	Factories and Machinery Act
NIOSH	National Institute of Occupational Safety and Health

DOSH	Department of Occupational Safety and Health
IHD	Industrial Hygiene Division
OHD	Occupational Health Division
USECHH	Use and Standard of Exposure of Chemical Hazardous to health
RC	Regulatory Compliance
JICA	Japan International Cooperation Agency
OHTA	Occupational Hygiene Courses by Occupational Health Training Association
MS	Medical Surveillance
LFTA	Lung Function Testing Analysis
CHRA	Chemical Health Risk Assessment
IAQ	Indoor Air Quality
CEM	Chemical Exposure Monitoring
NRA	Noise Risk Assessment
OMC	Occupational Medicine Center
LEV	Local Exhaust Ventilation
HCP	Hearing Conservation Program
PHP	Personal Hearing Protector
ONRHD	Occupational Noise Related Hearing Disorder

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FOREWORD

I would like to congratulate NIOSH for the publication of "Occupational Safety and Health in Malaysia: Securing the Future", a compilation of articles authored by experts from various OSH background in Malaysia. . This publication will serve as a platform for local OSH experts in the dissemination of occupational safety and health (OSH) information in Malaysia. It has been the aspiration of NIOSH to ensure that information, messages and technical knowledge related to OSH are communicated to the grass root level.

Among the pre-requisites to create good OSH management practices include acquiring and managing a pool of knowledge and expertise on OSH and applying them based on the operational requirements and environment.

I am confident that the publication will prove useful and beneficial to local and international OSH practitioners as it covers a whole range of topics from various fields and disciplines.

We should always encouraged and applauds the efforts taken to create and congregate a pool of OSH experts in Malaysia. Thus, I would like to commend all individuals and agencies for their invaluable contributions in making this publication a reality.

Although this publication is meritable, I hope that all of the OSH experts and practitioners in the country will continue to act and work collectively to bring the administration and management of OSH to new heights.

YB DATUK WILSON UGOK ANAK KUMBONG
Chairman,
NIOSH

PREFACE

The publication of "Occupational Safety and Health in Malaysia: Securing the Future" intends to address the need for more OSH related information as well as to provide an overview of OSH in the country with respect to legislation, OSH development, hazards and programs in various industries, and other pertaining issues.

The different contributors in the book who are experts from various industries and technical background have documented relevant information that can be utilized by OSH practitioners, organizations and any individualsin Malaysia andall over the world.. It is important to note that the contributors are actively involved in the field and come from government agencies, universities, private sectors and non-govermental organizations (NGOs).

Hence, information shared can be used as a reference or for benchmarking to enhance OSH in Malaysia in the future.Apart from that, this book is also useful for those who are involved in safety and health in the workplace or who need to have a better understanding of OSH in Malaysia.

We hope this publication will encourage more knowledge and experience sharing opportunities among OSH practitioners and others which is important to enhance the database of OSH related information.

HAJI AYOP SALLEH
Executive Director

ACKNOWLEDGEMENTS

Thanks to the Almighty for His blessings and grace that the publication of "Occupational Safety and Health in Malaysia: Securing the Future" is successfully completed. We are extremely grateful to the contributors for their effort in preparing the manuscripts. This book would not exist without their contributions.

We like to express our deepest appreciation to the Executive Director of NIOSH, Haji Ayop Salleh and General Manager of Consultation, Research and Development Department (CRD), Khairunnizam Mustapa who are very helpful in ensuring the smooth running of the activities and programs conducted throughout the publication period.

Special thanks to the publication team, comprising of Haji Shahronizam Noordin, Ms Roslina Md Husin and Mr. Muhamad Syarizat Azmi for their cooperative, constructive views and comments in completing this book. Not forgetting NIOSH staff from other departments for their help in ensuring the smooth running of the completion of this book.

Fadzil Osman
Mohd Esa Baruji
Editors team

PART I

OSH MANAGEMENT

1

NIOSH: THE OSH LEADING CENTER OF EXCELLENCE IN MALAYSIA

Fadzil Osman CPIH

INTRODUCTION

In the 1980s, the rate of industrial accidents and fatalities in Malaysia reported by Social Security Organisation (SOCSO) was very high compared to other developed countries such as Japan, the United Kingdom and the United States. The Factories and Machinery Act (FMA) was predominantly the legislation that covered safety, health and welfare of workers in factories. The law was very prescriptive and depended very much on the enforcement from government authority. However, it did not cover the self-employed person and premises outside of its definition of factories. As industrial activities and employment opportunities grew, the Government has realized that law enforcement approach alone is insufficient to improve occupational safety and health (OSH) in Malaysia. It was important to put into practice the OSH philosophy of the developed industrial countries in which employers and employees played an important role to improve the standard of OSH.

In 1994, a comprehensive Occupational Safety and Health Act (OSHA) was gazetted, which requires employers to control risks arising from workplace and to protect their employees as well as people affected by their activities. However, employers and employees may encounter difficulties in their efforts to raise the standard of OSH. They must have knowledge and skills related to workplace hazards to ensure that they can fulfil their roles while taking appropriate measures to controls the hazards. Finding an organization that provide comprehensive training and consultants to help them solve problems in the workplace was not an easy task. At the same time, latest information on OSH was hard to come by as there were limited number of research activities and none of the organization functioned as a reference centre. These created significant problems especially for the Small and Medium Enterprises (SMEs) which made up the majority of the country's industry. On September 3, 1985, the National Advisory Council on OSH established by the Ministry of Labour has conducted a meeting to identify and examine workplace accident and fatality issues in depth. The meeting unanimously recommended to the labour minister that an OSH institute should be established to tackle the issues. It was also proposed that the activities of the institute will include conducting training for employers,

employees and professionals; provide technical advice, disseminate information; and conduct research. As a result the groundwork for the establishment of OSH institute was included in the Fifth Malaysia Plan with an allocation of one million ringgit.

Historical Development of NIOSH

The government through a consultation with International Labor Organizations (ILO) has requested for a feasibility study to be conducted under the United Nation Development Program (UNDP) Fourth Country Program in which the recommendations will include objectives, functions, organizational structure, form and implications as well as financial resources for the setting up of an OSH institute. A consultant, J. Bainbridge was in Malaysia from July to September 1988 for the study. Among the conclusions of the study was that the establishment of OSH Institute at the national industrial development stage was critical as a "catalyst" to upgrade OSH in Malaysia. Among his suggestions on the establishment of OSH institute were:

- The main objective of the institute is to provide practical services to employers and employees in efforts to reduce accidents and diseases of the enterprise.
- Priority is given to training activities and followed by technical advisory services, information dissemination and research.
- It should be established as an independent, neutral and highly credible body.
- It should be placed under the supervision of ministries that enforce labor relations laws and have close ties with employers and employees.

The report prepared by Bainbridge was discussed in a meeting that consisted of representatives from government ministries, departments, employers, employees, universities, professional and voluntary bodies on September 20, 1988. The meeting agreed and supported the recommendations made in the report. The meeting also gave options for OSH Institute to be established as a government agency, statutory body or government-owned company. However, the Ministry of Labor has suggested that it is established as a government-owned limited by guarantee company for the following reasons:

- As the main target of OSH is private sectors, the OSH Institute should be an independent body, neutral with high credibility and free of bureaucratic ties in order to achieve its objectives.
- The objective of establishing OSH Institute is to improve the level of safety in the workplace through training activities, advisory services, research and dissemination of

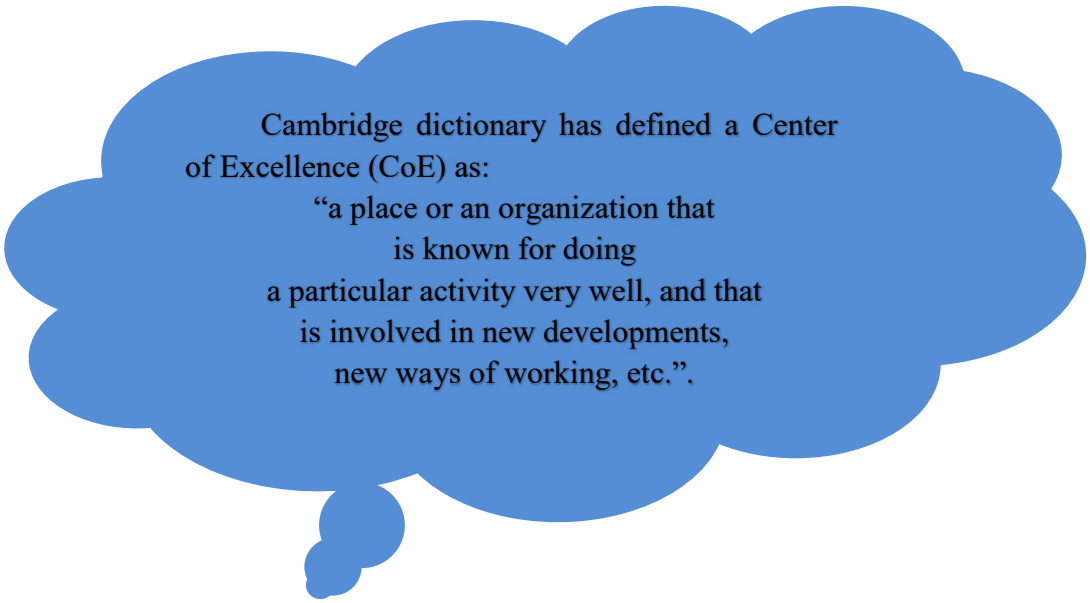
information to employees and employers. Therefore, the institute must gain the trust of employees and employers whose interests often differs.

- The assumption of OSH institute as a neutral body with high credibility should exist to enable employees and employers to raise their problems without worrying about legal implications.

As a result, in early 1990s the Government has approved the establishment of the National Institute of Occupational Safety and Health (NIOSH) and stipulated the Social Security Organization (SOCSO) role in setting-up the institute. An endowment fund of RM 50 million was established, out of which SOCSO has contributed RM 40 million. NIOSH was established as a company limited by guarantee under the Ministry of Labor on June 24, 1992. With the stated vision, 'to be a leading centre of excellence in occupational safety and health in Malaysia', NIOSH has operationalized its strategic mission 'to provide practical solution in occupational safety and health'.

The Memorandum and Articles of Association stipulated the objectives of the Institute as:

- To contribute to the efforts of upgrading OSH through the development of curriculum and training programs for employees, employers and others who are responsible either directly or indirectly for OSH.



- To assist industry, commerce and others to solve problems relating to OSH.

- To assist those who are responsible for OSH with the latest information in the field of OSH from the country and overseas.
- To conduct primarily applied research and both short term and long term research on OSH relevant to the country.
- To disseminate information on research and findings on OSH issues in the main and other pertinent activities undertaken by or on behalf of the Institute and to become the centre of reference.

As a Centre of Excellence (CoE), it is extremely important for NIOSH to establish itself as incubators of innovation and possess the ability to innovate constantly. NIOSH personnel should comprised of highly skilled individuals and experts, who will disseminate knowledge and share best practices. In order for NIOSH to be a CoE that is effective and relevant, several factors such as location, structure, talent strategy and operating model should be considered (Sukanya, R. and Kejriwal, R., 2018).

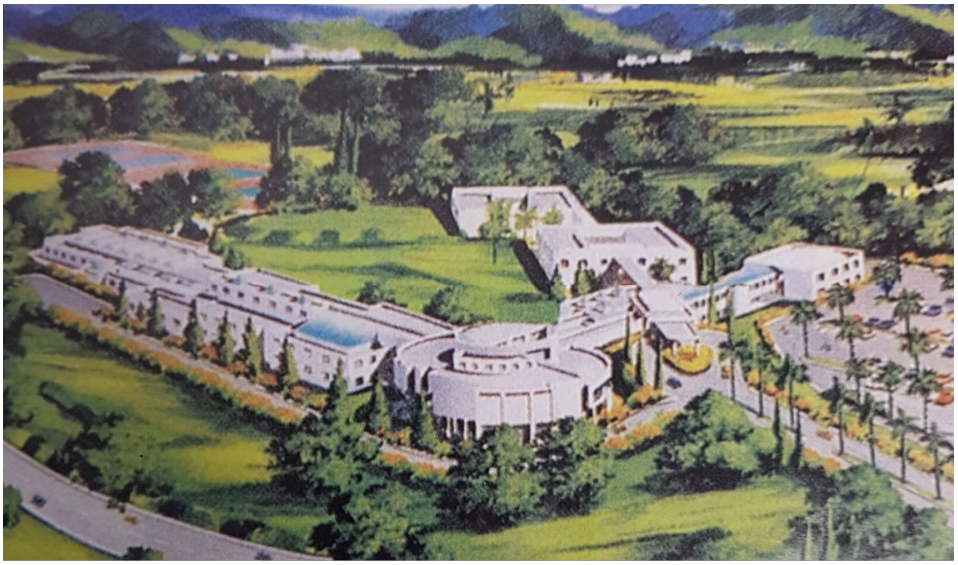


***Figure 1.1*. Proposed NIOSH Building in Bandar Baru Bangi (Source: NIOSH Bulletin 1995)**

NIOSH Establishment

NIOSH started its operation in a temporary office in Pusat Bandar Damansara, Kuala Lumpur. Then, in1996, NIOSH moved its operation to a purpose-built headquarters in Bandar Baru Bangi, Selangor, a town surrounded by several universities and research institutes. Later, NIOSH extended its services through the establishment of regional offices, site offices and subsidiaries. To date, NIOSH has managed to extend its services to all regions in Malaysia. Each of its

regional offices has effectively played their role in providing OSH training and disseminating OSH information. NIOSH's strategic plan for each of its regional offices includes enhancing its services to be the centre of excellence for specific industries.

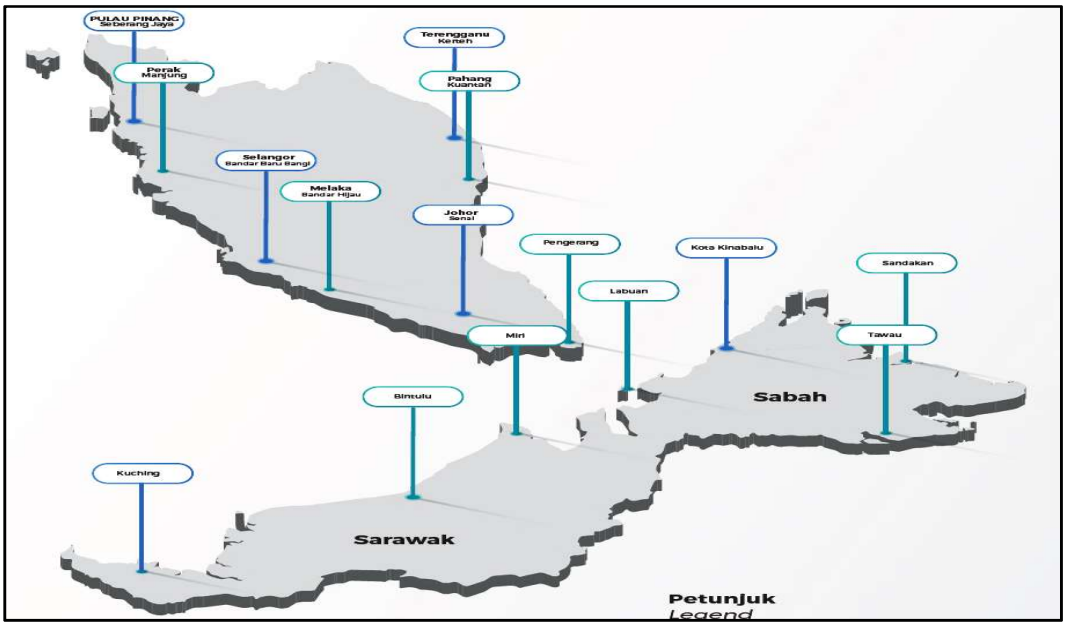


Figure 1.2. **NIOSH Regional and Branch Offices (Source: Annual Report 2019)**

Since its establishment, NIOSH has made several changes to its organizational structure. In 2008, four technical divisions (health, hygiene, ergonomics and safety) were realigned and placed under one department namely Consultancy, Research and Development (CRD) Department. The realignment was done to due several factors that impacted NIOSH over the years such as lacking consultancy services, lacking research and development activities, increases in the number of staff turnover, administrative changes, etc. It was timely in order to meet the demand for comprehensive consultancy services, establishment of new branch campuses, changes in the characteristics of the staff and the importance of research and development in the field of OSH. All the technical divisions in the department were fully focused on consultancy, research and development activities and at the same time supporting the training and examination divisions by providing trainers and examiners. Training coordinations conducted by the technical divisions were reassigned to the Higher Education and Training Development Department. The reorganization did not affect the total number of staff but the staff was better utilized based on their roles and technical background. Some of the advantages of the exercise were:

- Bigger technical team with common ideas and objectives in relation to product development, customer support, market needs, technical development and infrastructure.

- More emphasis was given to other areas of technical expertise, development and specialization thus further strengthened NIOSH's capacity in OSH technical services and Research and Development (R&D).
- Surplus of administration staff were transferred to other departments to better utilize their capabalities.

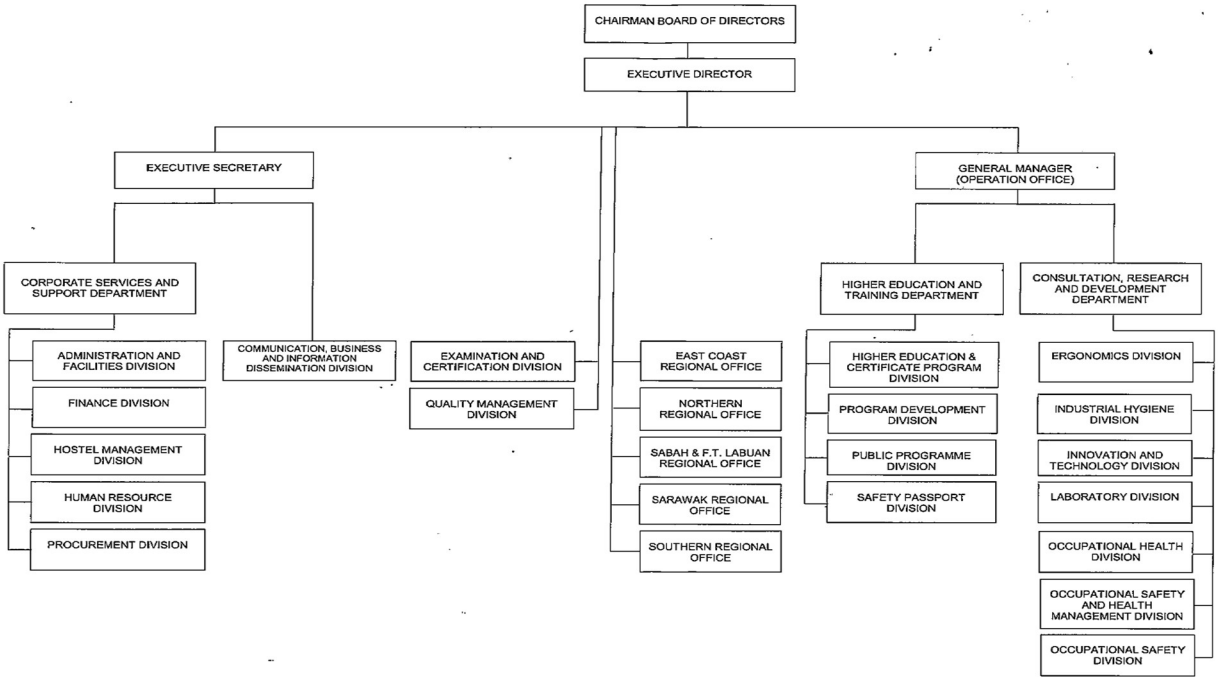


Figure 1.3. **Organisational Structure 2010 (source: NIOSH)**

2014 and 2017 saw some changes, but in 2019, NIOSH took another turn by reorganizing some of the functions to accommodate the company's growth and further enhance and expand its consultancy and research activities. The new structure was build upon the type of business services in which divisional manager positions and the division based on OSH technical disciplines in CRD Department were eliminated. Since then, NIOSH has initiated the technical specialist position for those in CRD Department and other staff from corporate, training and regional offices. There's also a change in the line of reporting as all of them will report to the General Manager of CRD Department. The new structure is shown in figure 1.4. No one knows what the future holds, but hopefully, the reorganization will steer NIOSH to achieve its long-range strategic goals as well as to reach its vision and mission as the centre of excellence in OSH.

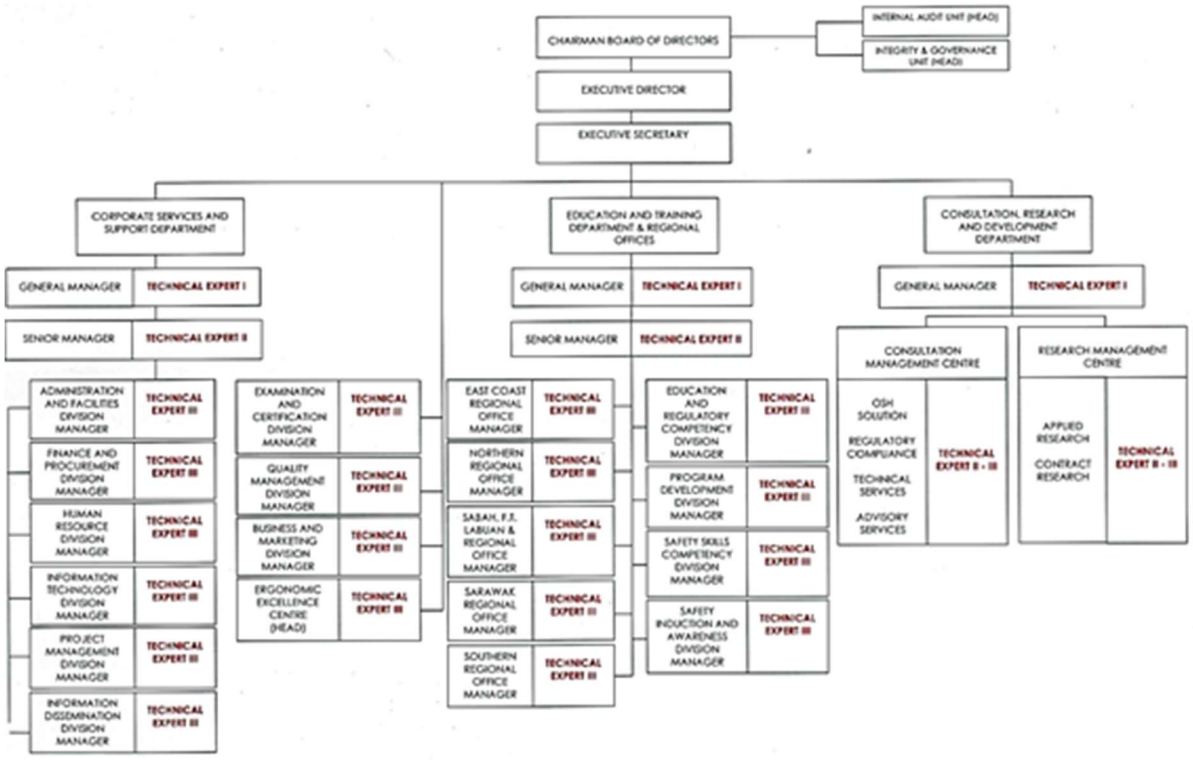


Figure 1.4. **Organisational Structure 2019 (source: NIOSH)**

International Collaboration and Cooperation

The internationalization of NIOSH is strengthened through collaboration and cooperation with various bodies, institutions and organizations in the area of training, research, human resources, technical equipment, knowledge and information sharing. Smart partnerships were established with local and international organizations to jointly carry out consultancy and research activities. NIOSH has engaged with Worksafe Western Australia, Japan International Cooperation Agency (JICA), Organization of Islamic Countries (OIC), ASEAN Occupational Safety and Health Network (ASEAN-OSHNet), Asian OSH Research Institute (AOSHRI), National Institute of Occupational Safety and Health, Japan (NIOSH Japan), USA and Sri Lanka.

The collaboration with JICA included funding and technical expertise to develop specific areas of OSH such as industrial hygiene, health and ergonomics as well as explore staff training opportunities with organizations in Japan. The NIOSH-JICA Project was a five-year technical cooperation program started on November 15, 2000, with the objective to enhance the capacity of NIOSH. The activities of this project covered a wide range of occupational health issues such as the Working Environment Monitoring and Improvement, Health Management, Biological

Monitoring and Ergonomics. The assistance given by the government of Japan varied from providing the up-to-date equipment, dispatching of long- and short-term experts and provide opportunities for NIOSH's staff to be trained in Japan. NIOSH takes pride in its technical staff who are highly trained by JICA to deliver comprehensive services in the different fields of OSH namely Occupational Health, Industrial Hygiene and Ergonomics. The expertise and facilities combined allow NIOSH to provide quality OSH solutions and recommendations. OSH technical competency related courses such as Occupational Health Doctors, Occupational Health Nurse, Industrial Hygiene Technicians, Chemical Health Risk Assessor and Indoor Air Quality Assessors are also carried out efficiently until now.

In 2000, a memorandum of understanding was signed by ten high-ranking officials authorized by their respective governments among the Association of Southeast Asian Nations (ASEAN) countries to officially form ASEAN-Occupational Safety and Health Network (ASEAN-OSHNet). Indonesia has offered to host the ASEAN- OSHNET Secretariat for the first term from 2000 until 2003 in a workshop conducted in November 1999 in Jakarta which was received warmly by the delegates. Malaysia has agreed to be the secretariat for the next term from 2005 to 2007 and the secretariat office was set up in NIOSH. The main objective of the secretariat was to cultivate cooperation between the OSH centres in the ASEAN countries. Numerous activities were conducted such as periodic meetings, joint seminars and information dissemination activities. NIOSH and the Department of Occupational Safety and Health (DOSH) benefitted a lot as they played their role in ASEAN-OSHNet effectively.

NIOSH has also been actively involved in the Asian Occupational Safety and Health Research Institutes (AOSHRI) meetings which are held at least once every two to three years. The first AOSHRI meeting was organized by NIOSH Japan in 2004 in Tokyo, followed by Korea in 2007, China in 2009, NIOSH Malaysia in 2012, Singapore in 2015, Sri Lanka in 2016 and Taiwan in 2018. In 2019, NIOSH Malaysia became the host again and organized the AOSHRI Progress meeting. The meeting provided a platform for workplace safety and health research institutes in Asia to:

- discuss occupational safety and health (OSH) research activities in national or regional OSH research institutes in Asia;
- utilize the information acquired for further activities in each institute;
- set up an international network for continuous cooperation among institutes; and
- facilitate international research cooperation to help solve OSH issues.

Training Activities

NIOSH started its operation by conducting training programs in 1993. The number of participants trained by NIOSH continues to grow over the years as shown in figure 1.5.

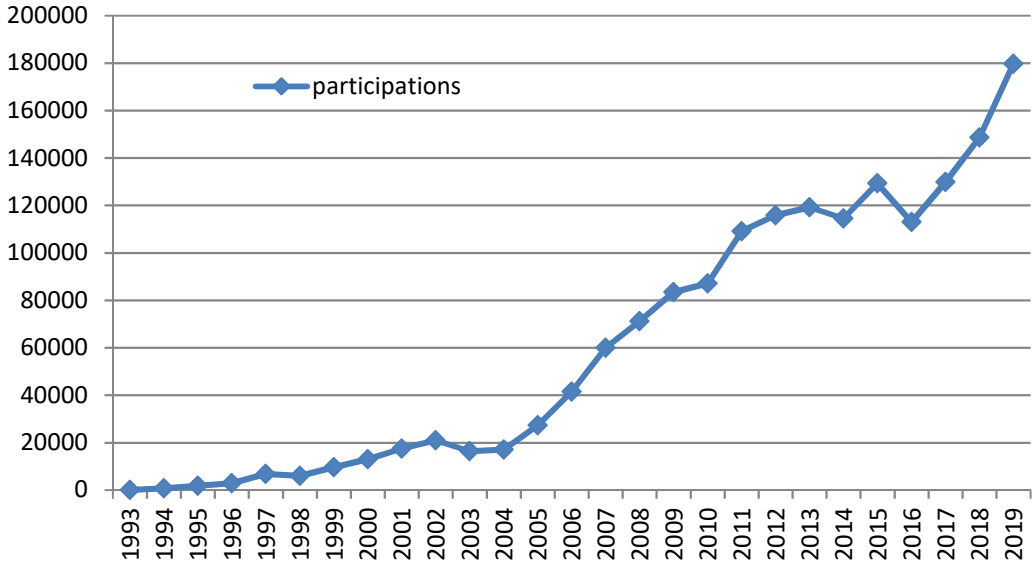


Figure 1.5. Number of participants attended various type of NIOSH Training Programmes 1993 - 2019

On November 19, 2003, the Minister of Human Resources agreed on NIOSH's proposal to establish OSH Higher Education Center. Subsequently, a resolution was made to amend the Memorandum of Association (MoA) of NIOSH with the inclusion of higher education as one of NIOSH's function. The amendment was approved during NIOSH Extraordinary General Meeting on February 20, 2004. NIOSH has submitted the application documents to establish the centre of higher education to the Department of Private Higher Education, Ministry of Education Malaysia onMarch 30, 2004 and was given the opportunity to present its justifications on January 16, 2005. However, the Department of Private Higher Education deemed that NIOSH Institution of Higher Learning has to be established as an entity independent from the current structure of NIOSH. This means NIOSH has to form another subsidiary with a different constitution as set by the Ministry of Education.

In 2005, NIOSH has embarked on the journey to provide higher education program to add value to OSH practitioners by offering the Executive Diploma in OSH program in collaboration with Open University, Malaysia. The program enabled registered Safety and Health Officer (SHO) and interested individuals to enhance their academic qualifications as well as contribute to the progress of their career path. After graduation they can further their

education in Bachelor in Safety, Health and Environment offered by Open University. NIOSH has also collaborated with Universiti Utara Malaysia for the Master of Science in Occupational Safety and Health Management program in 2007. The target of the program was competent SHOs with a degree who are interested in management and be part of the decision makers in the organization. The collaboration with these renowned Universities has benefited NIOSH in which the deliveries of its training and methodology have vastly improved. The timely decision to provide higher education program was not only good for NIOSH's corporate image, but it also helped charter a better carreer path for employees while at the same time creating the opportunity for others to learn OSH as a subject of interest. As a result, more graduates in OSH will be produced and organization will be able to employ more OSH savvy graduates. Hence, OSH will be the profession of choice of future graduates.

The collaboration with Open University and University Utara Malaysia is one of the approaches NIOSH took as a preparation for becoming the leading centre of excellence in OSH. NIOSH has gained the technical know-how and knowledge on managing OSH higher education programs through this collaboration. Thus, NIOSH planned to offer its own Diploma in OSH, namely OSH Management, Industrial Hygiene and Ergonomics once the Institution of Higher Learning is established. At the same time, NIOSH has also proposed to build a centre for OSH higher education in the Johor Campus. The development of infrastructures was approved in the development budget for the 9th Malaysia Plan for the year 2006 until 2010 and the project was completed accordingly.

However, things took another turn onn March 23,2011, in which a proposal on the Direction of NIOSH Higher Education activities was presented to the Board of Directors' meeting. After some deliberation, majority of the Board members suggested that NIOSH's priority should be on developing vocational and skills programs and not so much on academic or higher learning. NIOSH then starts to phase out its collaboration on academic programs with the universities.

Consultancy Services

In the beginning, NIOSH has focused mainly on the training activities. As the premier institute for occupational safety and health in Malaysia, NIOSH realized that it has to develop, enhance and offer other activities and services. Hence, it is most appropriate for NIOSH to drive the

consultancy and research activities related to OSH in Malaysia to cater to the need of the industry. Consultation is one of NIOSH's key functions in providing more optimal and practical solutions to OSH issues in the workplace. The consultancy activities began with ergonomics, occupational safety and occupational health services. Among the earlier projects were ergonomics assessments of control room at offshore petroleum platform, workstation design in the energy industry, and the causes of musculoskeletal injury diagnosed by medical practitioners in the semiconductor industry. Most of the consultation services conducted were for small and medium industries in regards to the implementation of system for managing workplace safety and health in their companies, identifying workplace hazards and monitoring employee health.

In the early years, the OSH consultation activities in NIOSH were categorized into 5 main categories: projects with contractual agreements; visit customer workplaces; discussions with customers at their premises or NIOSH premise; review customer documents and advise through telephone, fax or internet. Projects with contractual agreements were offered only by the ergonomic division for the semiconductor, petroleum and energy industries. Meanwhile, occupational safety and occupational health division were focused on other types of consultancy services.

When the new Occupational Safety and Health (Use and Standard of Exposure of Chemicals Hazardous to Health) Regulations 2000 or in short USECHH Regulations was gazetted, there were requirements for Chemical Health Risk Assessment, Chemical Exposure Monitoring, Testing and Examination of Engineering Control Equipment and Health Surveillance. Subsequently, NIOSH started to offer consultation services related to the USECHH Regulations. In the same year, NIOSH has also established an Industrial Hygiene Analytical Lab (IHAL) and Occupational Health Clinic to support Industrial Hygiene and Occupational Health consultation activities as well as supporting the NIOSH-JICA Project. Apart from getting the samples from NIOSH staff, IHAL has also started to receive external samples from Industrial Hygiene Technician registered person and Occupational Health Doctor registered person. Beginning 2003, consultation services were reclassified into 4 categories as shows in figure 1.6

Figure 1.6. **Categories of Consultation Services**

The number of consultation projects completed by NIOSH since 2002 until 2019 are as shown in figure 1.7.

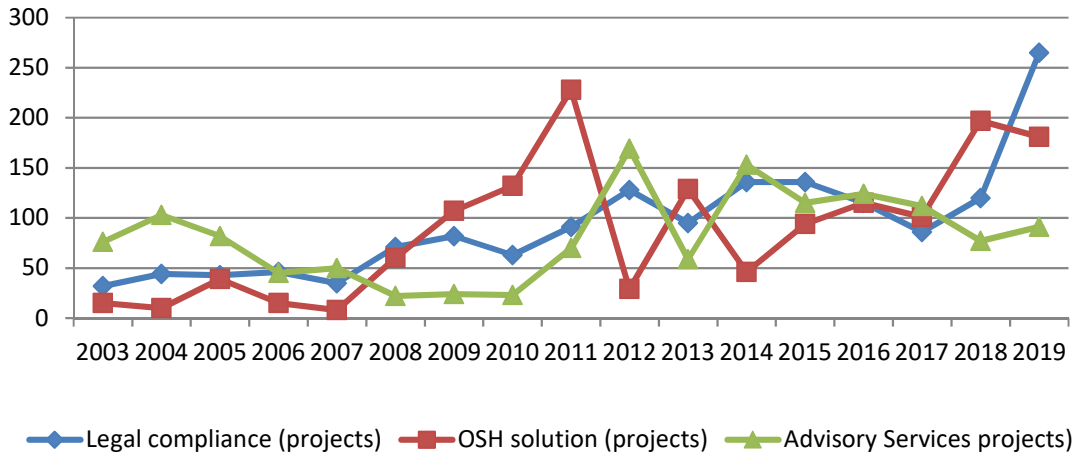


Figure 1.7. **Number of Consultation Projects Completed between 2003 until 2019**

NIOSH strived for the ISO 17025 accreditation for its IHAL service so that it can provide a recognized laboratory services to local as well as regional countries**.** The ISO/IEC 17025:2005 is used by laboratories to develop their management system for quality, administrative and technical operations. Laboratory customers, regulatory authorities and accreditation bodies may also use it to confirm or recognize the competence of the laboratories. ISO/IEC 17025:2005 specifies the general requirements for the competence to carry out tests or calibrations. It covers testing and calibration performed using standard methods, non-standard methods, and laboratory-developed methods. Eventually, NIOSH obtained the above accreditation in 2008. After the accreditation of ISO IEC, the Lab Division was established, independent of the

Industrial Hygiene Division in 2009. It was a move to assure the integrity and reliability of laboratory processes for NIOSH consultation and research activities.

Research and Development

Compared to other NIOSH core functions, research activities in NIOSH have taken a back seat due to many factors, such as manpower, time and financial constraints. Regardless, the emphasis of R&D at NIOSH has started since 2000. It started with the establishment of Board of Directors (BOD) sub-committee on R&D. This committee led by one of the BOD, with mix members from NIOSH management, academicians, industries and DOSH. The major function was to establish NIOSH R&D policy, procedures, and monitoring R&D activities. Under this main committee, R&D secretariat was also established. It is at this time that NIOSH started to offer research grants to external researchers from higher learning institutions, industries and other interested organizations/ individuals. For that purpose, 10% of NIOSH's overall profit was allocated to OSH related research projects. In general NIOSH R&D were divided into three main categories: research projects using external grant (government and private sectors); research projects using internal resources and; supervision of research projects by students from higher education institutes.

Among the relevant focus of OSH issues included stress at the workplace, exposure to chemical substances, physical working capacity, workplace physical assessment and OSH in the logging industries. Information gained from these studies and research findings benefited NIOSH in its efforts to increase the quality of information services especially to the industries and the public as a whole. The objectives of conducting R & D in NIOSH were:

- To serve as the centre of excellence for OSH in the Nation.
- To conduct basic and applied research and development on OSH.
- To disseminate research and training information of the centre in OSH.
- To cooperate with OSH establishments in R&D.
- To expand the role of NIOSH in providing reference support on scientific literature and OSH publications.
- To provide the technicalities of technology transfer for OSH activities in NIOSH.
- To conduct research that contributes to the industry development and to the socioeconomic objectives of the Nation.

In November 2008, the direction, policy, vision and mission of the R&D in NIOSH were discussed in a retreat. one of the BOD as the chairperson and two other BOD members and NIOSH Managers from technical divisions participated in the discussion. Among the recommendations made during the discussion were to amend and update the policy, organization chart, objectives, strategy and action plan for the newly established Consultation Research and Development Department CRD Department. A dedicated division was recommended to be established under CRD Department for the purpose of administering and coordinating research projects; monitoring the grants awarded to internal and external researchers; promoting R&D activities internally and externally; seeking opportunities with academia, business organization, and government agencies. Subsequently, the Innovation and Technology Division embraced the function as well as act as the Research Management Center (RMC) in NIOSH.

Despite all the limitations, several projects were undertaken in its effort to place R&D activities on firmer ground by submitting the applications for R&D grants from the Government's top-down Intensive Research in Priority Areas (IRPA) grants and the Japanese International Cooperation Agency (JICA). In October 2010, NIOSH was recognized by the Malaysian Ministry of Science and Innovation as one of the Research Institute, which entitled NIOSH to apply for the grant for R&D purposes under the Science Fund.

Under the 11th Malaysia Plan (2016 – 2020), NIOSH has secured four research projects from the Ministry of Human Resources via the Department of Occupational Safety and Health (DOSH). The duration of research for each project varied. All the projects were led by NIOSH officers, with the team members made up of researchers comprising NIOSH representatives and external experts from academia and industry. A total of 62 studies were completed between 2010 until 2019 and the breakdown of the subjects is shown in figure 1.8.

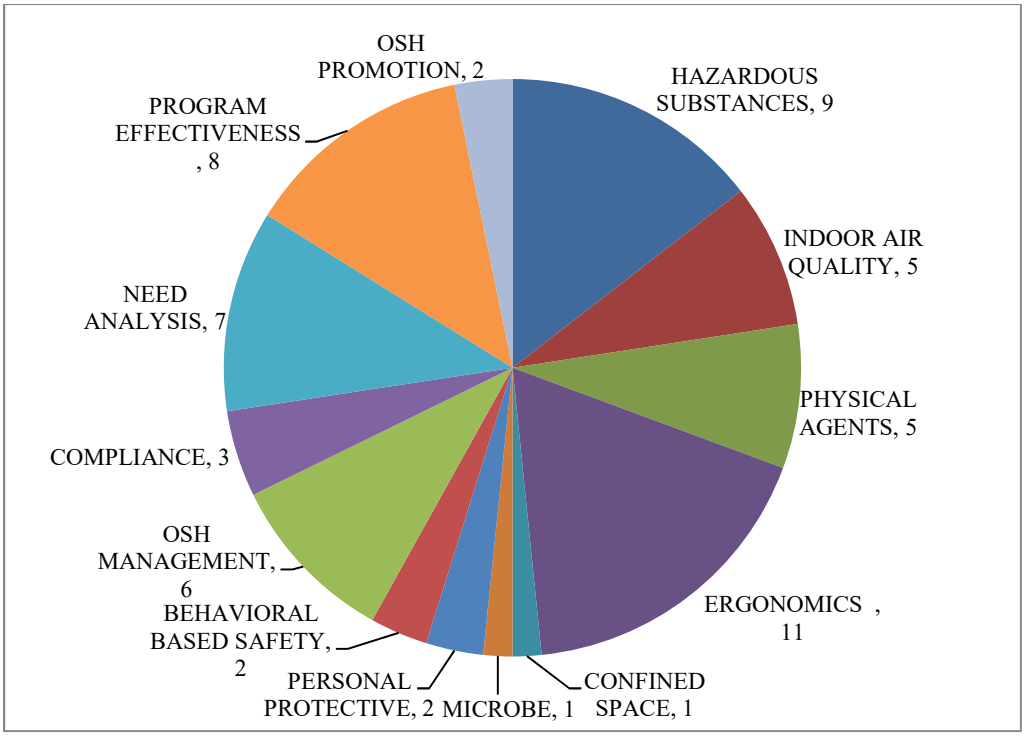


Figure 1.8. **Number of Study Completed between 2010 until 2019**

At the same time under the 11th Malaysia Plan, the Government of Malaysia through the Ministry of Human Resources has provided financial assistance for NIOSH to develop the OSH Hazard Evaluation and Control Technology Centre (OSHECT). The project is part of the government's aspiration to help NIOSH achieve its vision and mission as the centre of excellence in occupational safety and health in Malaysia. It is an additional facility development project for NIOSH campus to diversify its activities including training, consultation, research, development and information dissemination. The project consists of developing several high technology laboratories such as personal protective equipment testing, chemical analysis, engineering forensic, scientific equipment calibration and workplace hazard simulation laboratories.

The Personal Protective Equipment laboratory aims to ensure that all dust mask, gas mask and fall protective equipment to be marketed in Malaysia are properly tested and verified. The Chemicals Analysis laboratory aims to enhance the existing IHAL facilities in assisting industry towards compliance with the legislative requirement and assist industry in the implementation of a more accurate and cost-effective chemical exposure control. Forensic Engineering laboratory is equipped with specialized expertise and equipment to conduct incident or accident investigations due to structural, equipment or material failure. The Scientific Equipment Calibration laboratory provides calibration on gas detector, noise dosimeter, noise meter calibrator and sound level meter aerotest and hydrostatic test for breathing apparatus

cylinders. This will ensure the equipment used by NIOSH staff and OSH practitioners are properly calibrated and maintained. Environmental and Human Factors Ergonomics laboratory is developed at NIOSH Johor Baru campus that allows NIOSH to carry out activities for certain issues such as thermal stress, vibration, lighting, return to work program, back protection program, musculoskeletal injuries assessment and manual handling analysis. Meanwhile, the Interactive Simulation laboratory provides a simulation space that allows training participants to feel the situation at the workplace and make their own decision to choose PPE that suits the given situation. It is equipped with high technology tools such as augmented reality simulation system.

The establishment of this OSHECT is very significant to support the existing legal structure. The centre provides a complete source of reference to the industry and assists them in effectively adhered to the OSH-related legislations. This centre can make NIOSH a leading research and commercialization centre in the field of OSH, especially for researchers, makers, designers, marketers and sellers. The establishment of OSHECT is also to ensure that NIOSH is always as dynamic and competitive as other research institutions. In addition, it will also improve the quality of NIOSH services in line with NIOSH's mission and vision to become a leader in the field of OSH.

Way forward

NIOSH Consultancy Services are striving towards getting acknowledged and better recognition locally and internationally. With a limited number of experts, it is hard to accommodate the request for high end consultancy services from specific industry such as process safety management for gas and petrochemical industry. Many opted to establish multinational consultancy companies that offer the said services with a more comprehensive and attractive package. A medium and long term strategy is required to overcome the challenges for a better recognition in the future.

In the coming years, the jobs workers do, the hazards they face, and the way their work is organized will change. After more than 25 years, NIOSH should focus more on conducting applied research on emerging workplace hazards, conduct intervention studies, and publish authoritative recommendations. In the two decades since its establishment, NIOSH has grown and developed more up-to-date facilities and laboratories. However, the lack of staff with higher

academic qualifications that can initiate progress through research will make it difficult for NIOSH to evolve.

As a company, NIOSH must retain competent and experienced staff in various OSH disciplines. Specific competencies are required for NIOSH staff to deliver quality OSH services to the industry. Numerous programs are needed to achieve the said objectives. NIOSH is in dire need to establish a long-term Human Resource Development Plan and enhance its employees' benefits to overcome the challenges.

Although NIOSH's strength in training and consultation for OSH technical fields remains intact, more applied research and development for future reference in the implementation of OSH in Malaysia are needed. Technical facilities in NIOSH must be fully utilised for applied research, development and commercialization activities. More outcomes and high impacts services are highly anticipated.

Conclusion

The function of consultation, research and development in OSH is getting more important to NIOSH and the industries. It also has a huge commercial potential and demand. Thus, to fully develop this potential, due attention has to be given to the function at all levels, from the BOD, management as well as technical divisions in NIOSH. Integration and coordination are of utmost importance and its success has to be objectively contemplated. There's a significant link between consultancy, R&D and ultimately commercialization activities. The expertise in specific area of RD&C will improve the performance in consultancy activities. Information and findings of the research projects can be utilized by NIOSH in its effort to upgrade the quality of consultation, training and information services to the industries and public at large. NIOSH Malaysia, as an organization entrusted to be the Leading Centre of Excellence for Occupational Safety and Health in Malaysia should be playing bigger role through Research and Development in order to stay relevant.

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2

TRAINING IN OCCUPATIONAL SAFETY AND HEALTH (OSH)

Ruzita Mohd Shariff

INTRODUCTION

Malaysia, as a fast developing country, holds safety and health at work close to the heart. Recent emphasis on the need to balance between the need for labor protection and the need for economic growth through policies and activities related to employment carried out by the Ministry of Human Resources means employers and workers have to assume greater responsibility for the outcomes of their activities.

Approaches have also moved progressively from enforcement and penalties to prevention and workplace improvement. Such emphasis requires the Ministry to strengthen their capacity in all areas such as training, creating awareness, workplace assessment, setting up standards and etc. The National Institute of Occupational Safety and Health (NIOSH) was set up for this very purpose in mind.

Upgrading employee performance and improving their skills through training is a necessity in today's competitive and challenging work environment as job demands are changing very rapidly with the advancement of up-to-date technology.

It is an undeniable fact that untrained or poorly trained employees may cause enormous damage to the organization resulting in bad service, dissatisfied customers and consequently increased costs and loss in business for the organization as well as a tarnished image of the company.

With regards to OSH, training consists of instruction in hazard identification, risk assessment and risk control measures, learning safe work practices and proper use of personal protective equipment, and acquiring knowledge of emergency procedures and preventive actions. Training provides workers with ways to obtain added information about potential hazards and their control. They could also gain skills to assume a more active role in implementing hazard control programs or to effect organizational changes that would enhance worksite protection.

Most importantly, training in OSH will enable managers, supervisors and workers to interpret the needs of occupational safety and health management systems (OSH–MS) as well as the legal requirements. They will then apply their learning into performance in fulfilling their responsibilities and take necessary actions towards upgrading safety and health practices at their respective workplaces.

For workers in Malaysia, we are fortunate to have a strong legislative framework for occupational safety and health (OSH). However, enforcement by the Government alone is insufficient to ensure workplace safety and health. There has to be cooperation and efforts by the industries to initiate procedures and implement systems towards the Occupational Safety and Health Act (OSHA) 1994 compliance.

NIOSH is in the position to assist industries achieve this aim. NIOSH complement the Government's efforts by providing training, consultation, and information dissemination services to industries. NIOSH also undertake research and development activities that will assist in the development of OSH in the country. The mission is to become the partner of industries towards full OSH compliance.

NIOSH Training

As far as OSH training in Malaysia is concerned, The National Institute of Occupational Safety and Health (NIOSH), which was established as a company limited by guarantee on June 24, 1992 by the Ministry of Human Resources; is responsible to provide training, consultation services, disseminate information and conduct research in the field of OSH. The Board of Directors of NIOSH, which is the authority that makes policies and decisions, consists of individual from government, unions and industrial sectors.

With the vision, 'To be the leading centre of excellence in OSH', NIOSH operates its strategic mission by becoming 'The preferred partner in OSH' while delivering its functions by providing training, consultation services, disseminate information and conduct research in the field of OSH. As stipulated in the Memorandum and Articles of Association, the objectives of the Institute are:

- To contribute towards efforts in upgrading Occupational Safety and Health through developing curriculum and training programs for workers and employees, employers and those responsible, either directly or indirectly for OSH.
- To assist industry, commerce and others to solve problems relating to OSH.
- To assist those who are responsible for OSH with the latest information in the field of OSH in the country and overseas.
- To conduct applied research in OSH related areas that will benefit and bring advantages to the country.
- To disseminate information on research findings and to become the centere of reference in the field of OSH.

NIOSH Malaysia provide training for various economic sectors such as petrochemical, electronics, agriculture (notably the palm oil industry) and especially building construction. In most companies, training is an isolated event and not an integral part of the development of its human resources especially industries which have been operating as a small scale family business entities for generations such as in the furniture, printing, shoemaking, batik, handicraft, wood, automotive workshop, food, spare parts for machinery and automobiles, hardware, textiles and ceramics industries.

NIOSH offers training services on understanding the legislative requirements of OSHA 1994 and the Factories and Machinery Act (FMA) 1967, the training of competent persons for certain job tasks as required under the Act, training of trainers for specific courses and etc.

Most of its training courses are designed for the management and supervisory personnel, especially those directly involved in OSH. In 2019, 8,409 training programs were conducted compared to 7,157 in 2018 and 179,709 participants have been trained in those training programmes which recorded a 26.8% (131,569) increase compared to the previous year. NIOSH training programs can be categorized as below:

i) Public and In-House Programmes
ii) Certificate/Competency Programmes
iii) Trainer's Programmes
iv) Conference and Seminar Programmes
v) NIOSH Safety Passport Programmes (Induction for plant access)

NIOSH training programs is a structured approach to the development and attainment of competencies for a particular qualification to meet the requirements of the endorsed components of Training Packages that is a set of national training resources consisting of national competency standards, assessment guidelines and national qualifications.

NIOSH training programs include the choice of units or options within the package and the method, training and location for achieving the competencies. In respect of apprenticeships and traineeships, training programs are negotiated between providers on the one hand and employers and individuals on the other, reflecting choices made by the employers and individuals.

The ADDIE model which name is an acronym for the five phases it defines for building training and performance support tools namely Analysis, Design, Development, Implementation and Evaluation is also used as instructional systems design framework for NIOSH training programs. It is also described as 'best practice' as it relates to competency based training and assessment in many countries around the world, including the United Kingdom, Canada, New Zealand and Australia.

Figure 2.1: ADDIE Model (Source: https://elearning.niu.edu/edtech/courseDevelopmentdemo/courseDevelopmenttxt_demo.html)

OSH Training and the Industries

As an organization strives to make profits, it's easy to overlook issues that could render all of the hard work futile. These may include failure to comply with relevant statutory and social obligations.

Managing Occupational safety and Health effectively is one of those statutory obligations that need to be given appropriate consideration by the employers. It has been stipulated under the Occupational Safety and Health Act 1994, in particular of Section 15, which requires all employers and self-employed persons to ensure the safety, health and welfare at work of all his/ her employees. Under certain provisions on the same Act, they are also responsible to ensure the Safety and Health of the other person and the public.

To meet the above mentioned legislative requirement, organization should establish ways to manage safety and health issues that may arise. In particular, they must take a systematic approach to prevent injuries and the managements of the organization's hazards and risks. This can be achieved by formulating, establishing and implementing an effective Occupational Safety and Health Management System (OSHMS) at the workplace.

Training is an integral part of Occupational Safety & Health (OSH) Management System. To ensure the success of any OSH program at the workplace, adequate and effective training must be implemented for all those responsible for OSH. Training enables managers, supervisors and workers to understand the workings of safety management systems and the legal compliance required. They will then understand their own responsibilities and the necessary actions to be taken towards upgrading safety and health at their respective workplaces.

Successful employee training programs result from thoughtful and serious planning. A great deal of attention must be paid to details and desired outcomes. Difficulties arise when there is a lack of a coherent foresight regarding what training is expected to accomplish and how those accomplishments will be measured and rewarded. If these preliminary considerations are not given careful thought and the program is not implemented in a logical, systematic and sensitive manner, it will be very difficult, if not impossible, to execute successful employee training (Hughey & Mussnug, 1997).

There are legitimate reasons for many of the problems currently associated with employee training programs. If training outcomes are not fulfilling initial expectations, it may be time to rethink how it was conceived, implemented and managed. In other words, it may be time to pause, step back and make sure that the company's reasons for engaging in employee training are legitimate and responsive to actual company and employee needs. Training requires a great deal of commitment; it is very time-consuming and demands relentless ongoing support. The dedication needed to conduct good employee training is substantial.

The other benefits of training include improved consistency of product and service offerings; resulting in higher customer satisfaction; improved safety of employees and customers; improved self-esteem of employees, who feel confident because they "know" what they are doing; improvement in yield as a result of lower wastage and spoilage; reduction in employee turnover; and bottom-line benefits of all the above (Clements & Josiam, 1995).

There are many reasons why employees are not adequately trained. To begin with, training is seen as an expense, not an investment. It often takes place on an ad hoc basis, especially after a problem has been detected. In most companies, training is an isolated event and not an integral part of the development of its human resources.

Top management also failed to see that the success of such training is dependent on their commitment to allow its implementation in an effective manner as well as to allocation of sufficient budget. Moreover, in many organizations, no proper analysis of the actual training needs of the employees is carried out and as a result, some of the training attended by the employees are totally irrelevant to the needs of their job tasks.

Training for SMI

By various definitions, small and medium industries (SMIs) are those organizations that either have a small number of employees or limited amount of paid-up capital. However, small or limited their resources are, we must acknowledge that they play an important role in our economic development and thus their contributions to the country's economic growth must never be ignored.

Observations and evidences have shown that an increase in productivity and an improvement in workplace environment were the results from good safety and health work practices and culture. However, to our disappointment, many of the SMIs in the country are far from achieving such work conditions, neither do they have the correct work culture to benefit their organizations.

To understand the challenges and constraints suffered by the SMIs in meeting the demand of their customers, we took a closer look at how various types of such industries overcome their shortcomings using the limited available resources.

Various types of industries have been operating as a small scale family business entities for generations such as in the furniture, printing, shoemaking, batik, handicraft, wood, automotive workshop, food, spare parts for machinery and automobiles, hardware, textiles and ceramics industries. Financial constraints is one of the vital issues among these industries and hence they try to limit their activity towards profit or income generating purposes. Some of the owners do not believe in the idea that a good safety and health work practice would generate benefit and increase productivity. Many of the premises are still without proper infrastructures such as adequate drainage and ventilation systems and well-equipped workstations.

Apart from that, the premises are only equipped with old machinery and with no built-in safety and protective features to protect the workers. Some of the workers only know how to operate the machines with little understanding of its system or even its safety requirements. Limited availability of quality raw materials and high expectations on the products from the market force these industries to lower their prices in order to remain competitive and hence at large neglecting their other social obligations. However, the enforcement of OSHA 1994 has seen a slight improvement in workplace conditions despite unreliable accident statistics from such industries as many accidents were not reported.

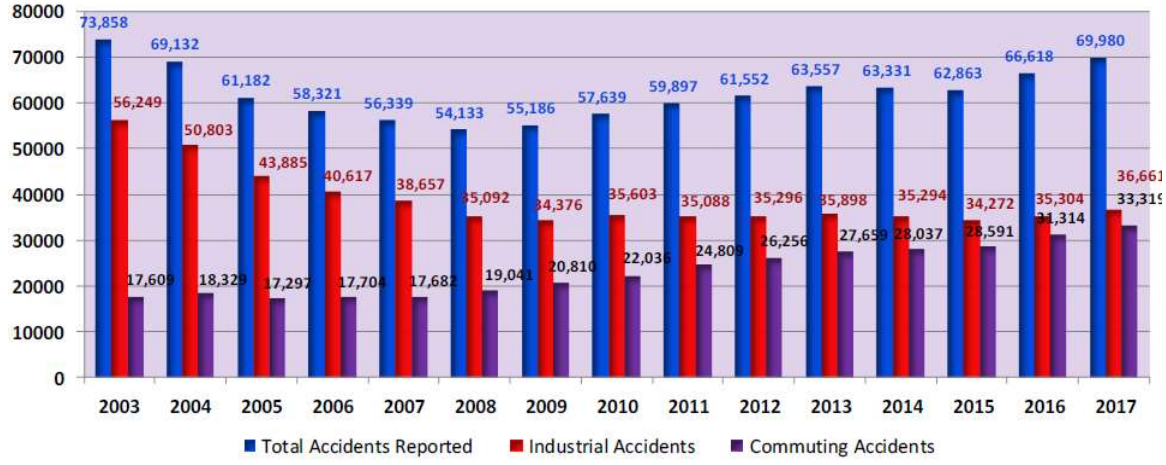

Figure 2.2: Total Number of Accidents Reported to Social Security Organization (SOCSO) 2003 - 2017

On the other hand, the rate of growth of the nation has also necessitated an influx of foreign workers (from Indonesia, Philippines, Myanmar, Ceylon, India, Bangladesh, Nepal) to support growth in most labour intensive commercial activities.

Thus, NIOSH has initiated the NIOSH Safety Passport for contract workers through a memorandum of agreement with interested industries. Under the agreement, NIOSH and the proposed industry would jointly develop and conduct Occupational Safety and Health Induction training for personnel.

The safety passport program is expected to improve the safety practices and standard among workers, particularly contractor's workers. Besides sharing best practices and experiences, the partnership and cooperation will ensure efficiency in term of cost, elimination of redundant induction training, and increase the workers' competency level.

All working personnel is required to attend the induction program. An assessment is conducted by NIOSH and successful candidates will be awarded the safety passport, which is valid for a maximum period of two or three years. It can be renewed after successfully attending a refresher course and passing the assessment conducted by NIOSH.

Training and Development: Its Principles and Approaches

In general, training refers to instruction and practice for acquiring skills and knowledge of rules, concepts, or attitudes necessary to function effectively in specified task situations (Cohen & Colligan, 1998).

Training can also be described as systematic process of acquisition of knowledge, skills and attitudes required to perform more effectively on one's current job (Blanchard & Thacker, 1999). Effective training must address the personal needs of employees, helping them to learn, to grow, and to cope with the issues that are important to them. Meanwhile, effective training strategies and practices are those that meet the needs of the organization while simultaneously responding to the needs of individual employees.

The learning pedagogy for adults requires the learner to be willing and responsible of the learning process and at the same time able to participate at their own speed. The learning activity must start from their existing knowledge and experience and they learn best by doing in a non-threatening environment. The success of any learning process can be measured by observing the degree of behavioral change from the participant. There are three types of behavior to be observed:

a) cognitive or knowledge,
b) skill or psychomotor and
c) attitude or feelings.

To market any training program for the SMI, we must first convince the owner of the company either through personal/direct contact or through existing trade associations with both informal and coercive approaches. Highlighting the immediate productivity gain they would enjoy versus the impact of their trained workers would be an indirect marketing strategy. Such strategy is focused on their achievement, linking working and other management conditions and building on local practice.

The cultural background of the workforce such as ethnic group, education, age and earlier work environment contribute to the selection of the learning approaches. Apart from that, the constraints and limitations faced by SMI would inevitably hinder the smooth implementation of the training program if serious commitment from the CEO was absent.

Cultivating the correct and positive mindset of the participants is also vital in an effort to create a conducive training environment as well as setting the right focus in the training program. Hence, the correct motivation and support from the management are essential to ensure the success of any training package. The training designer and the trainer must therefore adopt the appropriate approach and consideration before designing the program for the target group.

The selection of any training technique would depend on several factors such as cost effectiveness, desired programme content, appropriateness of the facilities, trainee and trainer preference and capabilities as well as the learning principles. However, the learning objectives could be achieved by means of adjusting the above factors to suit the target group and their training needs. The emphasis of each of the above factors would greatly depend on a particular situation and work condition of an organization.

One of the most popular techniques used by a trainer is lecturing simply because it is cheap and easy to prepare within a short time frame. Unfortunately, this allows little or no participation of the participants. Feedback and interaction from the participants could be achieved if there is either a discussion or question and answer sessions in between lectures.

A combination of these techniques would increase and enhance the understanding of the students as they allow the students to share and discuss their experiences and opinions. However, the use of audio visual aids such as an overhead projector, whiteboard and flip charts provide avenues for trainers to use their creativity in providing detailed explanations.

In general, televisions, films, pictures, videos and slides provide a better and clear illustration of complex situations and scenarios in a static or pictorial motion as these techniques are presented by means of audio and visual senses (except for slides and pictures). Explanation of hazards associated with confined space, noise problems, working at height and working with hazardous chemicals can best be presented using this technique. The use of videos and films

must not be too long i.e, a maximum of five to twenty minutes and must be followed with an explanation or summary at the end of the show.

In a situation where a practical session is not possible such as analysis of an accident or a disaster, a case study technique is most suitable as it provides a real life scenario for a trainee to evaluate and learn from real or hypothetical circumstances and the actions or decisions taken by others under those circumstances. Some vital skills could be learnt through participating in a real life simulator such as what needs to be done during an underwater emergency. Such simulation provides a real experience for the trainee with maximum learning benefits in handling those critical moments of lifesaving.

Another participatory approach that provides an equivalent practical experience is a role-play session in which a situation could be play-acted by a group of participants. Using this technique, experiential learning takes place during acting and others may learn through observation of the role-play. These techniques however require extra effort, vast knowledge, additional time and detailed preparation from trainers and hence is not so popular.

With the emergence of new technologies are new types of hazards. Solving problems or issues in occupational safety and health then require discussions and new ideas generated from experienced OSH practitioners as well as academicians. Tapping such learning situations is usually available in the form of forums, dialogues and seminars conducted either at national or international level.

Acquiring skills on understanding how a machine operates safely or how an equipment functions safely can only be best learnt by a trainee through a technique called on-the-job training. During this process, the trainee receives the overall scope of the job, its purpose and desired outcomes with emphasis on the relevance of training. The training would go through a sequential process in a systematic way as understood by the trainer and requires full participation of the trainee.

Demonstrations and explanations by the trainer and practice by the trainee are repeated many times until the trainee can perform the job with confident without mistakes. Unlike on-the-job training, which is conducted at the premises, laboratory training is usually conducted in a training institution but with the same emphasis on participation from the trainee. During laboratory training, a trained professional would facilitate the session and sharing of experience and know-how among the trainees would develop the desired behavior for a specific job responsibility.

Job rotation in an organization is not uncommon as it helps the worker to enrich his/ her job responsibilities before a promotion can be offered. It is also a way of creating the job function less boring or sometimes a way of resolving existing problem such as absenteeism or resignation. Training program in the job rotation activity requires a proper job instruction manual, demonstration by an experience supervisor followed by repeated practice by the trainee.

Participatory approach training techniques must be adopted whenever possible as they utilize methods suitable for maximum learning benefits and hence produce the best training output. In the new era of information technology, self-study and distant learning is the most sought after technique by a busy and enthusiastic employee. This method allows him to learn at his own pace in and plan his own timetable. This is a flexible approach whereby they get their own reading materials, notes and information using the Internet or PC based references with little or no supervision from a trainer/lecturer.

Technical Content and Resource Requirement

Competent worker is the key to ensure sustainability of the organization and strengthen their competitiveness in global market. Competency based approach originated from parallel developments in vocational training in many countries such as the United Kingdom, United States of America, Australia and New Zealand as political perceived need to make the national workforce more competitive in the global economy (Leung, 2002). Competency based programme consists of functional analysis of occupational roles, translation of these roles into outcomes, and assessment of trainee's progress on the basis of their demonstrated performance of these outcomes.

Potential advantages include individualised flexible training, transparent standards and increased public accountability. However, if competency based program applied inappropriately, it can result in demotivation, focus only on minimum acceptable standards, increased administrative burden and a reduction in the educational content. Competency based program could be the answer for the gap between 'what is' and 'what should be' found in some literatures (Gebbie, Merril, & Tillson, 2002).

The selection of the technical input for the purpose of training must have clear, realistic, relevant and achievable objectives for a particular target group with their background, existing work situation and the training needs taken into full consideration. Selective popular and practical topics can be chosen to meet the required job demands as shown below:

1. Adequate Lighting Facility
2. Stress at Workplace
3. Machinery Safety
4. Noise and Its Conservation Program
5. OSH Management System
6. Legislative Requirement and Its Implementation
7. Welfare Facilities
8. Housekeeping
9. Risk Management for SMI

10. Preparation of Checklist and Inspection
11. Working at Heights
12. Control of Hazardous Substances
13. Material Storage and Handling
14. Workstation Design and Ergonomic Issues

In designing training modules, resources such as staff requirements, training facilities (including classroom design), audio visual aids and allocation of budget must first be discussed and identified before the actual program can be drawn. The availability of these resources will determine the sequence and versatility of each program developed.

Monitoring and Evaluation for Improvement

The objectives of the evaluation conducted at the end of each training program is to analyze any feedback received from various parties regarding the training program and also to measure the performance of trainee, trainer and whether the course objectives are met. Measurements on the change of behavior as perceived by the trainee and their employer provide some indication on the success of a particular training in the form of either knowledge or skill acquisition and changing of attitudes or behaviour. Depending on the objectives of the evaluation, various types of evaluation methods can be adopted such as verbal feedback, questionnaires, simple tests, assessments or even examinations.

Rae (2004) explained, elements which contributed to training effectiveness include course contents, course duration, training methodology, trainer's performance, participant's involvement, training location, balance of program and its administration. He also suggested that 'reactionnaire' for post-training feedback are the most effective way of:

i) determining what the participants have learned
ii) giving the learners time to reflect on their learning during the program prior to their completion of their post-training personal action plan
iii) getting useful feedback in an organized manner, to help with future training planning, and
iv) ensuring trainees and learners follow-up their training with relevant actions to apply, improve, develop and reinforce learning attained.

It is often valuable to obtain the reactions of training participants to matters outside the evaluation of the learning itself, e.g., domestic arrangements, style and pace of training delivery, training administration, etc. By using a well-constructed and effective 'reactionnaire', useful data can be obtained to help plan future training. It is not necessary to have this type of feedback completed after every course or program. Use 'reactionnaires' for the first two or three times that a new programme or course is run, to enable fine-tuning and to identify problem areas.

The most well-known and used model for measuring the effectiveness of training programs was developed by Kirkpatrick (1959). It has since been adapted and modified by a number of writers; however, the basic structure has well stood the test of time. The basic structures of Kirkpatrick's four-level model are as follows:

Level 4 - Results	What organizational benefits resulted from the training?
Level 3 - Behavior	To what extent did participants change their behavior back in the workplace as a result of the training?
Level 2 - Learning	To what extent did participants improve knowledge and skills and change attitudes as a result of the training?
Level 1 - Reaction	How did participants react to the program?

An evaluation at each level answers whether a fundamental requirement of the training program was met. All levels of evaluation are important. In fact, the Kirkpatrick model explains the usefulness of performing training evaluations at each level. Each level provides a diagnostic checkpoint for problems at the succeeding level. So, if participants did not learn (Level 2), participant reactions gathered at Level 1 (Reaction) will reveal the barriers to learning. Moving up to the next level, if participants did not use the skills once back in the workplace (Level 3), perhaps they did not learn the required skills in the first place (Level 2).

OSH Training Way Forward

The success of the above training approaches and principles solely depend on the honest commitment, correct motivational attitudes and self-awareness of the CEO of the organization. However, maximum training can only be achieved if the participants undergoing the training are personally willing and positively motivated to become better and skilled workers.

The recommendations below seem feasible to be expedited in an effort to create a conducive environment for the SMI to actively participate in the OSH training programmes with an objective to promote a safe and healthy workplace for the SMI:

1. More research and study should be conducted by government agencies, training institutions and SMI groups to identify the training needs for different types of workers as perceived by the group from various types of industries.
2. Government institutions should provide infrastructure and basic facilities such as proper work premises according to the respective industries including systems like roads & transport, drainage & sewerage, IT & communication as well as loan facilities and technical information on the industry concerned.
3. The authorities should carry out enforcement in a subtle approach.
4. Training institutions with the help of multi-national companies should develop specific training programs to meet the needs of different types of workers from different SMI groups.
5. The mass media should help to promote and facilitate the training programs for the SMI using the available means and resources.

In conclusion, continuous education and training must be regularly included in the program for SMIs, especially in the aspect of occupational safety and health. Constant and consistent effort in the spirit to upgrade and improve their existing work conditions is the pre-requisite of making OSH in SMIs a dream come true. With support from the relevant agencies, governmental and non-governmental, as well as awareness and dedication of the industries, the goal of promoting a safe and healthy environment at all workplaces in Malaysia would become closer to achieving its aim.

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3

OSH LABORATORY ANALYSIS AND TESTING FOR SCIENTIFIC EVIDENCE

ChM. Mohd Norhafsam Maghpor

INTRODUCTION

OSH professionals must base their advice, recommendations or interventions on evidence from science. Scientific evidence can help policy makers in their decision making process. For example, the increasing trend of occupational diseases in Malaysia from 2010 – 2019 as shown in Figure 1. Laboratory testing will be done to diagnose the occupational diseases, in which the data derived from this can be used to drive the policy makers to strengthen the OSH policy in the country.

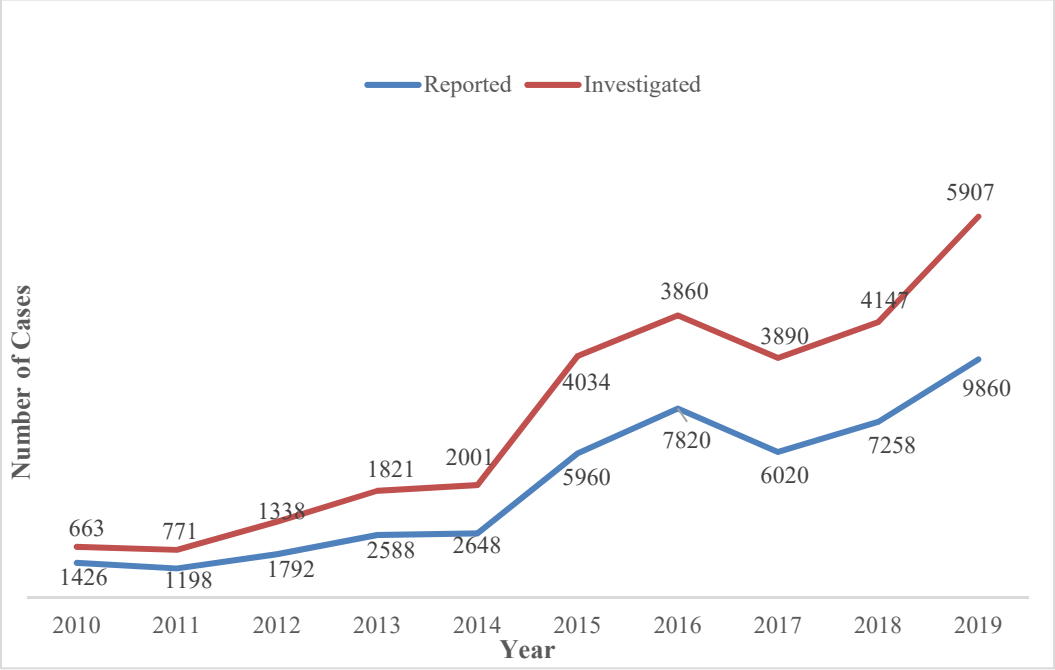


Figure 3.1. **Occupational disease trend in Malaysia 2010- 2019(Source: DOSH Annual Report, 2019)**

Legislation that Drives OSH Lab Testing

Industrial Hygiene activities in Malaysia began in 1970s when the Department of Occupational Safety and Health Malaysia (DOSH) started to inspect the factories to identify health hazards.

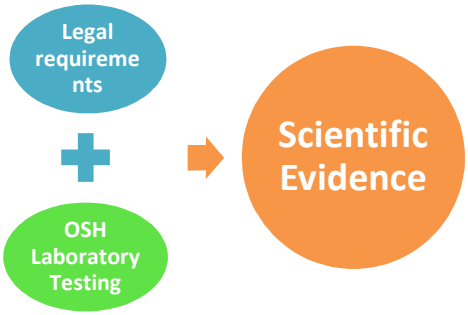
Four regulations related to the practice of Industrial Hygiene were gazetted under the Factories and Machinery Act 1967 (FMA 1967) namely:

- Factories and Machinery (Lead) Regulations 1984
- Factories and Machinery (Asbestos Process) Regulations 1986
- Factories and Machinery (Mineral Dust) Regulations 1989
- Factories and Machinery (Noise Exposure) Regulations, 1989

Under these regulations, employer must have scientific evidence that indicate employees' exposure to health hazards is within the permissable limit. For instance, to determine that the level of exposure to chemical hazardous to health and noise does not exceed the Permissible Exposure Limit (PEL) as stipulated in the clauses, scientific evidence will be derived from of the chemical and noise exposure monitoring results. Other examples of scientific evidences is health surveillance, which consist of medical surveillance and biological monitoring. In 2000, the Use and Standards of Exposure of Chemicals Hazardous to Health (USECHH) Regulations was introduced to strengthen the legislation in which all chemicals hazardous to health are controlled under its clause.

Several legislations including regulations, guidelines, code of practices and manuals were also introduced, amended or revoked between year 2010 to 2020. Amongst them are:

- Occupational Safety and Health (Noise Exposure) Regulations 2019
- Manual of Recommended Practice on the Assessment of the Health Risks Arising from the Use of Chemicals Hazardous to Health at the Workplace 3rd Edition, 2018
- Guidelines for Asbestos Removal, 2017
- Classification, Labelling and Safety Data Sheet of Hazardous Chemicals (CLASS) Regulations, 2013
- Industry Code of Practice of Indoor Air Quality, 2010



The introduction of these legislations create the needs for more scientific evidences obtained through laboratory testing which resulted in the establishment of many OSH-related laboratories in Malaysia.

Industrial hygiene testing laboratories in Malaysia

In Malaysia, industrial hygiene testing laboratory is really small in number compared to the existing testing laboratories. Most of the existing laboratories offered a wide range of testing such as water, food, medical, physical and mechanical testing which is way more profitable due to high numbers of sample received. According to Department of Standards Malaysia, a total of 981 laboratories has been accredited with *Skim Akreditasi Makmal Malaysia* (SAMM) based on ISO/IEC 17025 ((Testing and Calibration Laboratories). It is the international reference for testing and calibration laboratories, wanting to demonstrate their capacity to deliver reliable results. Meanwhile, out of 636 accredited laboratories, 15 laboratories were identified as providing industrial hygiene testing in 2014 ,equivalent to only 2.4 percent of the accredited laboratories. However, this does not reflect the whole population since a lot more laboratories are not accredited.

Industrial Hygiene Analytical Laboratory in NIOSH Malaysia

Industrial Hygiene Analytical Laboratory (IHAL) was set-up as part of Industrial Hygiene Division (IHD) in late 90s with the objective to conduct research and support IHD monitoring activities.

Human capacity building has been identified as the utmost priority along with facility development. In collaboration with Japan International Cooperation Agency (JICA), NIOSH Malaysia was given the opportunity of developing technical workers under the project called "The Capacity Building of NIOSH Malaysia". Other programs conducted during the NIOSH Malaysia – JICA collaboration were placement of long-term Japanese expert in NIOSH, despatched of Japanese short-term expert to NIOSH from time to time (as needed) and training of NIOSH staff in Japan.

A number of NIOSH staff were sent for training in Japan from 2001 to 2005 for laboratory related training that included sampling and analysis with more emphasis on industrial hygiene, occupational health and ergonomics such as:

- Biological monitoring and analysis
- Working environment measurement and evaluation
- Measurement of mineral dust and x-ray diffractometer
- Diagnosis and prevention of health disorder due to heavy metals
- Noise control
- Ergonomics in workplace

Other than NIOSH-JICA program, human capacity building for OSH laboratory testing was also conducted through collaboration with several other agencies locally and internationally. They are:

- National Institute of Occupational Safety and Health, Japan (JNIOSH)
- INSPEC United Kingdom
- Technical University of Munich, Germany
- Korean Occupational Safety and Health Agency (KOSHA)
- Malaysian Institute of Chemistry (IKM)
- Local Universities

IHAL scientific equipment were acquired through funds from the Malaysian government grant, JICA assistant as well as from internal operating expenses. This laboratory is equipped with numbers of equipment for industrial hygiene analytical testing such as:

- High performance liquid chromatography (HPLC)
- Gas chromatography (GC)
- X-ray diffractometer (XRD)
- Atomic absorption spectrophotometer (AAS)
- Phase contrast microscope (PCM)
- Ion chromatography (IC)

The main focus of IHAL is to evaluate the worker's level of exposure to chemical hazardous to health as well as microbe at the workplace while helping the industry to comply with the local legal requirements. Uniquely, compared to other laboratories in Malaysia, IHAL is a niche occupational safety and health (OSH) testing especially industrial hygiene. The scope of testing include:

- **Workplace environmental sample** – sampled by Hygiene Technician (IHT1) as per requirement under Part VIII of USECHH 2000 (Monitoring of Exposure at the Place of Work)
- **Biochemical samples such as urine and blood** - by Occupational Health Doctor (OHD) as per requirement under Part IX of USECHH 2000 (Health Surveillance)
- **Microbiological samples** - by indoor air quality assessor to complement the Industry Code of Practice of Indoor Air Quality, 2010

Initially, only samples collected by Industrial Hygiene Division, NIOSH were analyzed. In 2005, the laboratory services was commercialized and offered to Occupational Health Doctor and Industrial Hygiene Technician (IHT1) DOSH competent person for testing of biological sample and environmental sample respectively. The objective was to help the industries in strengthening the industrial hygiene testing as well as helping the employer in complying with the legislation through laboratory testing.

In the early years of operation (before 2005), few samples were collected and analyzed yearly but it increased to nearly ten thousand samples after almost two decades of operation with the exception of more than fifteen thousand samples in 2015 as shown in Figure 3.2. The increasing trend coincides with the increase in the number of tests provided. As in 2018, a total of 72 testing parameters were offered for testing by IHAL commercially as in Table 3.1.

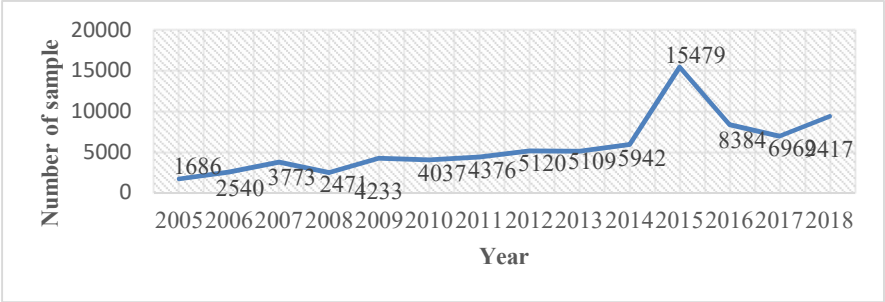


Figure 3.2. **Trend of sample analysed by Industrial Hygiene Analytical Laboratory (IHAL)**

Table 3.1 **Testing parameter provided by the Industrial Hygiene Analytical Laboratory (IHAL)**

Tested sample	Testing parameter	Number of parameter
Workplace environmental sample	Heavy metal	14
	Organic solvent	20
	Dust and fibers	7
Biological sample (urine)	Heavy metal	12
	Organic solvent	4
Biological sample (blood)	Heavy metal	12
Microbiological sample	Total bacteria/fungi count	2
	Legionella Pneumophila	1
Total		72

Journey towards IS0/IEC17025 Accreditation. The journey of Industrial Hygiene Analytical Laboratory (IHAL) to be accredited for *Skim Akreditasi Makmal Malaysia* (SAMM) based on ISO/IEC 17025 was accomplished in 2009. IHAL was accredited with SAMM identification number of 412 with only 5 parameters. Since then, IHAL has advanced to be one of the leading IH analytical testing laboratory in Malaysia driven by a team comprises biomedical expert, chemists, microbiologists and medical laboratory technologists. In 2020, IHAL accreditation was extended to ISO/IEC to 52 testing parameters.

In 2011, for the first time IHAL has received the Laboratory Excellence Award organized by the Malaysian Institute of Chemistry (IKM). The award is a a recognition to laboratories that have achieved competency in the practice of analytical work. Besides that, the award was designed to ensure the laboratory's commitment to achieve excellence in providing quality and competent testing

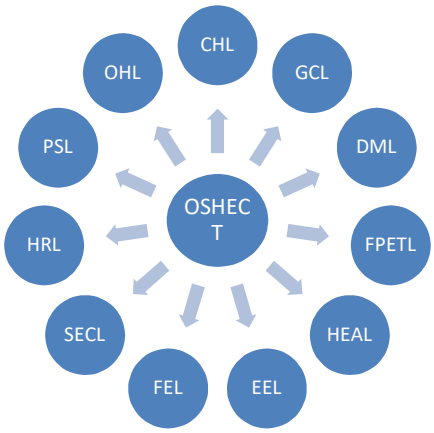
services pertaining to local legislation especially in the fields of health, safety and the environment. IHAL has proven their excellence in laboratory services by continuously receiving the award in the next ten consecutive years (2011-2020).

Development of OSHECT

Under the Eleventh Malaysia Plan (11th MP), Government of Malaysia through Ministry of Human Resources has provided fund for NIOSH Malaysia to develop an integrated OSH laboratories. Known as OSH Hazard Evaluation and Control Technology Centre (OSHECT), the project was developed from 2016 to 2020. The overall objective of the project is to provide support facilities for activities at NIOSH Headquarters in Bandar Baru Bangi and at Southern Region Campus, Johor. Other objectives of OSHECT are:

- To provide the capability and capacity of OSH technical service as well as the quality of delivery and its effectiveness.
- To provide OSH scientific evidence through upgraded and modernized testing facilities.
- To enhance OSH research development through technical sharing.
- To preserve and strengthen relationship between government and industry in terms of OSH.

By the end of 2020, 11 laboratories has been developed and operated. Some of the laboratories have been accredited and the rest are in the process of accreditation with SAMM by Department of Standards Malaysia. The eleven laboratories are:



- Chemical Hazardous Laboratory (CHL)
- Gas Detector Calibration Laboratory (GCL)
- Dust Mask Laboratory (DML)
- Fall Protection Equipment Testing Laboratory (FPETL)
- Human Ergonomics Assessment Laboratory (HEAL)
- Environmental Ergonomics Laboratory (EEL)
- Forensic Engineering Laboratory (FEL)
- Scientific Equipment Calibration Laboratory (SECL)

- Hydrostatic Testing Laboratory (HRL)
- PPE Simulation Laboratory (PSL)
- Occupational Health Laboratory (OHL)

Chemical Hazardous Laboratory (CHL). As part of the OSHECT, IHAL was renamed as Chemical Hazards Laboratory (CHL). It continues to offer testing and analysis of samples mostly from industrial hygiene scope including:

Workplace Environmental Samples - Sample collected by Hygiene Technician (IHT1) as per requirement under part VIII of USECHH 2000 (Monitoring of Exposure of the place of work.)

Biological Samples - By Occupational Health Doctor (OHD) per requirement under part IX of USECHH 2000 (Health Surveillance).

Microbiological Samples - By indoor air quality assessor to complement the Industry Code of Practice on Indoor Air Quality 2010.

CHL is equipped with state of the art scientific equipment such as Inductively Coupled Plasma Mass Spectrometry, Mercury Analyser and Gas Chromatography. CHL offers analysis of various parameters from particulate matter, solvent, heavy metals, as well organic and inorganic. Most of the testing methods are referred to internationally recognised test method such as NIOSH Manual Analytical Method (NMAM). CHL is also accredited with *Skim Akreditasi Makmal Malaysia (SAMM)* which is equivalent to ISO/IEC17025 accreditation.

Gas Detector Calibration Laboratory (GCL). NIOSH Gas Detector Calibration Laboratory (GCL) was established in 2015 and accredited with SAMM accreditation by Department of Standards Malaysia based on ISO/IEC 17025 under the field of Electrical in 2016. At present, GCL is part of OSHECT. GCL's mission is to assist industries to comply with the Industry Code of Practice for Safe Working in a Confined Space 2010 (ICOP CS 2010) and OSHA 1994. Under

the Requirement to Ensure Safety at Atmosphere of ICOP CS 2010, it is essential to ensure that the gas detector used at the workplace is calibrated as in clause 8.6.5(b).

GCL calibration service:

- conducted in a controlled environment to comply with the calibration procedures;
- performed in triplicate to acquire the best measurement uncertainty;
- performed by competent personnel and technical experts; and
- result is endorsed by the Approved Signatory, which is approved by the Department of Standard Malaysia.

To date, more than 250 units of portable gas detector were calibrated, which comprised of more than 10 different models. Currently, GCL is capable of calibrating detectors with sensor such as methane, oxygen, carbon monoxide, hydrogen sulphide, carbon dioxide, chlorine, ammonia and volatile organic compound (VOC). GCL also provide advisory services with regards to the proper usage, maintenance and storage of the gas detector.

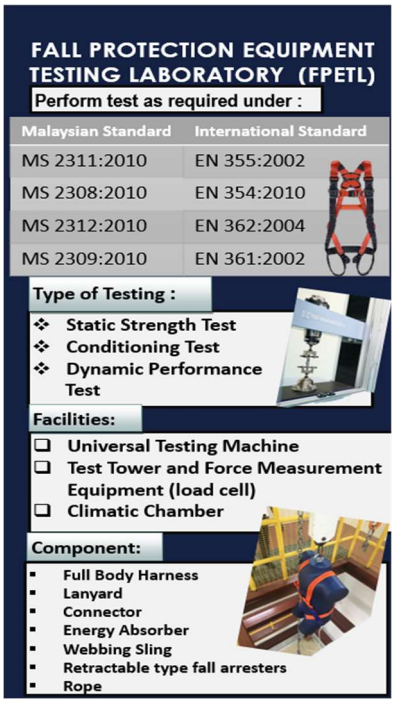
Dust Mask Laboratory. Dust Mask Laboratory (DML) was established in 2018. The establishment of this laboratory is to conduct laboratory testing on respiratory protection, specifically for dust mask, which include reusable and non-reusable respirators. All of the tests conducted are referred to the Malaysian Standards, which is also equivalent to the European Standards. Therefore, DML is equipped with mostly European technology instruments.

After almost 2 years in operation, DML has dealt with more than 60 companies with 2000+ samples. Other than laboratory test, DML believes that research is also important to

strengthen the fundamental and justification pertaining to the technical parts of respiratory protection. Hence, DML was involved in research collaboration with other government agencies such as Ministry of Health Malaysia (MOH), Malaysian Nuclear Agency and local universities.

Fall Protection Equipment Testing Laboratory (FPETL). NIOSH Malaysia was given the responsibility under the Eleventh Malaysia Plan (11th MP) to develop a testing laboratory to be used to test and ensure fall protection equipment used by workers in Malaysia is in accordance with the relevant standards such as British Standard (BS EN) and Malaysian Standard (MS). Consequently, the construction and renovation of Fall Protection Equipment Testing Laboratory (FPETL) started on June, 2017. A year later, on August, 2018 FPETL was fully established with three main facilities such as static strength testing room, climatic testing room and dynamic performance testing tower.

FPETL has conducted a research namely "Compliance Study of Fall Protective Equipment to MS standard". The research found that 60% of the common brand available in the Malaysian market complied with the MS standard. FPETL also collaborated with SIRIM QAS International in term of certification process for DOSH-SIRIM PPE approval. Currently, there are various types of fall protection equipment offered in the market that are not being controlled and monitored comprehensively before they are available to the users. This has led to inconsistent views especially on the marking and certification, quality, safety and health features of the fall protection equipment offered by different companies among the users. Therefore, FPETL as one of the laboratory under OSHECT aims to be a leading laboratory for fall protection equipment testing in this region with 'Safety Mark' and in the process of obtaining ISO 17025 accreditation.



Forensic Engineering Laboratory (FEL). Forensic Engineering Laboratory (FEL) was developed in 2018 as a part of the OSHECT development. The laboratory has the capability to analyze scientific evidence collected from accident site. NIOSH technical expert will prepare a technical report based on the scientific evidence and to be issued for further action by relevant parties. The Objectives of FEL are to:

- provide technical service on investigating the root cause of incident based on scientific evidence.
- formulate technical safety recommendation for the industries to prevent industrial accidents.
- conduct scientific researches for risk reduction of industrial accidents and creating safer and comfortable work environment.
- collaborate with government and industries on accident prevention program

Table 3.2 FEL Major equipment and their functions and applications

Name of Equipment	**Function & Application**
Metallographic Abrasive Manual Cutting Machine	To be used for cutting metal and non-metal specimen
Metallographic Automatic Mounting Press Machine	Mount Metallurgical, petrographic and other Materials for Microstructural Analysis
Metallographic Semi-Automatic Grinder-Polisher	Consistently grind to the area of interest by programming the machine to remove a certain depth.
Micro Hardness Tester	To determine hardness in materials in the micro hardness test load range
Metallurgical Microscope With Microscopy Camera & Analysis Software	High power microscope used for the purpose of viewing metallurgical samples as well as a variety of other opaque objects in which this instrument is capable of producing a magnified image of a small object
3D Printer For Rapid Prototyping	To develop a model or prototype directly from CAD data with complex geometry wax support structure.

Human Ergonomics Assessment Laboratory (HEAL). The Human Ergonomics Assessment Laboratory (HEAL) is located at Ergonomics Excellence Centre (EEC) Johor Bahru. As part of the OSHECT, HEAL is committed to become the centre of excellence which can serve as the best reference facility for research and services in the field of human ergonomics. To achieve the goal, HEAL has been equipped with complete advanced equipment to ensure that the necessary competencies required by Research and Development (R&D) and services staff in the human ergonomics discipline are fulfilled. HEAL focuses more on research activities, one of the cores in the field of ergonomics. The outputs obtained from the establishment of HEAL have enabled NIOSH to carry out the following activities:

- Conduct research and facilitate the process to produce a standard on Malaysian anthropometric measurements
- Work hardening program
- Back to work program
- Back Protection program
- Assessment of musculoskeletal injuries
- Manual handling study/advice on load handling
- Physical and mental fatigue studies
- Gait and kinesiology studies

Since 2018, HEAL has successfully contributed massive amount of researches and services output such as Industrial Ergonomics Evaluation and Risk Management, Ergonomics Product/Design Verification, and Functional Capacity Evaluation to various industries that include governments agency and private sectors. To date, the laboratory testing was performed on more than 20 agencies either on-site or off-site (laboratory settings). Led by NIOSH's

ergonomics expert and technical officer, the HEAL laboratory covers a wide spectrum of research and evaluation with the use of the following advanced equipment:

- 3D Motion Capture (OptiTrack)
- Freedom Functional Capacity Evaluation System
- Industrial Lumbar Motion Meter (LMM)
- Ergonomics and Analysis Software (ErgoMaster, 3DSPP)
- Wearable Muscle Oxygen Monitor and Lactate Threshold
- Ergometer (Cortex)
- High-Performance Treadmill (Cortex)
- Wearable Electroencephalogram (EEG)
- Wearable Metabolic System (Cortex)
- Tobii Pro Eye Tracking with Sensor
- Physiological Monitoring System (Zephyr)
- Delfin VapoMeter
- Near Point Meter

Environmental Ergonomics Laboratory (EEL). Environmental Ergonomics Laboratory (EEL) is one of the OSHECT that was established at NIOSH Ergonomics Excellence Centre. The establishment of this laboratory is to provide ergonomics environmental technical services and support as well as research and development activities in assessing and evaluating the environmental effect to human. EEL is able to measure and test environmental ergonomics factors related to:

- Heat stress and heat strain
- thermal comfort
- Whole body and hand arms vibration
- Light intensity, luminance and visual comfort
- simulation of control environment and human performance in extreme environment condition

With the availability of sophisticated and up-to-date equipment, the laboratory attempts to provide more services, technical support and development activities to the stakeholders such as industry, government and educational institution. Several research project and publication have been completed and published in various high impact articles and journals.

Scientific Equipment Calibration Laboratory (SECL). Scientific Equipment Calibration Laboratory (SECL) was completely built in December,2019 under RMK-11 grant. SECL is established to calibrate equipment used for monitoring purposes especially in safety and health.

Its main objective is to provide local calibration facility and to produce reliable result for monitoring activities. SECL has been equipped with scientific equipment to calibrate sound level meters, dosimeters and noise calibrators under the standards set by IEC 61672. SECL plans to further expand the scope of calibration to several areas that will include vibration, heat and velocity calibration. It is hoped that the laboratory will be able to cater to all equipment used in the field of safety and health in Malaysia.

Hydrostatic and Refilling Laboratory (HRL).

Hydrostatic and Refilling Laboratory (HRL) was established in 2015 and a part of the OSH Evaluation and Control Technology Centre (OSHECT). HRL provides maintenance services for Breathing Apparatus (BA) cylinder which is required under 49 CFR 180.209 – Requirement for Requalification of Specification Cylinders for every 5 years. Currently, there are 2 types of cylinder that are widely used in the industry; a) composite cylinder and b) steel cylinder. Both cylinders will be tested according to ISO 11623:2015 and BS EN 1968:2002 respectively.

HRL also provides the refilling of breathing air cylinders that meet the BS EN 12021:2014 requirement. The quality of air generated from compressor are monitored every quarter of the year to ensure the air quality is consistent with the standard requirement.

PPE Simulation Laboratory (PSL). The development of PPE Simulation Laboratory (PSL) began in 2017. PSL is located at level 2 Bangunan Utama, NIOSH Bandar Baru Bangi. PSL is a teaching laboratory that uses Augmented Reality (AR) which allows interaction with holograms in the real world. The system embedded into the device is called NIOSH Augmented Reality Simulation of Safety and Health Training (NART). As the benefit of the system include improved safety, efficiency, communication and collaboration. NART simulate training in which managers, supervisors and workers are made to understand their own responsibilities and the necessary actions to be taken to upgrade safety and health at their respective workplaces, the workings of safety management systems and the required legal compliance.

PSL offer Interactive Training modules namely Laboratory Safety, Working at Height and Confined Space. Throughout the development of phase, PSL was visited by local and private universities, government agencies and organizations. Other than teaching laboratory, PSL anticipates more research collaboration pertaining to IR 4.0.

Occupational Health Laboratory (OHL). Occupational Health Laboratory (OHL) was established in 2016 under RMK-11. As a sub-unit under the Occupational Health Centre, OHL provides support and services mostly on occupational health issues and specifically on Total Wellness and Health Promotion (TWHP). The testing include physical body composition analysis, cardiovascular exercise testing and human performance testing. All of the analysis were conducted with a consultation that will recommed exercise as a prescription and cardiac rehabilitation program. In line with Sustainable Development Goals 2030 (SDGs), OHL aims for the promotion of good health and well-being including the reduction of premature mortality from non-communicable diseases through prevention, treatment and mental health.

In the 4 years of its operation, OHL has done more than 500 body composition analysis and cardiovascular exercise testing for companies and also NIOSH staff. Besides that, OHL is also conducting research on occupational fitness and productivity of the human workforce specifically in Malaysia. The current state of the country's workforce in terms of fitness and productivity can be determined from the research. This will facilitate the establishment of a guideline for fitness for work within most occupational sectors.

Way Forward

ISO/IEC17025 (SAMM) and other accreditation scheme. In Malaysia, Skim Akreditasi Makmal Malaysia (SAMM) which is based on ISO/IEC17025 is one of the accreditation scheme that is most sought by many laboratories. Any testing providers especially OSH laboratory in Malaysia is recommended to obtain such accreditation to demonstrate its competency and produce reliable result thus gain clients'confidence. It may require more resources and efforts but it is rewarding and worthwhile.

Another scheme that is specific to the industrial hygiene testing is the American Industrial Hygiene Accreditation (AIHA) Laboratory Accreditation Program (AIHA-LAP). One of the program, Industrial Hygiene Laboratory Accreditation Program (IHLAP), designed specifically for laboratories involved in testing samples to evaluate workplace exposures is also recognized internationally.

OSH Proficiency Testing Program (OSH PT). Proficiency testing is a program in which multiple specimens are periodically sent to a group of laboratories for analysis. The purpose of such program is to evaluate the laboratory performance with regard to the testing quality of a sample. It is quite hard to find any suitable PT program in Malaysia especially in the area of occupational safety and health (OSH). Some of the tests are available outside Malaysia but very limited and quite costly. Thus, it is necessary to have local OSH PT program.

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4

THE IMPLEMENTATION OF NATIONAL OSH MASTER PLAN 2016-2020 (OSHMP 2020)

Ir. Ts. Dr. Majahar Abd. Rahman, Azhan Majid, Mohd Farid Mastuki, Zulkifli Abdullah, Mohamad Fazli Masri, Noor Hafizie Sulkafle and Ts. Muhammad Shah Ab Rahim

INTRODUCTION

Malaysia is one of the countries that has ratified the ILO Convention C187 Promotional Framework for Occupational Safety and Health. Based on this convention, a country have to implement the three main requirements of the convention, namely:

i. Establish the national occupational safety and health policy;
ii. Establish a national occupational safety and health management system; and
iii. Establish and implement national occupational safety and health programs.

Currently, in principle Malaysia has met all three main requirements under this convention. The country's occupational safety and health policy was officially signed on February 15, 2019 by the Prime Minister at that time, Tun Dr. Mahathir bin Mohamad. The country also has a legal system related to occupational safety and health (OSH) by enacting and enforcing provisions under the Factories and Machinery Act 1967 and the Occupational Safety and Health Act, 1994. In addition, there are currently training institutions and universities offering occupational safety and health (OSH) programs, ranging from certificate to PhD level. In the context of the implementation of the OSH program, the country has launched a 5-year plan known as OSHMP. The first OSHMP known as OSHMP 15 was implemented for the period of 2011-2015 while the second OSHMP or OSHMP 2020 was implemented for the period of 2016-2020 and currently the country is planning to implement OSHMP 2025 starting in 2021 and ending at the end of 2025.

Goals and Objectives of OSHMP 2020

The main goal of OSHMP 2020 is to create a culture of prevention among workers and employers in the country. Preventive safety and health culture means the right to a safe and healthy working environment is respected at all levels, where governments, employers, and workers actively participate in securing a safe and healthy environment through a system of defined rights, responsibilities, duties, and where the highest priority is accorded to the principle of prevention.

There are three main objectives that have been set to be achieved through the implementation of OSHMP 2020. The objectives to be achieved by end of 2020 are:

i. To reduce the rate of occupational accidents to 2.53 per 1000 workers;
ii. To reduce the rate of occupational fatality to 4.36 per 100,000 workers; and
iii. To increase the reporting of occupational disease and poisoning by 30 percent.

Occupational accident rate, fatality rate and reporting of occupational disease and poisoning for 2015 have been used as benchmarks in setting the OSHMP 2020 target. The occupational accident and fatality rate in 2020 are targeted to decrease by 10 percent compared to the rate in 2015 with an average rate reduction of 2 percent per annum.

OSHMP 2020 Strategies and Programs

To realize the goals and objectives of OSHMP 2020, there are 5 strategies, 23 programs and 68 activities set and implemented from 2016 until the end of 2020. The strategies and programs are shown in Figure 4.1.

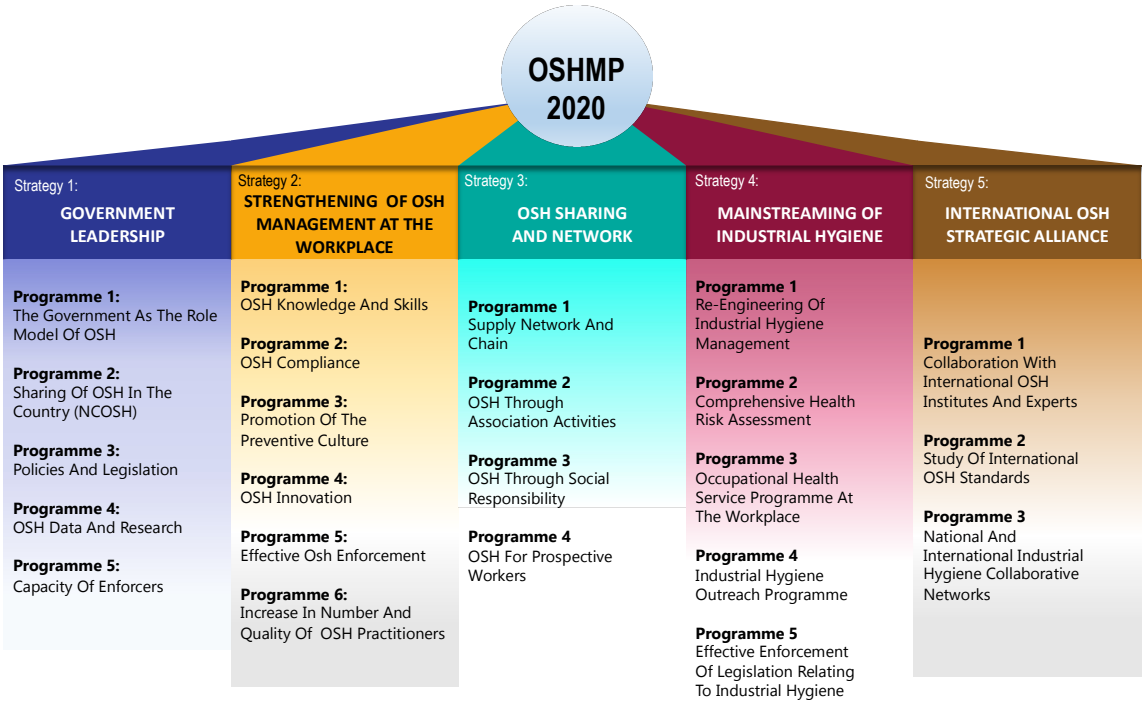

Figure 4.1. **OSH Master Plan 2020 Strategies and Programmes**

OSHMP 2020 Strategy 1: Government Leadership

Strategy 1 OSHMP is focusing on the government's role as the entity formulating and implementing policies and legislation. The government is the main driver to ensure continuous improvement of OSH in the country through various means and approaches to influence and inculcate preventive culture at the workplace.

Government agencies can serve as role models for industries through the practice of the OSH preventive culture by the public servants. The strengthening of OSH management in these agencies can be an example for the industries to jointly support the master plan. Government agencies also play a part in influencing the standard of OSH in the industries by imposing OSH as one of the mandatory requirement in the process of selection of suppliers and contractors offering their services to the government.

OSH policies and legislation are the primary agent of change which will mold the inculcation of preventive culture at the workplace. On-going development and review of OSH policies and legislation by the government are crucial to ensure their effectiveness and appropriateness to changes and development in the industries, businesses, knowledge and

technologies in resolving existing and new OSH issues as well as improving the quality of government service delivery to the industries.

Concurrent with industrial changes and development in various areas arising from government policies to achieve developed nation status, the capacity of OSH enforcers has to be bolstered. This will ensure that the policies are developed and implemented effectively, transparently and equitably. Enforcement knowledge, skills and expertise of the enforcers must be raised consistent with the needs and appropriateness of current and future changes.

Moreover, the capacity of the enforcers can further be strengthened with developed and improved technical equipment and information and communication technology (ICT) systems that can have positive effects on the effectiveness, productivity and implementation cost of policies and legislation. Such improved ICT systems must be integrated to boost the quality of service of the enforcers and OSH facilities for the industries.

As an outcome of this strategy, the government is aiming for effective OSH management practiced by public sector and also influences and inculcates preventive culture in the industries. Creation of a comprehensive data collection system and conducting OSH research to help resolving OSH issues and assessing OSH progress and performance in the country will be vital for this strategy. Improving capacity of OSH enforcers to plan, develop and carry out OSH policies and legislation effectively will enhance quality of service delivery and OSH facilities for the industries.

OSHMP 2020 Strategy 2: Strengthening of OSH Management at the Workplace

The Occupational Safety and Health Act 1994 (Act 514) stipulates that the primary responsibility of ensuring safety and health in the workplace rests with the employers. Employers can fulfil this through the creation of an occupational safety and health management system that is efficient and effective.

In this strategy, employers from industry whether large or small and medium enterprises must play a very important role to ensure the safety and health of employees in accordance with the legal requirements of the Occupational Safety and Health Act 1994. This

requires high commitment from employers to increase their understanding in the field of risk management related to workplace hazards.

Another important aspect in enhancing OSH standard is the involvement of OSH competent persons such as safety and health officers, site safety supervisors, crane operators, industrial hygiene technicians and supervisors of confined spaces who play the important roles of assisting the management in implementing OSH management system at the workplace. In this strategy, DOSH, which is responsible for administering and enforcing legislation on OSH in the country to perform the 3 main functions, namely, policy setting, effective enforcement and promotional activities.

Enforcement will be planned in a focused and strategic manner to increase compliance in the industrial sector, especially in the high-risk sectors such as construction and manufacturing industries. On the other hand, promotion is also focused on high-risk workplaces and the emphasis must be on the inculcation of preventive culture. At the same time, OSH best practice sharing platform was created to enable the industry to share creative and innovative solution and ideas in occupational safety and health among themselves.

As an outcome of this strategy, the government is aiming to increase awareness, knowledge and commitment of employers and workers towards a preventive culture, increase the level of OSH legal compliance and reducing the rate of occupational accidents and fatality in the country.

OSHMP 2020 Strategy 3: OSH Sharing and Network

Strategy 3 OSHMP2020 is focusing on extensive sharing that integrates the various strata of society to promote preventive culture. No entity can single-handedly overcome all existing challenges. Therefore, parties with links to the industries and workers must work hand in hand to support the government in achieving the objectives of OSHMP 2020.

The achievement of those objectives requires all related parties to fulfil their responsibilities and play their roles. Such support is crucial as the outcomes of this master plan will have a positive impact on the quality of the work environment, productivity and quality of life. Through the synergistic corporation of all parties, the potential to move ahead can be

unlimited. Related parties can ensure this master plan succeeds by contributing their efforts and giving their support to promote and inculcate preventive culture through legal compliance, education, networking with suppliers, social responsibility activities and also communal activities.

As an outcome of this strategy, the government is aiming to promote and inculcate preventive culture through sharing good OSH practice by inculcating ownership and self-regulation among related parties as well as increased awareness, responsibilities, knowledge and skills among employers, workers, non-government organization, OSH practitioners and the general public.

OSHMP 2020 Strategy 4: Mainstreaming of Industrial Hygiene

Occupational diseases and poisoning not only are burdened to workers who may lose their income but also have a significant impact on labor resources in the country in the long term should the problem failed to be diagnosed and prevented in the early stage. To further complicate the situation, the country's productivity, economy and competitiveness could be similarly affected, resulting in the government incurring higher medical expenses.

According to the International Labor Organization (ILO), an estimated 2.34 million deaths occur every year arising from occupational activities. Occupational diseases and poisoning are the major causes of such fatalities. Moreover, ongoing rapid technological development and new transformed work environments have complicated the observance of industrial hygiene and made the task of identifying occupational diseases and poisoning even more challenging.

Nevertheless, at this point in time, occupational diseases and poisoning are deemed not to be as serious as industrial accidents despite occupational diseases being the cause of an increased number of worker fatalities compared to fatal industrial accidents. The industries give greater attention to occupational safety programs than industrial hygiene programs at the workplace. This is due to the relatively low level of awareness of the importance, risk and impact of occupational diseases and poisoning.

Through heightened awareness among medical practitioners and employers to report the incidence of occupational diseases and poisoning affecting workers in Malaysia, there is an urgent need to boost the capacity for industrial hygiene management and occupational health support system at the workplace. These can be achieved through the program to promote preventive culture at the workplace including the awareness of reporting occupational diseases and poisoning.

Through this strategy, a mechanism has been put in place to raise the level of industrial hygiene management at the workplace. Moreover, necessary measures have been taken to prevent and resolve matters relating to occupational diseases and poisoning at the workplace in a more holistic manner. A systematic method which closely engages the employers, workers, OSH practitioners and the government is able to enhance through the implementation of programs and activities devised under this strategy.

As an outcome of this strategy, it helps to improve the level of industrial hygiene at the workplace, heightened awareness, knowledge and commitment of employers, workers and OSH practitioners towards industrial hygiene. It also creates awareness and commitment to report incidences of occupational diseases and poisoning.

OSHMP 2020 Strategy 5: International OSH Strategic Alliance

At the international arena, Malaysia was and will remain committed to develop infrastructure and human capital in the interest of building a formidable reputation in OSH. During OSHMP 15 period, Malaysia managed to organize nine (9) technical cooperation programs which benefited 167 participants from more than 16 countries. Within five years, 73 working papers had been presented, and DOSH was involved in the development of guidelines of OSH Management System for SMEs in collaboration with ASEAN+3 (Japan, Korea and China).

Furthermore, Malaysia had an important international role in OSH development under the OIC-OSHNet (Organization of Islamic Cooperation for Occupational Safety and Health Network). Through this strategy, Malaysia continue to mobilize efforts to foster collaboration and cooperation to manage OSH issues with other countries and international organizations to assist in raising its OSH knowledge and skills. Similarly, the country contributes its expertise in the development of standards, training, knowledge and experience to ASEAN Member States,

the OIC and other countries as a continuation of the program under OSHMP 15. Apart from this, Malaysia continue to benchmark international standards that are suitable for incorporation into its OSH system.

Outcomes of this strategy are to create awareness to further raise the image of the country in OSH by extending contributions and collaborative networks among ASEAN Member States and internationally. As a result, the country gain benefits in terms of the latest OSH knowledge, skills and information.

Execution Approach of OSHMP 2020

Generally, in the implementation of OSHMP 2020, there are several important committees established namely the Steering Committee, Implementation Committee and Special Program Committee. Each of these committees has different roles and responsibilities in ensuring the implementation of programs and activities under OSHMP 2020.

The Steering Committee is responsible for planning and monitoring overall implementation of OSHMP 2020. To fulfil that responsibility, this committee evaluates, approves recommendations and monitors all OSHMP strategies, programs and activities carried out by the Implementation Committee to achieve the specified objectives. If there is an activity or program that is not implemented as per schedule, this committee will decide to make a review of that activity or program. In addition, this committee is also responsible for managing and approving the financial needs and expenses of the Implementation Committee as well as reporting on the progress of OSHMP 2020 to Ministry of Human Resources (MOHR), National Council for Occupational Safety and Health (NCOSH) and the Cabinet.

In general, the Implementation Committee is responsible for planning and implementing OSHMP programs and activities under specific strategy to ensure it meetsthe specified key performance indicators (KPI). This includes planning, proposing budgets and managing expenses to ensure that the expenditure for each program and activity is used optimally. This committee also makes recommendations for the appointment of a Special Program Committee if necessary, in implementing activities and programs that involve collaboration with external parties whether the government, NGOs and industry. The Implementing Committee monitors and assists the Special Committee in implementing the program. For reporting on the

implementation of strategies, programs and activities, the Implementing Committee will prepare OSHMP implementation reports to be reported to the Steering Committee.

The Special Program Committee focuses on the execution of the program and prepares progress reports to the Implementing Committee. For example, the Industrial Hygiene Catalyst Committee (IH2C) was established to disseminate information, legislation and the importance of occupational health (OH), represented by various agencies including Government, NGOs and industry.

Monitoring Approach of OSHMP 2020

Monitoring the progress of each program and activity under OSHMP 2020 is done at every level of Government, Ministry, Headquarters, division and state of DOSH.

i. Monitoring at the Ministry level

The Department has received a development allocation of RM 2 Million to implement OSHMP 2020 during the implementation period. Accordingly, at the Ministry level, it is monitored through the following mechanisms:

a) Project Monitoring System II (SPP II) is used in monitoring the implementation of development programs and projects. In addition, the Ministry also monitors the programs and activities under each strategy in line with the Ministry of Human Resources Strategic Plan 2016-2020.
b) The Development Action Council (MTP) meeting chaired by the Secretary General of the Ministry of Human Resources together with representatives of agencies and Departments under the Ministry of Human Resources functions to monitor and evaluate the implementation of development projects under the ministry.

ii. Monitoring at the Department level

a) The Steering Committee chaired by the Director General (DG) of DOSH and comprised of all DOSH directors monitors the planning, implementation and achievement of the objectives of OSHMP 2020 through the report submitted by the Implementation Committee for each strategy.

b) The Implementing Committee ensures that all programs that have been planned under each strategy are implemented and prepares performance reports to be submitted to the Steering Committee.

c) Reporting of each program is made by the implementing secretariat of the program that has been appointed to the Secretariat of the Implementing Committee.

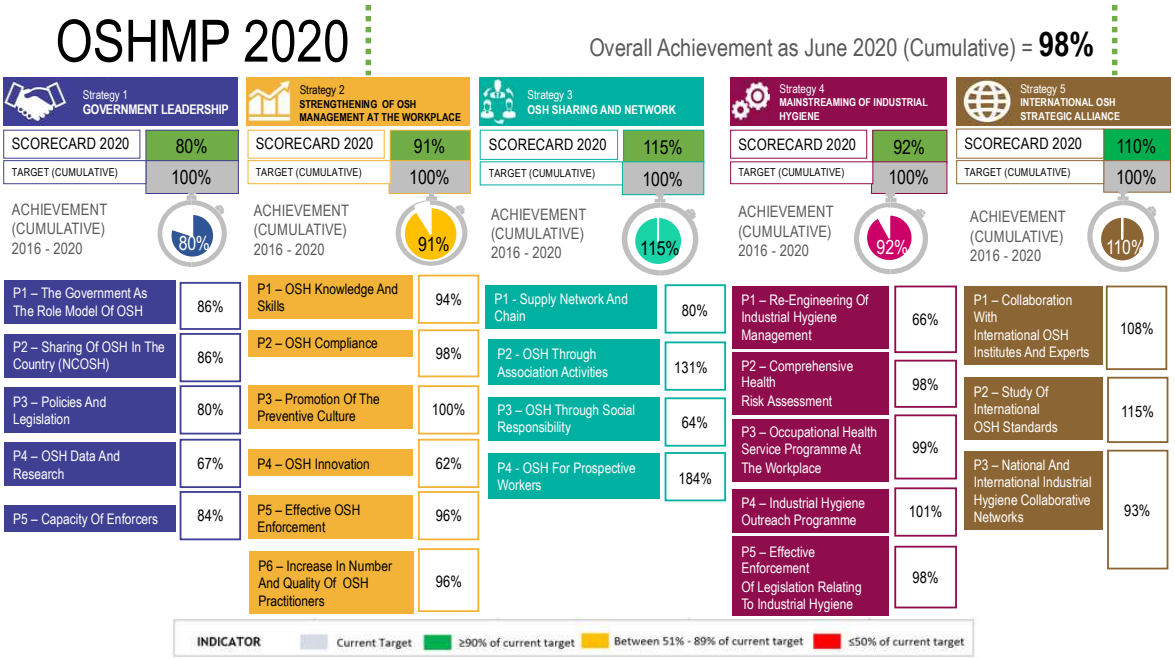

Figure 4.2. **OSHMP 2020 achievement as June 2020**

High Impact Program Under OSHMP 2020

Along the process of OSHMP 2020 implementation, a few programs were determined as high impact program (HIP) as shown in Figure 3. The selection of HIP is based on well execution, highly effective program, multiple target group and inclusiveness of the program. Among others, National OSH Policy was signed by the Prime Minister on January 15, 2019, which shown the government commitment on OSH management in Malaysia. To improve OSH at construction sector, Guidelines on Occupational Safety and Health in Construction Industry (Management) (OSHCIM) provides practical guidance to the client, designer and contractor on the management of safety, health and welfare when carrying out construction projects. For future workers, DOSH has introduced OSH4U to give OSH awareness for final year university student, to prepare them prior to entering the workforce. OSH promotion is also essential to enhance OSH public awareness. IH2C is a committee established in collaboration with various agencies and associations to disseminate OSH information related to Industrial Hygiene (IH) through promotional activities. This program will show the importance of IH2C in assisting Government in improving the workers quality of life and subsequently working in a safe and healthier

environment. For international training, DOSH is recognized as a trainer to train members countries through ASEAN Third Countries Training Program (TCTP) on various topic within Malaysian expertise.

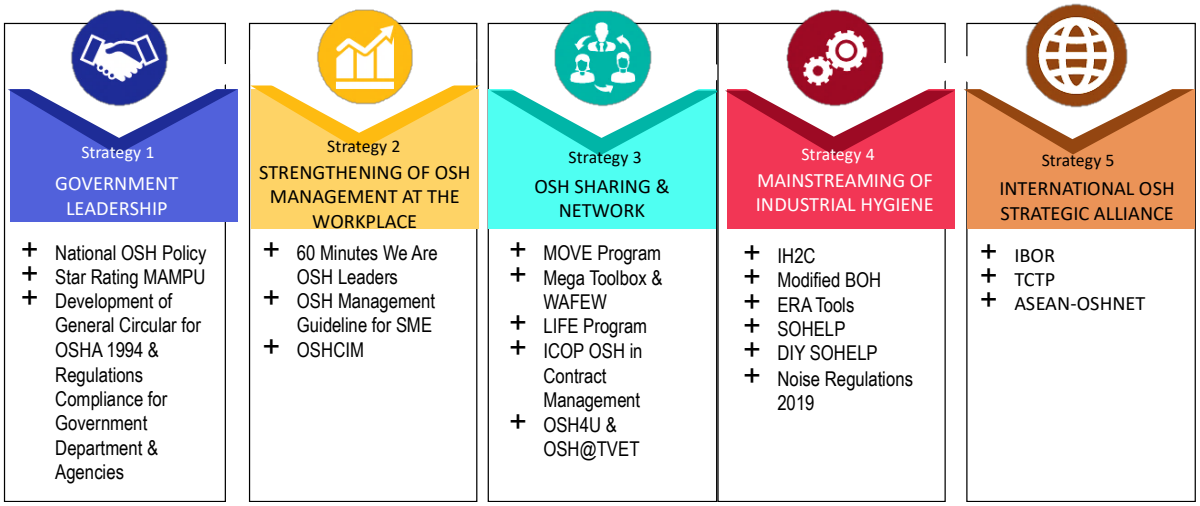

Figure 4.3. **High Impact Program under OSHMP 2020**

Achievement of OSHMP 2020 Objectives

Apart from monitoring the achievement of programs and activities, the achievement of OSHMP objectives is also monitored periodically. The achievement of the three main objectives of OSHMP 2020 based on the specified benchmarks is as follows:

Occupational Accident Rate per 1000 Workers. Based on Table 4.1, the annual objective of OSHMP 2020 to reduce the occupational accident rate is achieved in 2018 where the accident rate for every 1000 workers recorded in that year is 9.10 percent lower than the targeted accident rate. However, the occupational accident rate per 1000 employees for 2016, 2017 and 2019 is around 4.63 - 8.52 percent higher than predicted rate for the respected years.

Table 4.1 **Occupational Accident Rate per 1000 Workers 2016-2020**

Year	2016	2017	2018	2019	2020
OSHMP 2020 Target	2.75	2.70	2.64	2.59	2.53
Achievement	2.88	2.93	2.40	2.71	2.09 P
% Difference	4.72	8.52	-9.10	4.63	17.39 P

P = Provisional data

Occupational Fatality Rate per 100,000 Workers. Table 4.2 shows the annual OSHMP 2020 target of reducing the fatal accident rate per 100 000 employees are achieved in 2018 and 2019 where the actual rate is between 9.01 to 13.56 percent lower than the expected rate.

However, the fatal accident rate for year 2016 to 2017 is 2.10 to 5.59 percent higher than the expected fatal accident rate.

Table 4.2 **Occupational Fatality Rate per 100,000 Workers 2016-2020**

Year	2016	2017	2018	2019	2020
OSHMP 2020 Target	4.74	4.65	4.55	4.46	4.36
Achievement	4.84	4.90	4.14	3.83	2.18 P
% Difference	2.10	5.59	-9.01	-13.56	50.00 P

P = Provisional data

Reporting of Occupational Disease and Poisoning. Table 4.3 shows the annual OSHMP 2020 target of increasing awareness to report occupational diseases exceeds the original target set for 2016, 2019 and 2019 between 9.51 to 41.56 percent. Only in 2017 the number of reports achieved was 4.31 percent lower than the expected number of reports.

Table 4.3 **Number of Occupational Disease and Poisoning Reported to DOSH 2016-2020**

Year	2016	2017	2018	2019	2020
OSHMP 2020 Target	5,954	6,291	6,628	6,965	7,302
Achievement	7,820	6,020	7,258	9,860	9,108
% Difference	31.34	-4.31	9.51	41.56	24.73

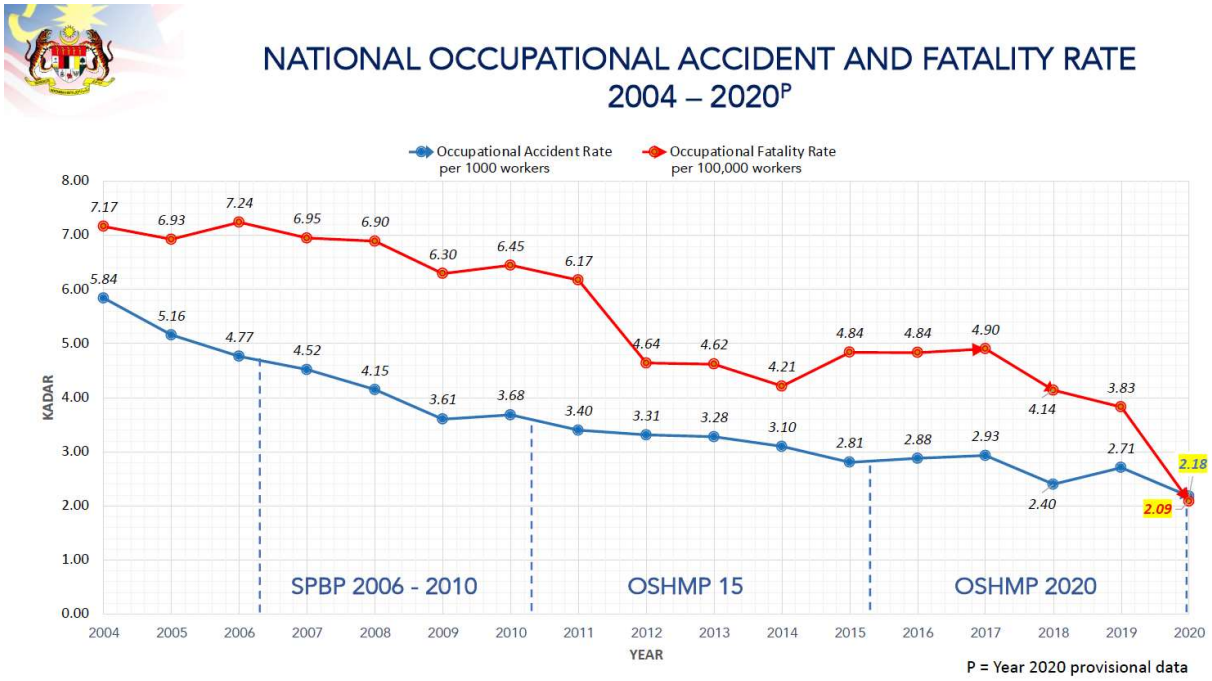

Figure 4.4. National Occupational Accident and Fatality Rate 2004 – 2020

Figure 4.4 shows the long-term declining trend for both accident and occupational accident rates for the period 2004 to 2019, where the accident rate and the 2019 death rate were 53.60 percent and 46.58 percent lower than the rates recorded in 2014 respectively.

Way Forward

The National Occupational Safety and Health Master Plan for the period 2021-2025 (OSHMP 2025) is being developed to ensure the continuity of the national OSH strategic plan. To date, the programs and activities to be implemented under OSHMP 2025 are placed under seven (7) strategies to address OSH issues within that period with the aim to further increase and strengthen national OSH standard by involving synergistic cooperation of all stakeholders namely the government, employers and employees as well as OSH practitioners, professionals and organizations.

Figure 4.5. **OSHMP 2025 Strategies**

Conclusion

Malaysia has started implementing the OSH master plan since 2005. Apart from involving tripartite cooperation, namely the government, employers and workers, the implementation of OSHMP also manage to secure close cooperation among OSH practitioners, professionals and non-government organizations. The positive achievement of OSHMP 2020 can be seen so far with two main indicators, namely the reduction in fatal accident rates and the increase in awareness to notify occupational diseases. Apart from that, OSHMP has also indirectly increased the number of OSH practitioners in the country to reach more than 60,000 people as of August 2020. This positive momentum must be continued through OSHMP25 to ensure continuous improvement of the country's OSH standard so that it reaches world class and comparable with developed countries.

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5

OSH LESSON LEARNT FROM COVID-19 PANDEMIC AND DOSH INITIATIVES DURING MOVEMENT CONTROL ORDER

Ir. Ts. Dr. Majahar Abd Rahman and Ts. Muhammad Shah Ab Rahim

INTRODUCTION

Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by the novel coronavirus, subsequently named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) were first reported by officials in Wuhan City, Hubei Province, China in December 2019. On January 30, 2020, World Health Organization (WHO) declared the COVID-19 outbreak a global health emergency. On March 11, 2020, WHO declared COVID-19 a global pandemic, its first such designation since declaring H1N1 influenza a pandemic in 2009.

To prevent the spread of COVID-19 among the Malaysian citizen, the Government of Malaysia enforced Movement Control Order (MCO) starting from March 18, 2020. At the beginning, almost all economic sectors were at stand still, with the exception to the essential services such as healthcare services, oil and gas industries, energy, food and water. Workers were allowed to work from home. Essential services workers were given permission to work at the workplaces under strict condition to prevent the spreading of COVID-19.

The Order eventually was loosened up on the May 4, 2020 in which majority of the economic sectors were given green light to do business as usual by following specific Standard Operating Procedures (SOP) approved by the Malaysian National Security Council (MNSC). SOPs have introduced ‘new normal’ to almost everything. For the business to run, certain criteria must be met. For example, employers or owners shall ensure all persons must undergo symptoms and temperature screening before entering the premises, practice physical distancing and good personal hygiene.

As of October 14, 2020, the Recovery Movement Control Order (RMCO) still took place in Malaysia. Therefore, this article will focus more in MCO and Conditional MCO period, from March 18, 2020 to June 19, 2020, as shown in Figure 5.1.

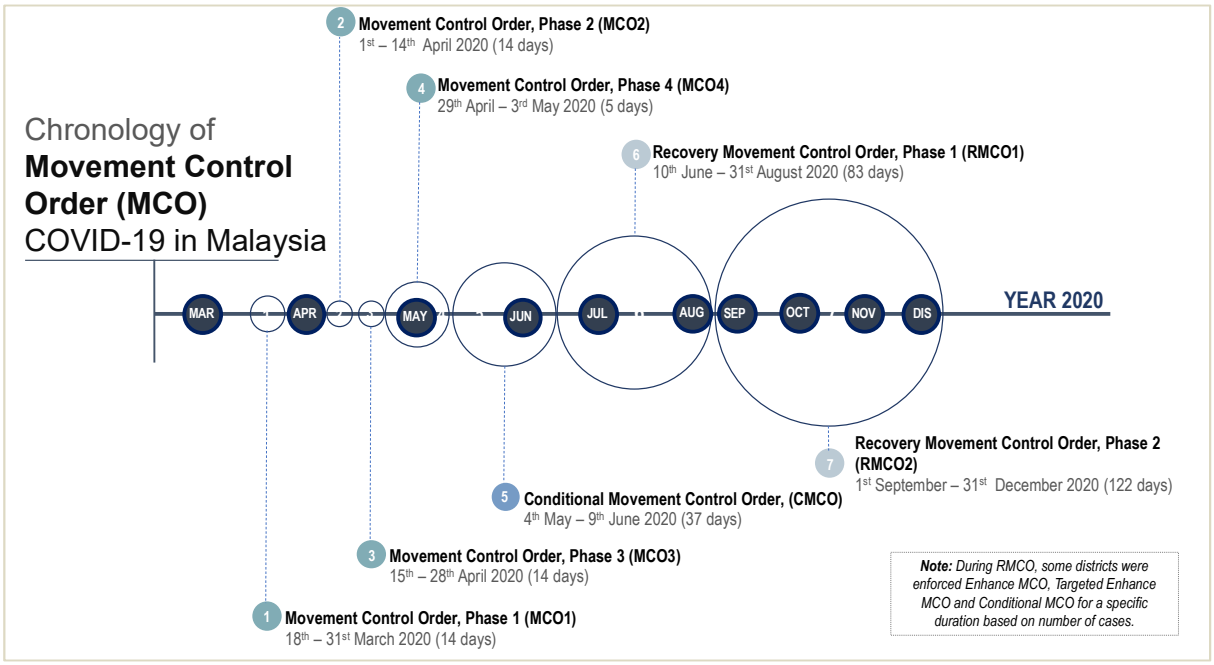

Figure 5.1. **Chronology of Movement Control Order (MCO) COVID-19 in Malaysia**

DOSH Approach and Roles during MCO

Operation Rooms and Work from Home. During MCO period (March 18 to May 3, 2020), similar to other government agencies, Department of Occupational Safety and Health (DOSH) continue to serve its stakeholders including employers and employees. Although all DOSH offices were close, the online services such as DOSH Services Integrated Platform (MyKKP) and Control Document Management System (SKUD) are still ongoing.

Operation rooms were established at Ministry level, DOSH Headquarters and state offices during the period. Subsequently, work at home and work at operation rooms duty rosters were established. Officers on duty were manning the operation rooms, 7 days per week, from 8.00 in the morning till 6.00 in the evening. In average about 5,000 calls were answered daily in the operation rooms.

Meanwhile, the central operation room at DOSH Headquarters was established for discussions, development of SOPs and FAQs, and meetings to decide the department's policy and services during the MCO.

Survey on "COVID-19 Impact on OSH in Malaysia". On April 4-16, 2020 , DOSH conducted "COVID-19 Impact on OSH in Malaysia" online survey. The purpose of the survey was to gather input from DOSH clients on how COVID-19 and MCO affected OSH management at the workplace. 1,336 respondents participated in the survey, and majority (72%) are OSH practitioners. About 2/3rd of them are from construction and manufacturing sectors, as illustrates in Figure 5.2.

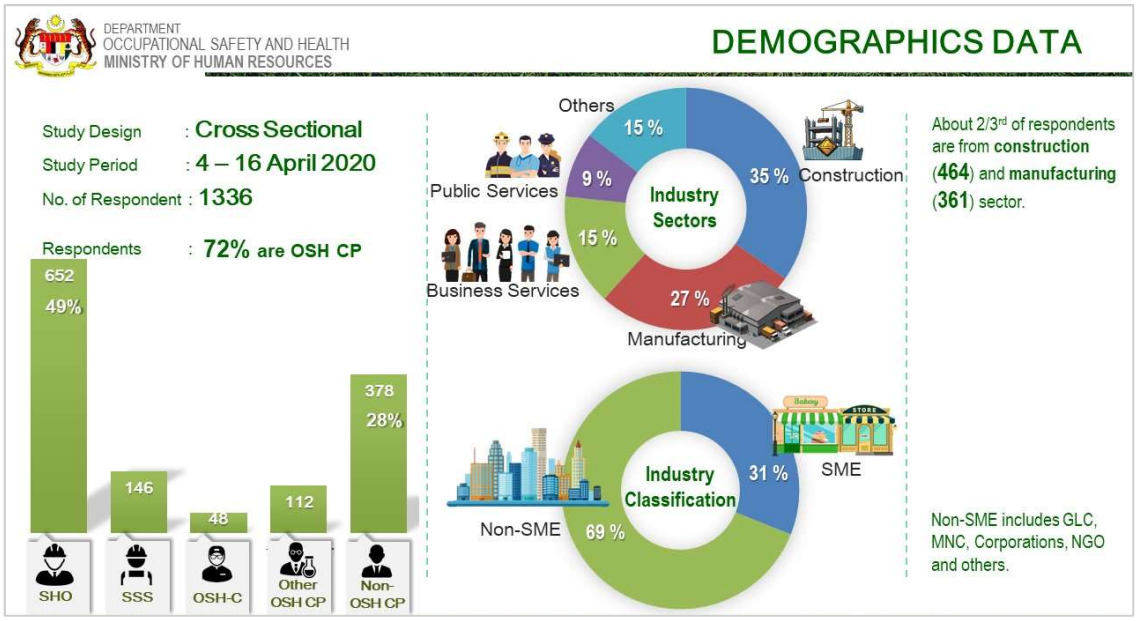

Figure 5.2. **Respondent's Demographics Data of "COVID-19 Impact on OSH in Malaysia" online survey**

Based on the survey, 88% of the respondents believed that COVID-19 will have long lasting impact on OSH. Majority (more than 50%) respondents perceived COVID-19 will have negative impact on business operation and worker's mental health. On the other hand, the respondents believed COVID-19 episodes will have positive impact, among others on OSH Management Systems, Emergency Response Plan, and OSH training and promotion.

Through this survey, DOSH also had gathered various suggestions from the respondents, such as:

i. Exemption of Continuous Education Program (CEP) points during MCO period for competency renewal purposes
ii. Award CEP points for online learning
iii. Automatic extension of machinery Certificate of Fitness (CF) for 3 months or until the end of MCO
iv. Recognize self or third-party inspection for renewal of CF

v. Establish OSH Guidelines on COVID-19 Prevention at the Workplace
vi. Increase promotion and public awareness on biological hazards and its control measures

Many of the suggestions and recommendations were took into consideration and implemented by DOSH as discussed in the following paragraph.

Enforcement of Compliance of MCO SOP.

DOSH officers are appointed as authorized officers to enforce Prevention and Control of Infectious Diseases Act 1988 (Act 342) during the MCO period. Therefore, DOSH officers together with other enforcement agencies have conducted enforcement activities to ensure workplaces' compliance of the MCO SOP.

DOSH also established online reporting platform for Self-Reporting of Compliance to Conditional Movement Control Order (CMCO) Standard Operating Procedures (SOP). In the beginning, this report can be accessed via DOSH portal and subsequently been integrated with Ministry of International Trade and Industry (MITI) online system namely COVID-19 Information Management Systems (CIMS) via https://notification.miti.gov.my.

This reporting is one of the methods used by DOSH to ensure the employers follow the SOP for Reopening of Economy and at the same time, fulfilling the general duties of employers as stipulated under Section 15 of OSHA 1994, which is to ensure, so far as is practicable, the safety, health and welfare at work of all his or her employees. This is also in line with the self-enforcement approach mooted by DOSH.

Until October 11,2020, **2,549,912** reports were received through the online reporting system. 23% of the reports came from manufacturing sector, followed by retail trade sector (21%), business service sector (14%), construction sector (13%), wholesale trade sector (8%) and others (21%). Summary of the report is illustrated in Figure 5.3.

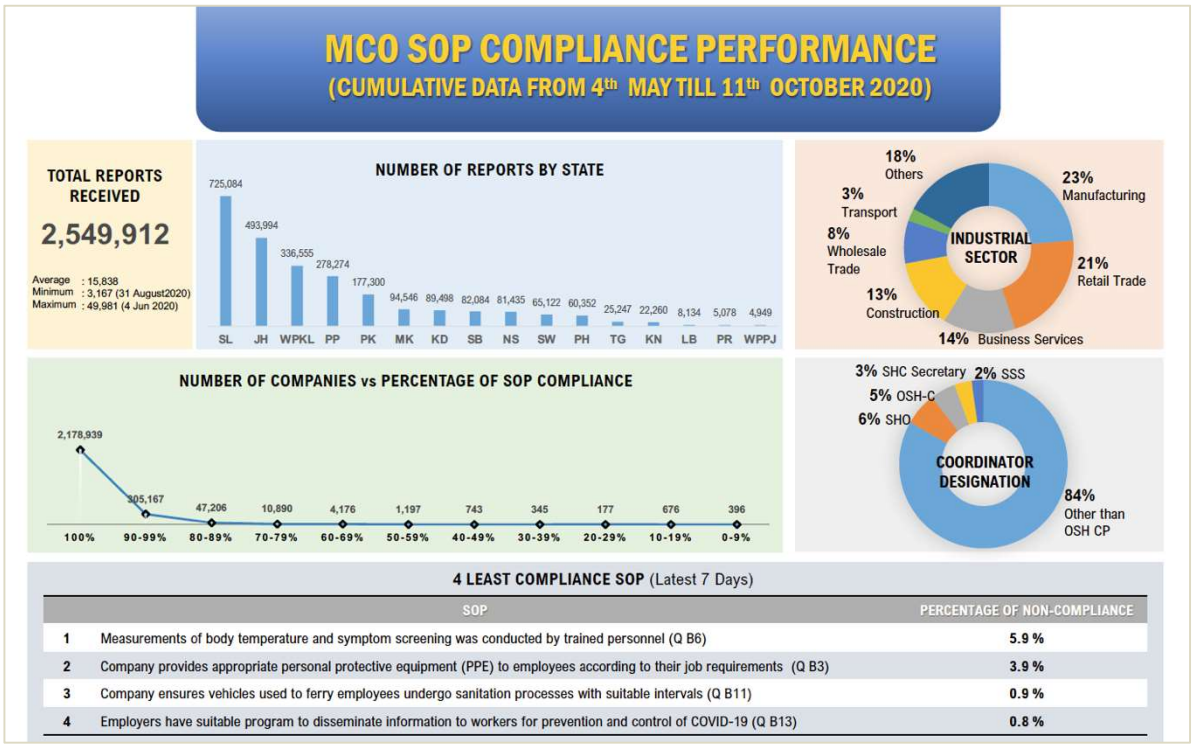

Figure 5.3. **Reports of MCO SOP Compliance (Cumulative Data from 4th May till 11th October 2020)**

DOSH has also conducted workplace inspection, monitoring and verification from time to time based on the report submitted through two main approaches:

i. Alternative approach: DOSH officers will contact employers through mobile phone applications or phone call; or

ii. Conventional approach: DOSH officers will visit workplace for verification in collaboration with other agencies such as Department of Labour. These reports are then submitted to the COVID-19 Task Force lead agency, Royal Malaysian Police (RMP).

From May 11 till October 11, 2020, a total of 15,713 workplace inspections and verifications were conducted by DOSH. 12,752 (81%) of the workplace fully complied with the MCO SOP, 2,764 (18%) have been given verbal warning, 197 (1%) have been issued either notice for improvement, instruction letter or notification to Ministry of Health to institute further legal actions. Summary of this reports are presented in Figure 5.4.

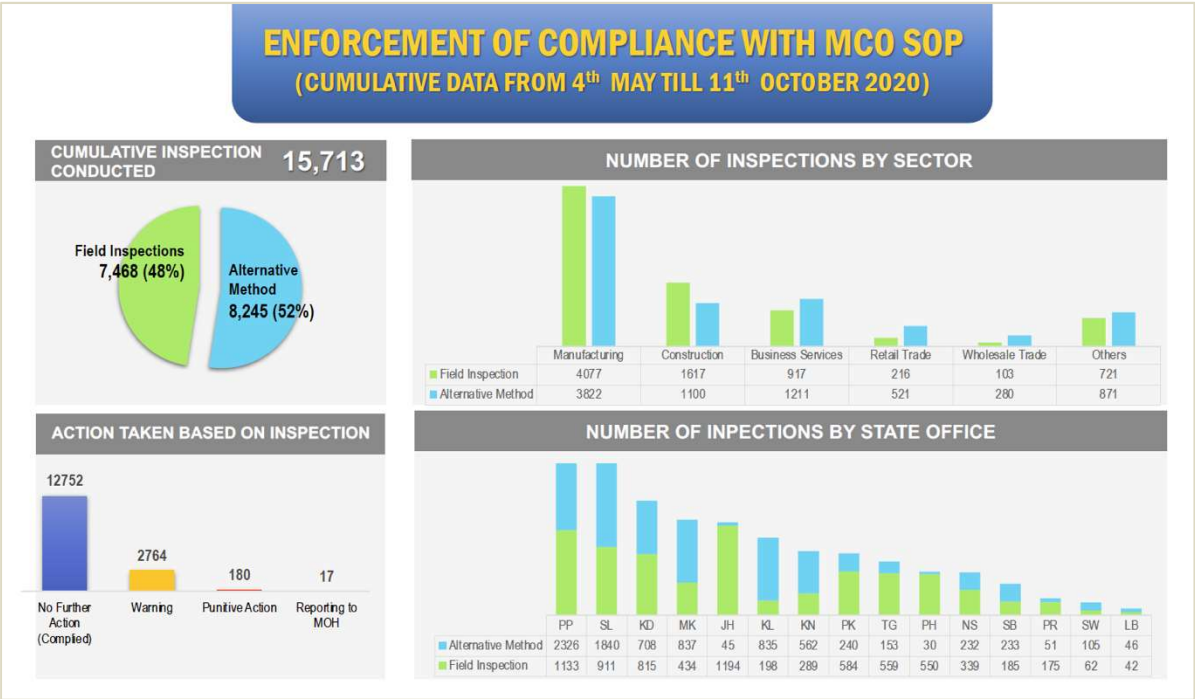

Figure 5.4. **Reports of Task Force Inspection on MCO SOP Compliance (Cumulative Data from 11th May till 11tt October 2020)**

New Initiatives by DOSH

Based on the findings and feedback of the survey and considering the concept of 'new normal', DOSH has changed the method and approach to conduct the existing activities. Examples of the changes are:

i. Granting 3 months automatic extension for statutory inspection of certificated machinery, according to provision under Factories and Machinery (Notification of Fitness and Inspections) Regulations 1970.

ii. Allow alternative inspection approach for machinery inspection and OSH enforcement, according to provision under Factories and Machinery (Notification of Fitness and Inspections) Regulations 1970.

iii. Make changes on Competent Person (CP) registration and renewal procedures, such as conducting interview through phone or teleconference.

iv. Recognize online courses for the purpose of CP's Continuous Education Program (CEP).

v. Use alternative approach in organizing seminars, workshop, dialog, and meeting.

OSH Lesson Learnt

There are many great lessons and learning opportunities from the episodes of COVID-19 pandemic and the Movement Control Order so far. Some of the lessons that related to OSH are listed below:

i. Organizations including enforcement agency need to be dynamic and agile to ensure that the method of execution of duties and responsibilities is relevant to the current needs including in contingency situations.

ii. The application of the latest technology can assist OSH enforcement agencies in enforcing legal requirements more comprehensively with optimal use of resources. For example, in the period of May 4 to October 11, 2020, DOSH has received and analyzed more than 2.5 million compliance reports on MCO COVID-19 SOP, from self-reporting online platform.

iii. Preventive approach should be given priority in addressing safety and health issues in the workplace as opposed to corrective actions. Therefore, it is crucial for all organizations and workplaces to conduct OSH risk assessments and take necessary preventive actions based on the risk level.

iv. The existence of OSH practitioners is important in assisting employers and the government in dealing with OSH-related issues immediately including during contingency time that require immediate and swift action such as the COVID-19 pandemic.

v. Based on the MCO COVID-19 SOP compliance data, in general, employers, employees and OSH practitioners are committed to ensure implementation and monitoring of COVID-19 transmission prevention measures are in place, based on the latest Government directives.

Conclusion

Concerted efforts between government agencies, industries and others are needed in order to overcome the obstacles caused by the COVID-19 pandemic. Due to the pandemic, returning to normal routine will take some time. Therefore, new normal has to be practiced without sacrificing on common goal to create a safe, healthy and productive workplace.

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6

CHEMICAL MANAGEMENT IN MALAYSIA ANDS ITS EVOLUTION FROM THE OCCUPATIONAL SAFETY AND HEALTH PERSPECTIVE

Hazlina Yon

INTRODUCTION

Chemicals are important in our daily life. Around 100,000 chemical substances are found in products or are on the market. It is estimated that by 2020, developing countries will produce 31 percent of global chemicals and use 33 percent of global chemicals. If improperly managed, chemicals and the pollution linked with their manufacture, use, and disposal come at a cost to the economy, human health and the environment. Occupational exposure to hazardous substances alone cause an estimated 651,000 known deaths annually, mostly in the developing world, a figure that may be greatly underestimated in many countries (UNEP, 2006).

After the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, at which the Rio Declaration and Agenda 21 were adopted, much has been done to improve chemicals management globally. Regulatory systems have been introduced or strengthened and much more information has been made available about chemicals. Many chemicals have been assessed at the national level and internationally; a wide range of risk management measures have been introduced; and new tools such as the Globally Harmonized System (GHS) of Classification and Labelling of Chemicals and pollutant release and transfer registers have been taken up and developed. These changes has been further enhanced after the The World Summit on Sustainable Development (WSSD) in 2002. The resolution of WSSD is to achieve by 2020, the sound management of chemicals throughout their life cycle and of hazardous waste in ways that lead to minimization of significant adverse effects on human health and the environment (UNEP, 2006). Governments worldwide establish chemical safety guidelines and regulations, and the United Nations and other international organizations work to promote safe use of chemical products globally.

In 2012, at the United Nations Conference on Sustainable Development in Rio de Janeiro, sustainable development goals (SDG) were introduced to produce a set of universal goals to be achieved by 2030 that meet the urgent environmental, political and economic challenges facing the world. Chemicals and waste management are reflected explicitly in a number of goals and targets particularly addressing health, water, cities and human settelements. They were also addressed in the goals of poverty, agriculture, oceans, decent work and climate change (United Nation Development Programme, n.d.). Malaysia together with other 192 world leaders adopted the 2030 Agenda for Sustainable Development Agenda at the United Nations General Assembly in New York on 25 September 2015 (Economic Planning Unit, 2020).

Malaysia is not exempted in reaching these goals in which enhancement of chemical management legislations was made through various Malaysia plans and after the introduction of Occupational Safety and Health Act 1994. Many guidelines, code of practices and legislations, trade agreements were introduced in the country paralel with global efforts in sound management of chemicals. The Eight Malaysia Plan emphasized the need to review enforcement tools to improve effective management of chemicals while the Nineth Malaysia Plan recognised the need for the adoption of the GHS. Under the Eleventh Malaysia Plan, priority is given to the people in all development efforts. This approach reinforces the Government's commitment to improving the standards of living, dignity and the potential of the people to capitalize on development and economic progress. In line with the goal of achieving advanced and inclusive nation status by 2020, all levels of society need to benefit from the economic prosperity of the nation (Percetakan Nasional Malaysia Berhad, 2015).

Global and local usage of chemicals

Globally, chemicals produced and used across the rest of the world, yield an estimate in the range of 40,000-60,000 hazardous chemicals yearly. It is further estimated that about 6000 of those chemicals account for more than 99% of the total volume produced and marketed (United Nations Environment Programme & ICCA, 2018). A report of the Ministry of International Trade and Industry (MITI, Ministry of International Trade and Industry, 2019) revealed that the chemicals and petrochemicals sector is among the top three contributors to Malaysia’s total imports and exports of manufactured goods. According to Malaysia External Trade Development Corporation (Unit Statistic Trade, 2020), total exports of chemicals and

chemical related products in Malaysia for January to August 2020 are 187 billion which is 30 percent of Malaysia total exports.

Data from Chemical Information Management System (DOSH, 2018) indicates an increasing trend of the number of chemical suppliers in Malaysia. Figure 6.1 illustrates the increasing trend of the number of chemical suppliers in Malaysia from 2015 to 2019. The total volume of chemicals supplied in Figure 6.2 shows a fluctuating trend possibly due to Covid-19 pandemic and world economy in 2019. The increasing trend scenario reflects an influx of chemicals in Malaysia, hence, the need of good chemical management to manage these chemicals.

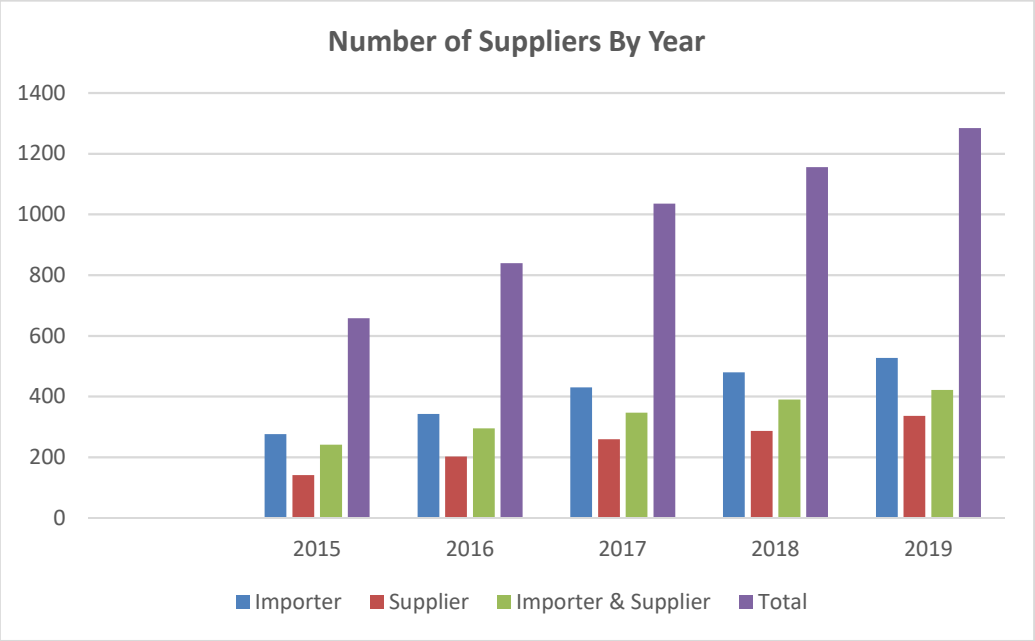

Figure 6.1 Increasing trend of total number of chemical suppliers in Malaysia from 2015 to 2019

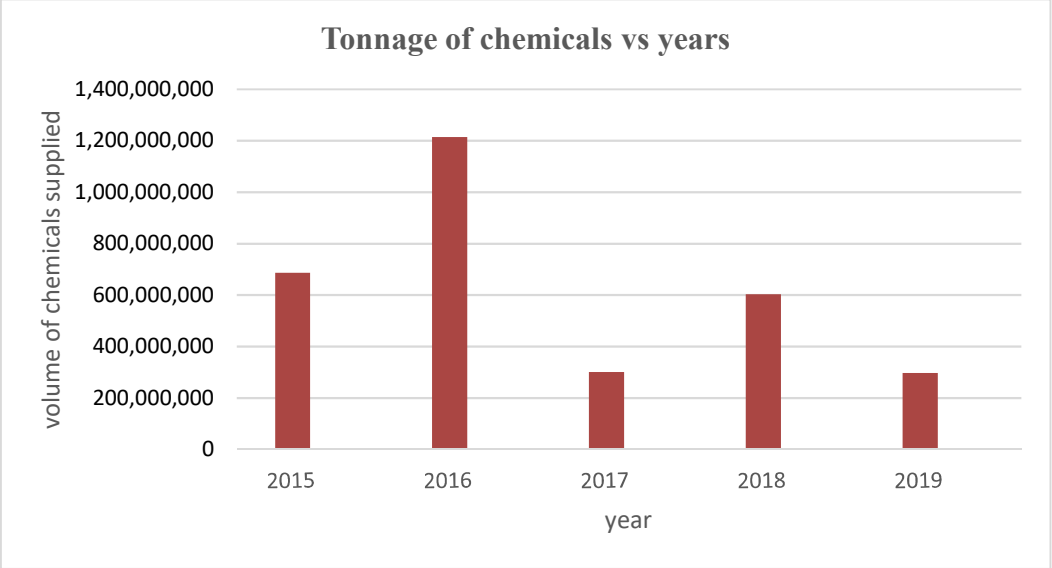

Figure 6.2. Fluctuating trend of volume of chemicals supplied in Malaysia from 2015 to 2019.

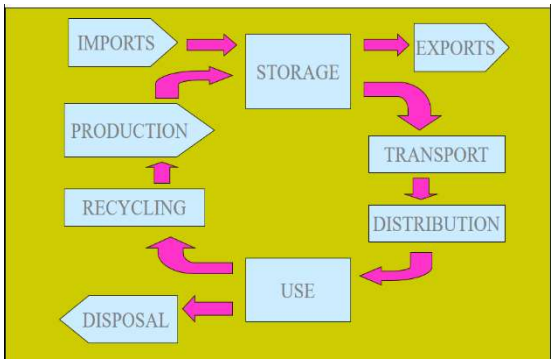

Figure 6.3. Cradle to Cradle Concept

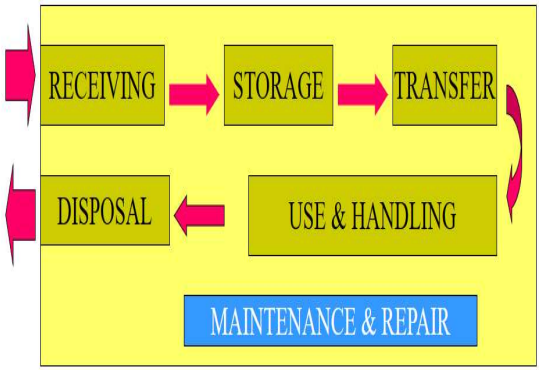

Figure 6.4 Cradle to Grave Concept

Definition of chemical management

Chemical management is defined as managing chemicals in their life cycle starting from production, storage, transportation, handling, use, treatment and disposal. This lifecycle approach is popularly known as “cradle to grave” or “womb to tomb”. This concept only looks at chemicals as it enters the place of work and as it exits the place of work. The concept is normally designed for enterprise level. This approach has been expanded further to address the recycling of the chemicals in its entirety as an industrial feedstock to produce new products of the same or similar type which is known as “cradle to cradle” (W. McDonough & M. Braungart, 2002). Figure 6.3 and Figure 6.4 illustrates “cradle to cradle” and “cradle to grave” concept respectively. To comprehensively address chemical safety management issues, the cradle to cradle approach should be adopted.

Table 6.1. Elements of Chemical Management (Abu Bakar Che Man & David Gold, 1993)

Components	Objectives
Chemical Policy	Establish chemical safety policy • Direction or goals to be achieved • Reflects commitment of Top management
Safety and Health Organization	Identify and appoint person-in-charge • Assigning responsibilities • Reporting, accountability
Arrangements/ procedures	Procedures to be established during the following activities: • Production and handling of chemicals • Storage of chemicals • Transport of chemicals • Disposal and treatment of waste chemicals • Maintenance • Repair and cleaning of equipment and containers

Elements of chemical management at work are the establishment of policy on chemicals, safety and health organization and organizational arrangement by assigning responsibilities to the person in charge. Table 6.1 illustrates and defines the elements of chemical management.

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The sound management of chemicals is an essential national activity in order to minimise risk, and to prevent the occurence of adverse impacts of chemicals on the environment and human health. Many international instruments has been raised to cover several key aspects of the sound management of chemicals such as listed in Table 6.2. Table 6.2 depicts the intruments ratified by Malaysia and instruments not ratified but where Malaysia has become a signatory or state party in order to meet the international obligations.

Table 6.2: Status of International Chemical Instruments adopted/ ratified in Malaysia

Name of instruments	Scope
Basel Convention	Control of Transboundary Movements of Hazardous Wastes and their disposal to combat toxic trade in hazardous waste. Ratified by Malaysia on the October 8, 1993. Designated competent authority is the Department of Environment (DOE) Issuance of permit by the DOE upon importation or exportation through Royal Malaysia Customs
Rotterdam Convention	Convention on Prior Informed Consent Procedure for certain Hazardous Chemicals and Pesticides in International Trade. Ratified on the September 4, 2002 Designated competent authority is the Department of Environment (DOE)
Stockholm Convention	Convention to reduce or eliminate the release of Persistent Organic Pollutants (POP) into the environment. Malaysia becomes signatory on May 16. 2002 Designated competent authority is the Department of Environment (DOE)
Minamata Convention	Convention on Mercury designed to protect human health and the environment from the adverse effects of mercury. Focal point is Ministry of Science, Technology and Innovation Malaysia becomes a signatory since 24/09/2014
Chemical Weapon Convention (CWC)	Malaysia signed the CWC on January 13, 1993 and ratified the Convention on April 20, 2000. The Convention entered into force in Malaysia on May 20, 2000. The convention aims to eliminate the entire category of weapons of mass destruction by prohibiting the development, production, acquisition, stockpiling, retention, transfer or use of chemical weapons by States Parties (OPCW, 2020).
The Strategic Approach to International Chemicals Management (SAICM)	It is a policy framework to foster multi sectoral and multi stakeholder engagement in the sound management of chemicals. Aim to ensure by 2020, chemicals are produced in ways to minimize significant adverse impacts on the environment and human health. Malaysia is actively involved in the programs. Malaysia was first represented in 2006.
International Labor Organization (ILO) Chemical Convention C170 and its Recommendation C177	The main ILO instruments dealing with chemicals which provide basis for the sound management of all types of chemicals at the workplace. The text of Convention No.170 served as the basis for the negotiation of the Rotterdam Convention as well as the basis for the development of the widely used Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Malaysia has adopted most elements of the convention and has integrated the elements into its local legislations such as the Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazrdous to Health Regulations) 2000.

History of Chemical Management and Chemical Law Evolution in Malaysia

In Malaysia, chemical legislations started from the gazetting of the Factory and Machinery Act (FMA) in 1967. The Industrial Hygiene Unit was established in 1975 under the Factories and Machinery Department, the previous name for the Department of Occupational Safety and Health (DOSH), Headquarters. The DOSH is a department under the Ministry of Human Resources, responsible for ensuring the safety, health and welfare of people at work as well as protecting other people from the safety and health hazards arising from the activities of all economic sectors. Currently, there is an Occupational Health Division led by the Deputy Director General, solely established to oversee OSH issues pertaining to occupational health, industrial hygiene and ergonomics and chemical management.

During this Industrial Hygiene Era (1970-1994), provisions relating to industrial health were further added under the FMA 1967. Legislations related to chemical management are:

i. Factories and Machinery (Leads) Regulations 1984
ii. Factories and Machinery (Asbestos) Regulations 1986
iii. Factories and Machinery (Mineral Dust) Regulations 1989

Only one guideline was introduced during this Industrial Hygiene Era which was Guidelines on Method of Sampling and Analysis for Airborne Lead, 1997 (DOSH, Industrial Safety and Hygiene – 1970 till 1994, 2020).

In 1994, when the Occupational Safety and Health Act (OSHA) was gazetted, the chemical safety legislations were also enhanced parallel with the international programs or movements towards enhancement of chemical management. The driving force for OSH policy and promulgations of legislations in Malaysia is the DOSH's OSH Master Plan. The Government of Malaysia through DOSH launched the OSH Master Plan to enhance the system of OSH in the country. The latest OSH Master Plan 2020 (OSHMP 2020) is focussing on the implementation of a culture of prevention (preventive culture) to further strengthen the establishment of a "Safe and Healthy Work Culture" among employers and workers. It is a continuation of the implementation of values of OSH ownership and self-regulation as in the previous two master plans before (DOSH, OSHMP 2016-2020).

Legislations related to chemical managements under the OSHA 1994 drafted during the tenure of OSH Master Plan are:

i. Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996
ii. Occupational Safety and Health (Classification, Packaging and Labelling of Hazardous Chemicals) Regulations 1997
iii. Occupational Safety and Health (Prohibition of Use of Substances) Order 1999
iv. Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazardous to Health) Regulations 2000
v. Occupational Safety and Health (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013

The Occupational Safety and Health (Classification, Packaging and Labelling of Hazardous Chemicals) Regulations 1997 which was based on EU classsification was later revoked and replaced with Classification, Labelling and Safety Data Sheet of Hazardous Chemicals Regulations 2013 which was based on the GHS classification. This is inline with Chapter 19, Agenda 21 of harmonising classification of chemicals (United Nations, 2020). There are many guidelines promulgated under the OSHA 1994. Figure 6.5 illustrates the guidelines and its production year from 1967 to 2018.

There are many guidelines progressively introduced after 2018 due to findings of poor occupational safety and health (OSH) compliance during OSH enforcement activities and in line with the latest method of assessment. They are Guidelines on Control and Safe Handling of Nanomaterials 2018, Manual on Simple Risk Assessment and Control for Chemicals (SiRAC) 2019 and Guidance on Conducting Generic Chemical Assessment 2019. An amendment of Industry Code of Practice (ICOP) on Chemicals Classification and Hazard Communication (Amendment) 2019: Part 1 was released in December 2019. However, due to the difficulty of complying during the Covid-19 pandemic, the industries are given a one year grace period to revise and review their classifications and labels as to comply with the latest amendment. The Simple Risk Assessment and Control for Chemicals (SiRAC) whilst adopting the control banding approach; was introduced in November 2019 to cater for the low compliance among the small and medium enterprises in chemical management (DOSH, Manual on SiRAC, 2019).

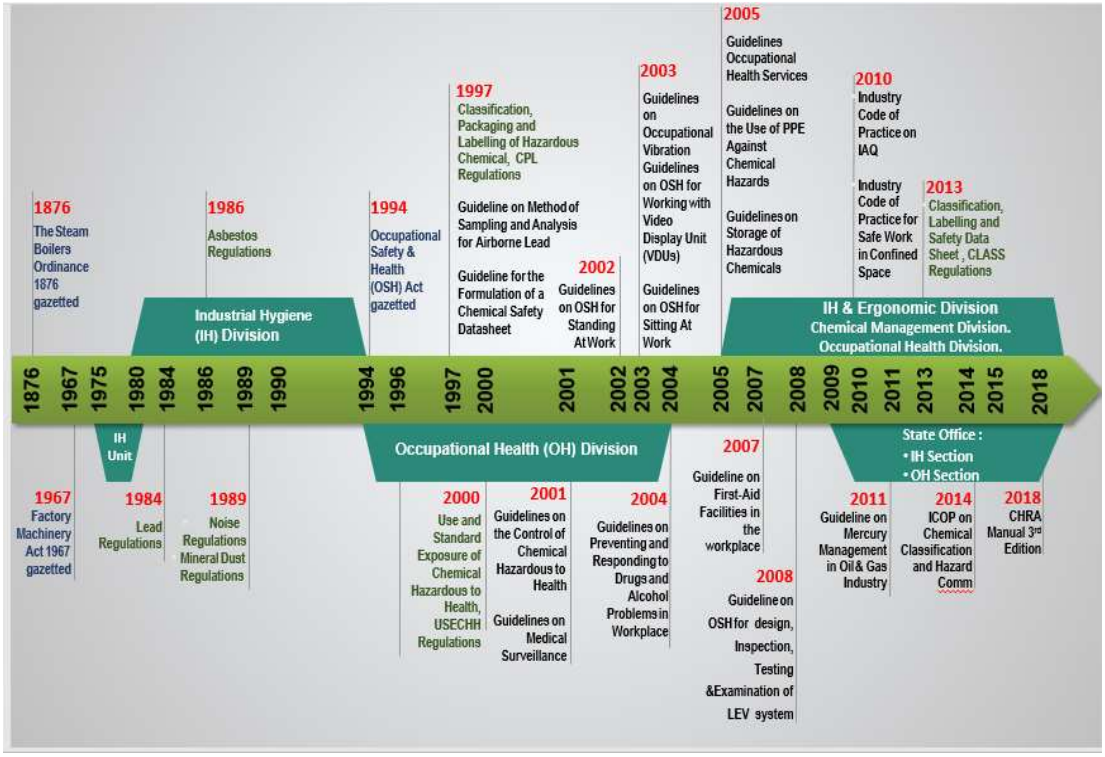

Figure 6.5. Legislations and guidelines established under the Industrial Hygiene Era by DOSH

Findings of OSH Enforcement Activities Related to Chemical Legislations

Enforcement of the OSH (Use and Standards of Exposure of Chemicals Hazardous to Health (USECHH)) Regulations 2000 on chemical management among various selected industries shows a decreasing trend of compliance. Enforcement of the OSH (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals (CLASS)) Regulations 2013 among chemical suppliers from 2016 to 2019, however, shows an increased compliance. These findings are depicted in Figure 6.6 and Figure 6.7. Analysis of CLASS enforcement activities found that the lowest compliance among suppliers is classification of hazardosu chemicals while the findings from USECHH enforcement activities specifies lack of compliance in the medical surveillance element upon recommendations by the competent person. However, the findings varies with sectors audited.

These findings further emphasized the need for new strategies to cater for the chemical enforcement in the country despite the introduction of various guidelines, manuals to assist compliance among industries and chemical suppliers. During the Covid-19 Pandemic, many OSH inspectors all over the countries have to reprioritize or change strategic plans and operations including the DOSH. DOSH also has to adapt the working methods to

ensure the safety and health of its inspectors. Public health policies have limited the ability to carry out normal inspection activities, whether because of quarantine, work from home or physical distancing requirements. In response to these changed circumstances, DOSH has come up with self-assessment checklist for industries to use to self-assess and self-check their compliance towards USECHH Regulation 2000 and the CLASS Regulations 2013.

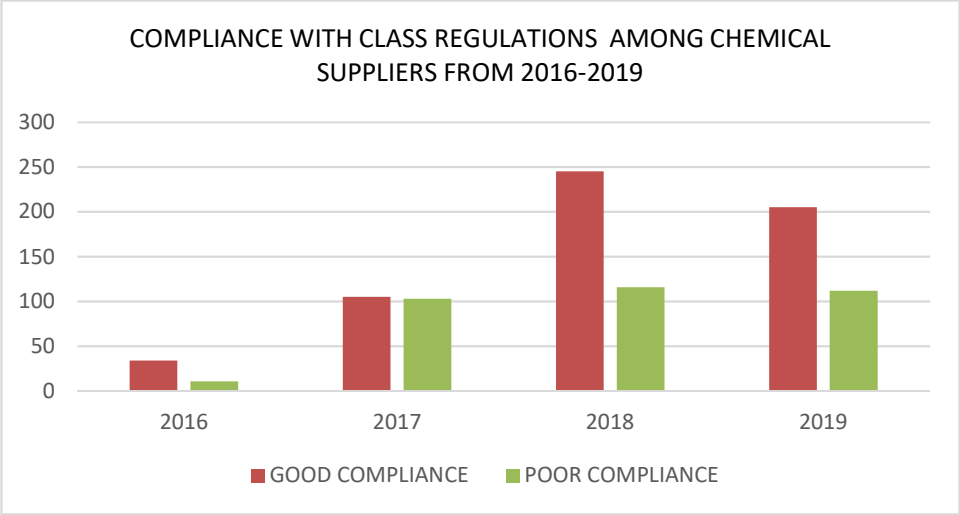

Figure 6.6. shows an increasing trend of compliance with CLASS Regulations 2013 from 2016 to 2019 among chemical suppliers.

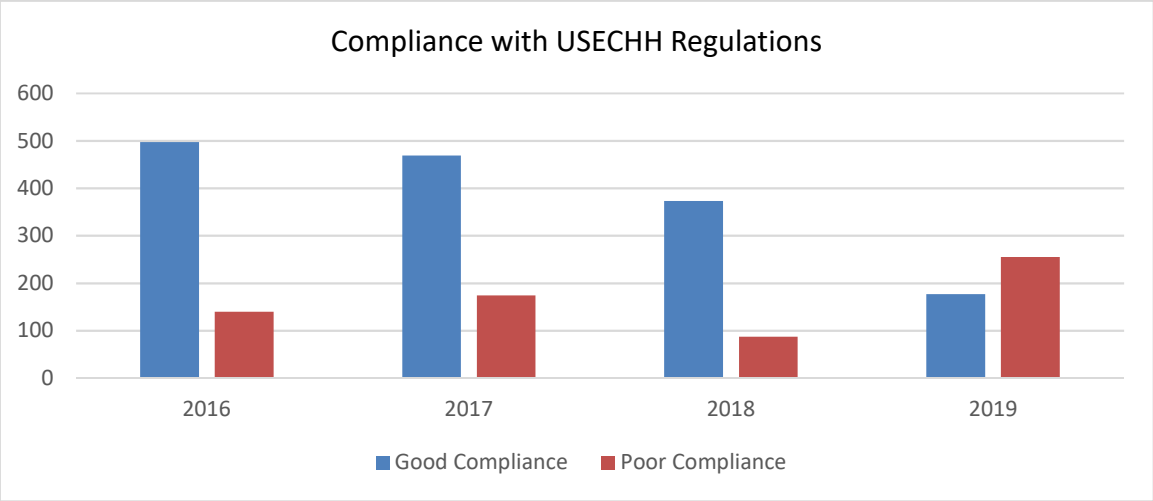

Figure 6.7 shows a decreasing trend of compliance with USECHH Regulations 2013 from 2016 to 2019 among selected industries

Potential Career Development in OSH

In line with the enhancement of chemical management in the country, DOSH is progressively developing new guidance, new normal procedure, amending ICOP, amending regulations and its Acts to assist industries. Growth in OSH career development can be seen as one of the positive impact of OSH in Malaysia. As of August 2020, there are 5798 Occupational Health Competent Persons while there are 55,666 Occupational Safety Competent Person in Malaysia amounting to 61,464 OSH personnel. The number of Occupational Health Competent Persons is linked directly with the requirements under occupational health legislations such as requirement of chemical health risk assessor, hygiene technician and occupational health doctor under the USECHH 2000 Regulations. In 2011, the total number of OSH Competent Persons was only 44116. The increment of OSH personnel signifies one of the successful objectives of the OSHMP 2020.

Chemical Lifecycle Management in Malaysia

Regulating chemicals responds to the need to control existing or potential risks, while retaining the socioeconomic benefits arising from the production and use of chemicals. Realizing these, DOSH is currently in the process of amending its chemical legislations to be in line with latest development of international obligations and in line with the findings of OSH enforcement. In Malaysia, chemical management is governed by many agencies through their respective acts as illustrated in Table 6.3.

Research by M. Mokhtar and C. T. Goh (2010) found that chemical management in Malaysia is properly done yet the existing act and regulations are decentralized or fragmented causing some grey areas not covered or regulated by the existing regulations unlike the case of New Zealand; where hazardous substances are regulated under one single act. The researchers further suggested that the same data might be submitted by industries to different government agencies in Malaysia causing duplication of effort. They further reiterated the need to establish a holistic and integrated chemical management system in Malaysia.

Table 6.3: ***Governing acts for various type of chemicals and its agency's jurisdiction***

Type of chemicals	Act	Agency Responsible/ Jurisdiction
Industrial chemicals	Occupational Safety and Health Act 1994 Customs Act 1967	Department of Occupational Safety and Health, Ministry of Human Resources Royal Malaysia Customs, Ministry of Finance
Pesticides	Pesticides Act 1974	Department of Agriculture, Ministry of Agriculture and Agro-based Industry
Chemical weapons	Chemical Weapons Convention Act 2005	National Authority for Chemical Weapon Convention, Ministry of Foreign Affairs
Pharmaceuticals Drugs, Poison	Control of Drugs and Cosmetic, Regulations 1984 Poison Act 1952	Ministry of Health
Petroleum	Petroleum Safety Measures Act 1984	Department of Occupational Safety and Health and Prime Minister's Department
Scheduled Waste	Scheduled wastes Environmental Quality Act 1974	Department of Environment, Ministry of Environment and Water
Consumer Chemicals	Consumer Protection Act 1999	Ministry of Domestic Trade and Consumer Affairs
Dangerous Goods Transported through air, rail, road, marine	Road Transport Act 1987	Ministry of Transport

Note: Adapted from (M. Mokhtar & C. T. Goh, 2009)

Recent pollution disaster in Pasir Gudang, Johor, a state in the south of Peninsular Malaysia in Mac 2019, caused a tremendous effort from various agencies in identifying and trying to find the culprit. The Kim Kim River was dumped with toxic waste chemicals that affected 5,039 students in twelve schools. It was suspected that the toxic waste dumped containing Volatile Organic Compound causing the adverse health effects to these vulnerable students (DOE, 2019). Another incident which broke out in June 2019 in Taman Mawar, Pasir Gudang was also related to the lifecyle of chemical management. Many agencies were involved during the disaster headed by National Disaster Management Agency under the Prime Minister's Department.

According to Y. H. Lee (2009) the awareness of disaster risk prevention and reduction is generally low in Malaysia and the management system for disaster is not very well developed. As a results of Kim Kim disaster, many chemical related agencies were asked to strengthen their enforcement within their scope and functions in order to enhance chemical management in the country.

Future of Chemical Management

Research by M. Mokhtar et al. (2009) identified that Malaysia requires structural and organizational reform beyond those offered by the existing legislation. Gap analysis by those researchers and report from the Ministry of Natural Resources and Environment (2009), differentiate between the need for action at a national level, and define the inter-relationship between existing consumer, occupational and environmental legislative frameworks in the country. Essential steps recommended by both researchers are the following:

Table 6.4 ***Essential steps recommended for chemical management system in Malaysia***

Steps	Scope
1.Strengthening National Capacities to Manage Chemicals. i.e establish National Chemical Council or National Chemical Board or Chemical Management Commission	To facilitate and coordinate the implementation of strategies identified in the action plan proposed i.e. GHS among four economic sectors,
2. Strengthening the legislative Framework to Manage Chemicals i.e. develop a single chemical act	To cover existing gaps in the existing chemical legislations and to introduce a legally binding principle of sustainable chemical management
3.Strengthening Information and Knowledge Base and Access to Information i.e. set up integrated chemical database	One stop-centre to manage chemicals submission/ registration/ inventories by industries
4. Establish indicators for monitoring and evaluation	To measure output, outcome and impact indicators of chemical management system

Note: Adapted from Mokhtar et al. (2009) and Report Activity 1.17 from Ministry of Natural Resources and Environment (2009)

Recommendations in terms of OSH are enhancement of chemical data captured by each agency using online management tools and risk mapping utilising geographic information system which can analyze spatial location and organizes layers of information

into visualizations using maps and 3D scenes. Besides that, risk estimations of chemical hazards using various effect models would be an added advantage to the country during disaster. Priority should be given to chemical security aspects of chemical plants as this will be the highest risk should there be a chemical disaster.

Conclusion

The legislations in Malaysia has evolved from the prescriptive traditional approach under the Factories and Machinery Act,1967 to the principle based approach after the gazetting of OSHA 1994 in which duties to ensure safety and health as far as practicable lies with the duty holder. General requirements specified in subsequent chemical legislations i.e. USECHH 2000 Regulations help to assist industries in its implementation. Minimum guidance is prescribed in the legislations followed by guidelines for specific hazards. Malaysia has been cooperative in responding to the international obligations and has progressively improved chemical management in the country. Nevertheless, to achieve the 2020 WSSD goal and the SDG goals by 2030, a lot more is needed to close the existing gaps in the legislations on chemical management in the country. In order to ensure sustainability of existing efforts in the chemical management, human capacity building, inter-agency coordination and data sharing via adoption of online tools need to be enhanced in the country.

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7

THE ROLE OF OCCUPATIONAL SAFETY AND HEALTH (OSH) NON-GOVERNMENTAL ORGANIZATIONS (NGOs) IN THE TRIPARTITE APPROACH

Aliasman Morshidi TechIOSH , SIIRSM

INTRODUCTION

The role of Non-Governmental Organizations (NGOs) in Malaysian Occupational Safety and Health (OSH) is explained and defined clearly in the National OSH Profile for Malaysia in 2016. NGOs are one of the social partners in the overall National OSH Structures in Malaysia. Their role is more as an independent party representing the members who believe in the vision, mission and objectives of promoting OSH based on capacity and capability as volunteers in the NGOs. As social partner, they become an advocate in promoting or influencing the key OSH stakeholders namely Department of Occupational Safety and Health (DOSH), the administration and enforcement body for OSH legislation. The NGOs also work closely with DOSH in providing feedbacks on any OSH issues and support any DOSH programs or activities in the promotion of safety and health at the workplace.

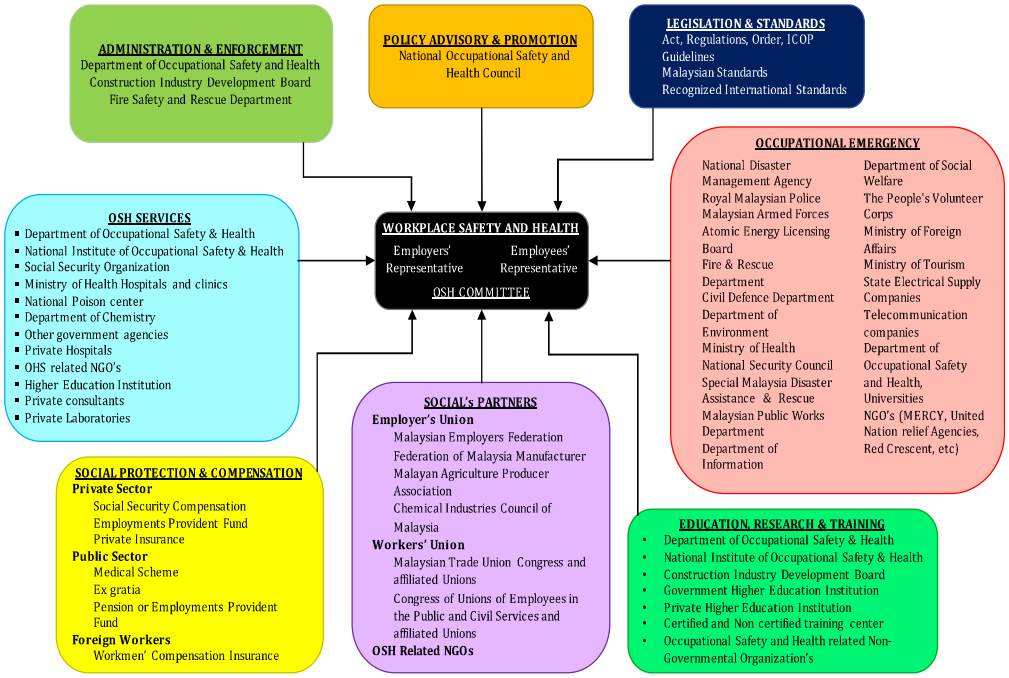


Figure 7.1. The summary of the overall OSH structure, function and organization in Malaysia (Sources: National OSH Profile for Malaysia 2016)

There are more than twenty OSH NGOs in Malaysia. Some of the OSH NGOs are established based on the regions such as Northern Region Group Safety Health Environment (NRG-SHE), Southern Region Group Safety Health Environment (SRG-SHE) and Sabah OSHE Association (SOSHEA). Apart from that, there are several OSH NGOs specializing in specific OSH disciplines such as Society of Occupational and Environmental Medicine (SOEM), Malaysian Steam and Internal Combustion Engine Engineer Association (MSIEA), Human Factors and Ergonomics Malaysia (HFEM), Malaysian Industrial Hygiene Association (MIHA). Besides that, a few of OSH NGOs focuses more on general OSH issues such as Malaysian Society for Occupational Safety and Health (MSOSH) and Malaysian Occupational Safety and Health Practitioners Association (MOSHPA). Table 7.11 is a summary of some of the OSH NGOs currently in Malaysia based on general and specific OSH disciplines. The focus of this article will be on one of the oldest OSH NGO in Malaysia, namely MSOSH which is established back in 1971.

Table 7.1 OSH NGOs in Malaysia

Types of OSH Association	Name of Association		Year established
General OSH Association	MSOSH	Malaysian Society for Occupational Safety & Health	1971
	MOSHPA	Malaysian Occupational Safety and Health Practitioners Association	1997
	NRG-SHE	Persatuan Pengamal Keselamatan dan Kesihatan Pekerjaan Wilayah Utara	2009
	SRG-SHE	Persatuan Pengamal Keselamatan dan Kesihatan Pekerjaan Wilayah Selatan	2011
	MISHA	Malaysian Industrial Safety and Health Association	2012
Specialized OSH Association	MAEH	Malaysian Association of Environmental Health	1978
	MIHA	Malaysian Industrial Hygiene Association	2003
	AOEMM	Academy of Occupational and Environmental Medicine	2005
	HFEM	Malaysia	2011
	MSIEA	Human Factors and Ergonomics Malaysia	2013
	MAGTA	Malaysian Steam and Internal Combustion Engine Engineer Association Malaysian Authorised Gas Tester Association	2016

The Journey of MSOSH

In 1970s, Malaysia initiated the National Industrialisation Policy that expedited the growth and development of manufacturing industry in Malaysia. Malaysia saw massive incoming investment from developed countries such as the USA, Japan and Germany on manufacturing establishment in Selangor, Johor and Penang. Consequently, the concern for workers' safety has also increased.

It all started on one sunny day in Klang Rotary Club back in 1971. Twenty OSH practitioners from different sectors and background came together to discuss on the need for industry's safety. On August 19, 1970, a meeting was held to develop the society's constitution and Dr Chan Jee Swee was appointed as the Protem Chairman of the Malaysian Society for Industrial Safety (MSIS). The MSIS was registered on the April 27, 1971. Since its formation and registration, the Society maintain its status as a non-profit, non-governmental and non-political organization.

On May 15, 1971, MSIS held its first meeting at the National Productivity Centre in Petaling Jaya. There were 20 founding members that became the initial backbone to spearhead the gigantic voluntary effort to develop and promote occupational safety and health in Malaysia. The effort to establish MSIS was recognized by two international OSH associations namely The Royal Society for The Prevention of Accidents (ROSPA) and also The National Safety Council, USA.

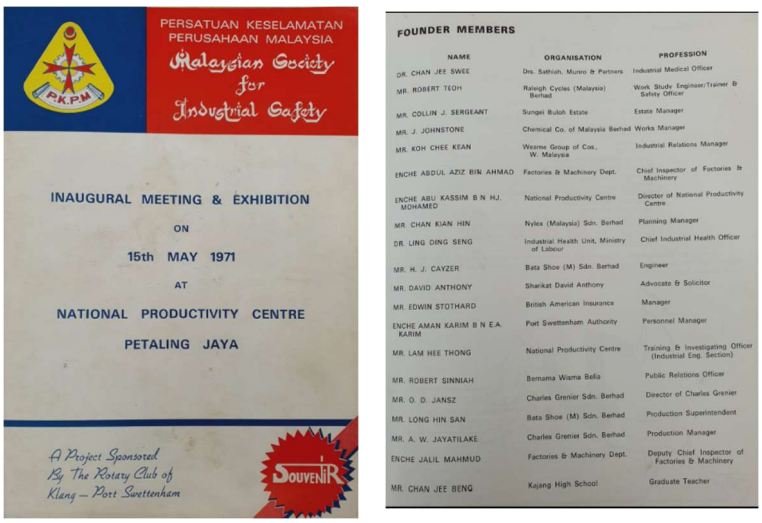
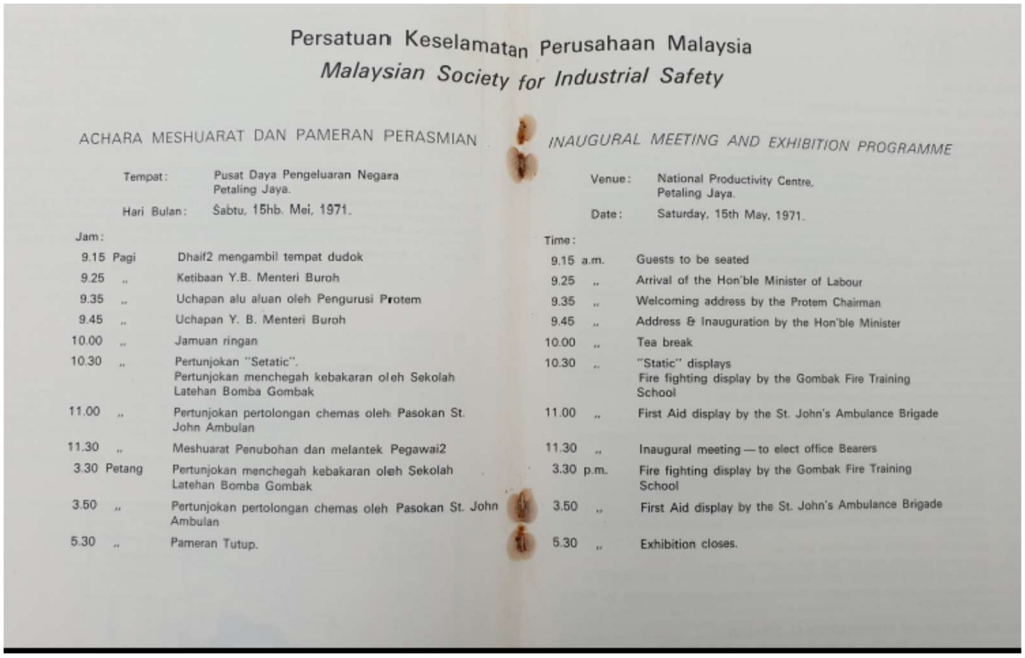


Figure 7.2. Twenty MSOSH's founding member as listed in MSIS 1st meeting on 15 May 1971 (Source: MSOSH Archive)



Persatuan Keselamatan Perusahaan Malaysia
Malaysian Society for Industrial Safety

ACHARA MESHUARAT DAN PAMERAN PERASMIAN

Tempat: Pusat Daya Pengeluaran Negara, Petaling Jaya.
Hari Bulan: Sabtu, 15hb. Mei, 1971.

Jam:

9.15 Pagi	Dhaif2 mengambil tempat dudok
9.25 „	Ketibaan Y.B. Menteri Buroh
9.35 „	Uchapan alu aluan oleh Pengurusi Protem
9.45 „	Uchapan Y. B. Menteri Buroh
10.00 „	Jamuan ringan
10.30 „	Pertunjokan "Setatic". Pertunjokan menchegah kebakaran oleh Sekolah Latehan Bomba Gombak
11.00 „	Pertunjokan pertolongan chemas oleh Pasokan St. John Ambulan
11.30 „	Meshuarat Penubohan dan melantek Pegawai2
3.30 Petang	Pertunjokan menchegah kebakaran oleh Sekolah Latehan Bomba Gombak
3.50 „	Pertunjokan pertolongan chemas oleh Pasokan St. John Ambulan
5.30 „	Pameran Tutup.

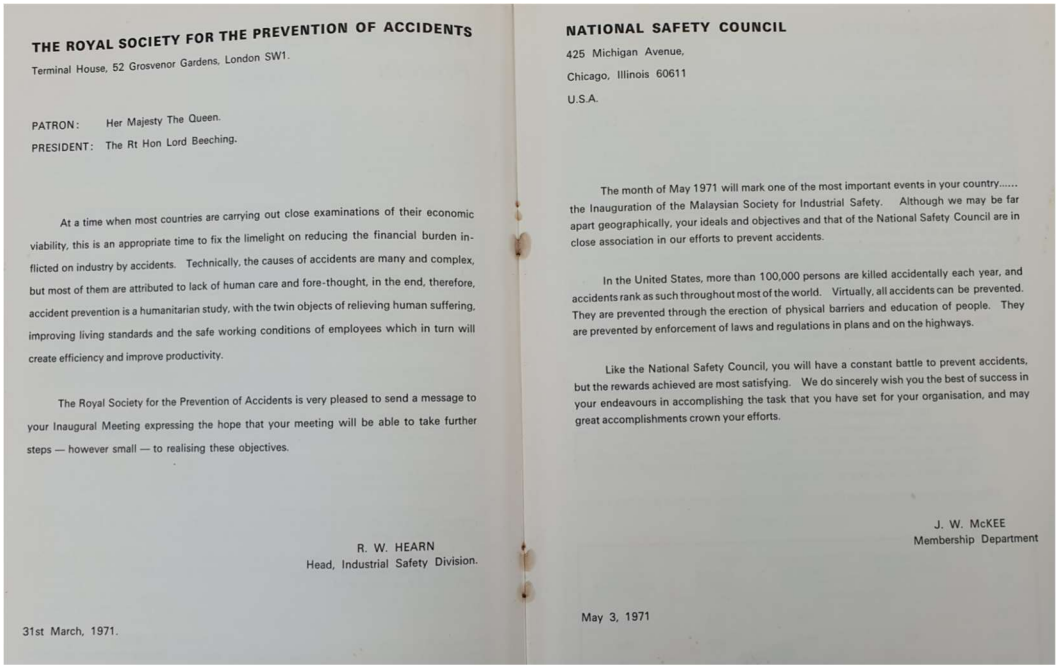
INAUGURAL MEETING AND EXHIBITION PROGRAMME

Venue: National Productivity Centre, Petaling Jaya.
Date: Saturday, 15th May, 1971.

Time:

9.15 a.m.	Guests to be seated
9.25 „	Arrival of the Hon'ble Minister of Labour
9.35 „	Welcoming address by the Protem Chairman
9.45 „	Address & Inauguration by the Hon'ble Minister
10.00 „	Tea break
10.30 „	"Static" displays Fire fighting display by the Gombak Fire Training School
11.00 „	First Aid display by the St. John's Ambulance Brigade
11.30 „	Inaugural meeting — to elect office Bearers
3.30 p.m.	Fire fighting display by the Gombak Fire Training School
3.50 „	First Aid display by the St. John's Ambulance Brigade
5.30 „	Exhibition closes.

Figure 7.3. MSIS 1st meeting and its meeting agenda on Saturday, 15th May 1971 (Source: MSOSH Archive)



THE ROYAL SOCIETY FOR THE PREVENTION OF ACCIDENTS
Terminal House, 52 Grosvenor Gardens, London SW1.

PATRON: Her Majesty The Queen.
PRESIDENT: The Rt Hon Lord Beeching.

At a time when most countries are carrying out close examinations of their economic viability, this is an appropriate time to fix the limelight on reducing the financial burden inflicted on industry by accidents. Technically, the causes of accidents are many and complex, but most of them are attributed to lack of human care and fore-thought, in the end, therefore, accident prevention is a humanitarian study, with the twin objects of relieving human suffering, improving living standards and the safe working conditions of employees which in turn will create efficiency and improve productivity.

The Royal Society for the Prevention of Accidents is very pleased to send a message to your Inaugural Meeting expressing the hope that your meeting will be able to take further steps — however small — to realising these objectives.

R. W. HEARN
Head, Industrial Safety Division.

31st March, 1971.

NATIONAL SAFETY COUNCIL
425 Michigan Avenue,
Chicago, Illinois 60611
U.S.A.

The month of May 1971 will mark one of the most important events in your country..... the Inauguration of the Malaysian Society for Industrial Safety. Although we may be far apart geographically, your ideals and objectives and that of the National Safety Council are in close association in our efforts to prevent accidents.

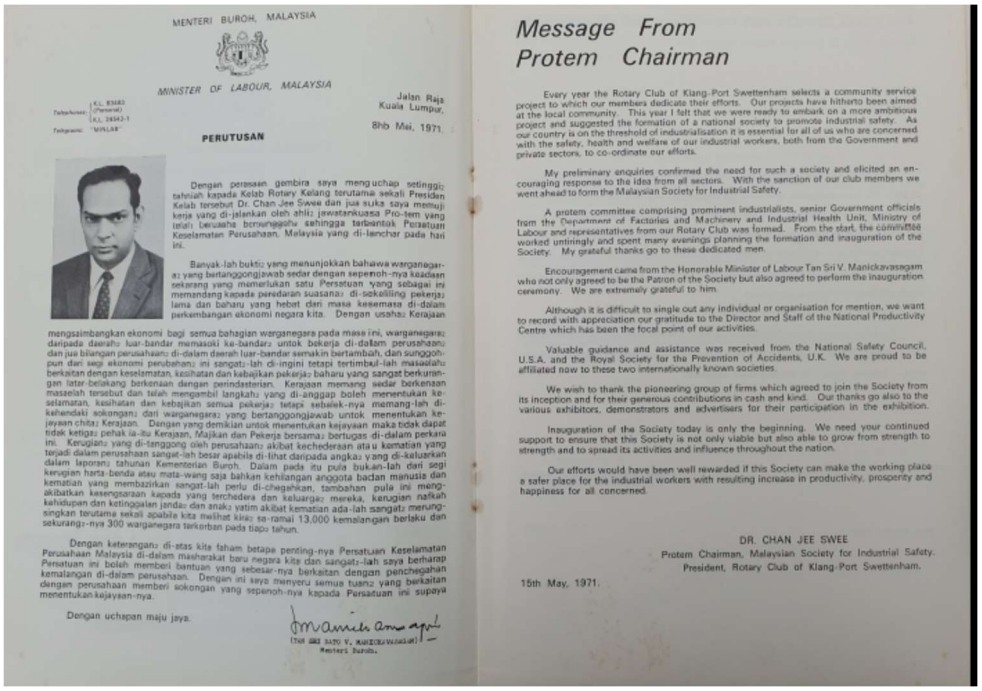
In the United States, more than 100,000 persons are killed accidentally each year, and accidents rank as such throughout most of the world. Virtually, all accidents can be prevented. They are prevented through the erection of physical barriers and education of people. They are prevented by enforcement of laws and regulations in plans and on the highways.

Like the National Safety Council, you will have a constant battle to prevent accidents, but the rewards achieved are most satisfying. We do sincerely wish you the best of success in your endeavours in accomplishing the task that you have set for your organisation, and may great accomplishments crown your efforts.

J. W. McKEE
Membership Department

May 3, 1971

Figure 7.4. The congratulatory notes by Mr R.W. Hearn, Head, Industrial Safety Division of ROSPA and Mr J.W McKee, Membership Department from NSC, USA (Source: MSOSH Archive)



MENTERI BUROH, MALAYSIA

MINISTER OF LABOUR, MALAYSIA

Jalan Raja
Kuala Lumpur,

8hb Mei, 1971.

PERUTUSAN

Dengan perasaan gembira saya mengucap setinggi-tahniah kepada Kelab Rotary Kelang terutama sekali Presiden Kelab tersebut Dr. Chan Jee Swee dan jua suka saya memuji kerja yang di-jalankan oleh ahli2 jawatankuasa Pro-tem yang telah berusaha bersungguh2 sehingga terbentok Persatuan Keselamatan Perusahaan, Melaysia yang di-lancher pada hari ini.

Banyak-lah bukti2 yang menunjokkan bahawa warganegara2 yang bertanggongjawab sedar dengan sepenoh-nya kedaan sekarang yang memerlukan satu Persatuan yang sebagai ini memandang kepada peredaran suasana2 di-sekeliling pekerja2 lama dan baharu yang hebat dari masa kesemasa di-dalam perkembangan ekonomi negara kita. Dengan usaha2 Kerajaan mengsaimbangkan ekonomi bagi semua bahagian warganegara pada masa ini, warganegara2 daripada daerah2 luar-bandar memasoki ke-bandar2 untok bekerja di-dalam perusahaan2 dan jua bilangan perusahaan2 di-dalam daerah luar-bandar semakin bertambah, dan sungguh-pun dari segi ekonomi perubahan2 ini sangat2-lah di-ingini tetapi tertimbul-lah masalah2 berkaitan dengan keselamatan, kesihatan dan kebajikan pekerja2 baharu yang sangat berkurangan latar-belakang berkenaan dengan perindustrian. Kerajaan memang sedar berkenaan masaelah tersebut dan telah mengambil langkah2 yang di-anggap boleh menentukan keselamatan, kesihatan dan kebajikan semua pekerja2 tetapi sebalek-nya memang-lah di-kehendaki sokongan2 dari warganegara2 yang bertanggongjawab untok menentukan kejayaan chita2 Kerajaan. Dengan yang demikian untok menentukan kejayaan maka tidak dapat tidak ketiga2 pehak ia-itu Kerajaan, Majikan dan Pekerja bersama2 bertugas di-dalam perkara ini. Kerugian2 yang di-tanggong oleh perusahaan2 akibat kecederaan ata u kematian yang terjadi dalam perusahaan sangat-lah besar apabila di-lihat daripada angka2 yang di-keluarkan dalam laporan2 tahunan Kementerian Buroh. Dalam pada itu pula bukan-lah dari segi kerugian harta-benda atau mata-wang saja bahkan kehilangan anggota badan manusia dan kematian yang membazirkan sangat-lah perlu di-chegahkan, tambahan pula ini mengakibatkan kesengsaraan kepada yang terchedera dan keluarga2 mereka, kerugian nafkah kehidupan dan ketinggalan janda2 dan anak2 yatim akibat kematian ada-lah sangat2 merungsingkan terutama sekali apabila kita melihat kira2 se-ramai 13,000 kemalangan berlaku dan sekurang2-nya 300 warganegara terkurban pada tiap2 tahun.

Dengan keterangan2 di-atas kita faham betapa penting-nya Persatuan Keselamatan Perusahaan Malaysia di-dalam masharakat baru negara kita dan sangat2-lah saya berharap Persatuan ini boleh memberi bantuan yang sebesar-nya berkaitan dengan penchegahan kemalangan di-dalam perusahaan. Dengan ini saya menyeru semua tuan2 yang berkaitan dengan perusahaan memberi sokongan yang sepenoh-nya kepada Persatuan ini supaya menentukan kejayaan-nya.

Dengan uchapan maju jaya.

(Tan Sri Dato V. Manickavasagam)
Menteri Buroh.

Message From Protem Chairman

Every year the Rotary Club of Klang-Port Swettenham selects a community service project to which our members dedicate their efforts. Our projects have hitherto been aimed at the local community. This year I felt that we were ready to embark on a more ambitious project and suggested the formation of a national society to promote industrial safety. As our country is on the threshold of industrialisation it is essential for all of us who are concerned with the safety, health and welfare of our industrial workers, both from the Government and private sectors, to co-ordinate our efforts.

My preliminary enquiries confirmed the need for such a society and elicited an encouraging response to the idea from all sectors. With the sanction of our club members we went ahead to form the Malaysian Society for Industrial Safety.

A protem committee comprising prominent industrialists, senior Government officials from the Department of Factories and Machinery and Industrial Health Unit, Ministry of Labour and representatives from our Rotary Club was formed. From the start, the committee worked unstingly and spent many evenings planning the formation and inauguration of the Society. My grateful thanks go to these dedicated men.

Encouragement came from the Honorable Minister of Labour Tan Sri V. Manickavasagam who not only agreed to be the Patron of the Society but also agreed to perform the inauguration ceremony. We are extremely grateful to him.

Although it is difficult to single out any individual or organisation for mention, we want to record with appreciation our gratitude to the Director and Staff of the National Productivity Centre which has been the focal point of our activities.

Valuable guidance and assistance was received from the National Safety Council, U.S.A. and the Royal Society for the Prevention of Accidents, U.K. We are proud to be affiliated now to these two internationally known societies.

We wish to thank the pioneering group of firms which agreed to join the Society from its inception and for their generous contributions in cash and kind. Our thanks go also to the various exhibitors, demonstrators and advertisers for their participation in the exhibition.

Inauguration of the Society today is only the beginning. We need your continued support to ensure that this Society is not only viable but also able to grow from strength to strength and to spread its activities and influence throughout the nation.

Our efforts would have been well rewarded if this Society can make the working place a safer place for the industrial workers with resulting increase in productivity, prosperity and happiness for all concerned.

DR. CHAN JEE SWEE
Protem Chairman, Malaysian Society for Industrial Safety.
President, Rotary Club of Klang-Port Swettenham.

15th May, 1971.

Figure 7.5. A message from the Labour Minister, Tan Sri Dato'V. Manickavasagam and also Dr Chan Jee Swee, the Protem Chairman of MSIS in the inaugural meeting and exhibition of MSIS on 15th May 1971 (Source: MSOSH Archive)

During the initial stage of the society's establishment, MSIS objectives were more aligned towards safety due to the situation at that time. In the early years of MSIS formation, the society listed ten objectives:

1. To promote the safety of industrial workers and the prevention of accidents
2. To encourage and promote co-operation between employers and employees in preventing accident at workplace
3. To promote, hold and sponsor congresses, conventions and gatherings as a platform to discuss safety of industrial workers
4. To reward gallantry in prevention of accidents
5. To prepare, print and publish in the public press on safety issues
6. To sell, hire or distribute for free of charge or otherwise to members and other persons any publication, model, apparatus or device and similarly, to provide consultant services
7. To organize, promote and carry out research on accidents' causes and ways of preventing them, and also to protect the workers from the adverse effects and/ or otherwise to promote their safety and in particular for the purposes of research to collect, classify and analyze related statistics

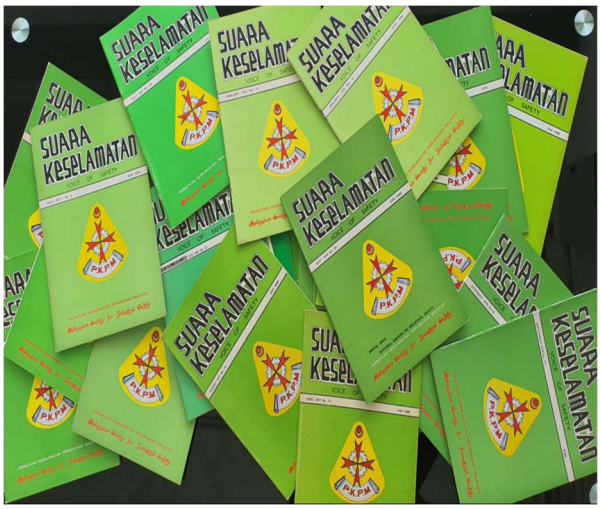
8. To publish and circulate statistics and information obtained by the society to facilitate the prevention of accidents and promote the safety of the workers
9. To undertake education work and information services for the purpose of instructing workers in the best methods to avoid accidents and persuade them to adopt such methods whenever practicable
10. To establish, form and maintain a library and collection of models, designs, drawings and other articles of interest.

In 1989, MSIS members discussed on a potential draft of an Occupational Safety and Health Act that will be enforced in the near future. This wind of change has steered MSIS to make a significant decision and change its direction in order to maintain its relevancy to the industry's needs. Hence, MSIS decided to change its name to Malaysian Society on Occupational Safety and Health (MSOSH). The Establishment of MSOSH became the game changer when they decided to increase their participation and roles in enhancing the understanding of OSH among individual OSH practitioners, not only focusing on training for companies.

The Early Era of MSOSH (1971 to 1988)

MSIS activities mainly focus on provision of talks, seminar and training, which are voluntarily conducted for the members. The society's fund was generated from the collection of fees from these activities which is used to pay for the administrative and operational cost.

Since 1971, MSIS become popular and started to recruit individuals and corporate members from all over Malaysia. In its cooperation with Social Security Organization (SOCSO), MSIS began to provide OSH training around Malaysia. MSIS also started to publish a monthly newsletter called "Suara Keselamatan" (Voice of Safety), which contained articles and issues on occupational safety and health.



In September 1973, MSIS President, Dr. Chan was invited to Asian Conference on Occupational Health which was held on September 1973. by 400 participants from 23 countries namely Australia, India, Japan, Malaysia, Philippines, Korea, Sri Lanka, Singapore and Thailand attended the conference. In 1985, MSOSH made a major step in the international OSH arena in which MSOSH was the pioneer members of the establishment of Asia-Pacific Occupational Safety and Health Organization (APOSHO). In its early establishment it was known as "the Coordinating Committee of Asia-Pacific National Safety Councils" before it was renamed to APOSHO in 1992.

The Era of 1989 to 2010

MSOSH played significant and more proactive role in this era. In 2008, the Vice President of MSOSH, Mr Suppiah Veerasingam was the first Malaysian elected as Secretary General of APOSHO from 2008 to 2010. During this term, APOSHO became one of the signatories for Seoul Declaration. It was adopted in a Safety and Health Summit on June 2008 on the occasion of the XVIII World Congress on Safety and Health at Work that was held in Seoul, South Korea. The Seoul Declaration was also signed by the Malaysian Government represented by Ministry of Human Resources and SOCSO.

This high-level signatories of the Declaration committed unanimously to pursue the protection of this fundamental human right through the implementation of the Declaration and committed to actively participate in securing a safe and healthy working environment through a system of defined rights, responsibilities and duties, where the principle of prevention is accorded the highest priority.

Together with the many supporters of the Seoul Declaration, the International Labour Office (ILO) through its Decent Work Agenda, the International Social Security Association (ISSA) and its members, and the Korea Occupational Safety and Health Agency (KOSHA) committed to promote preventive safety and health culture worldwide.

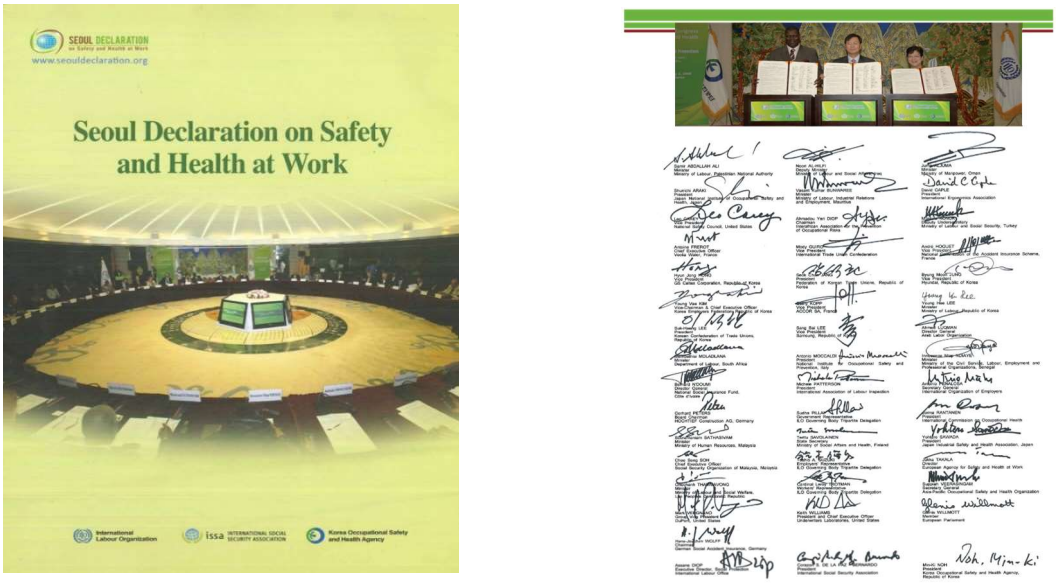


Figure 7.6. Seoul Declaration on Safety and Health at work in 2008 where Mr Suppiah Veerasingam is one of the signatories on behalf of APOSHO (Source: MSOSH Archive)

The Era of 2010 to the Current Year

With the challenging new agenda by the authority and the workplace challenges that are changing towards volatility, uncertainty, complexity and ambiguous (VUCA) environments, MSOSH must quickly adapt and be agile to overcome these. Besides being proactive in bridging employers, employees, government, other OSH NGOs and also OSH practitioners, MSOSH will strive to championing OSH issues and become eyes, ears and mouths of OSH stakeholders in Malaysia. Some of the major achievements and changes attained are

1. New MSOSH Building
2. New MSOSH website
3. New MSOSH logo

There are several new strategies for MSOSH to achieve its vision, mission and objectives. For the first time, MSOSH developed a 4-year strategies (2018-2021) to promote its existence as a prominent OSH association in Malaysia. These strategies were documented in the MSOSH2021 as part of MSOSH commitment to contribute OSH programs and development parallel with the Malaysian Occupational Safety and Health Master Plan (OSHMP).

Figure 7.7. Fours years MSOSH2021 Masterplan

One of the main agenda in the MSOSH2021 is to promote and reinforcet Occupational Health (OH) and Industrial Hygiene (IH) as the key components toOSH management at the workplace. Several sessions on OH and IH awareness and advanced training for OSH practitioners and public were conducted. The main objective is to educate them to understand and response correctly on how to manage OH and IH issues at the workplace.

MSOSH has promoted and established OSH Competency Framework for OSH Professionals as a part of a new career path and development for OSH Practitioners in Malaysia. MSOSH has also illustrated its commitment towards Singapore Accord and its intention to elevate Malaysian OSH Practitioners on par with other international OSH Professionals. Numerous discussions were done with key stakeholders such as Department of Occupational Safety and Health (DOSH), National Council of Occupational Safety and Health (NCOSH), Malaysian Board of Technologists, National Institute of Occupational Safety and Health (NIOSH), OSH Practitioners and other OSH NGOs for this purpose. MSOSH has also collaborated with the international OSH Professional Bodies such as Institution of Occupational Safety and Health (IOSH) of United Kingdom and also National Safety Council of Australia (NSCA). We hope that the OSH Competency Framework will be part of the Malaysian OSHMP2025.

MSOSH Award

The MSOSH OSH Award program was inaugurated in 1982 and it continues to be actively supported by member organizations since its inception. It is an annual award presented to organizations in Malaysia with proven and outstanding Occupational Safety and Health performance. Identified companies are subjected to stringent document and site verification audits by MSOSH panel of qualified and dedicated auditors in order to be considered by the MSOSH Committee for the respective awards.

The MSOSH OSH Awards are intended to give due recognition to all member organizations and companies which have achieved commendable Occupational Safety and Health performance.

Conclusion

It is hoped that all OSH NGOs in Malaysia will be more proactive and focused their objectives to provide awareness and support DOSH and the government in reducing the number of accidents in Malaysia. Additionally, NGOs should work hand in hand with other OSH stakeholders to promote OSH awareness and cultivate OSH culture at the workplace and in the community.

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PART II
OCCUPATIONAL SAFETY

8

OCCUPATIONAL SAFETY SERVICES AND IT'S DEVELOPMENT IN NIOSH

Ts. Haji Mohd Esa Haji Baruji

INTRODUCTION

Occupational Safety and Health (OSH) is a multidisciplinary field concerned with the safety, health and well being of people at work. OSH is a field comprised of different disciplines, perspectives and philosophies. The key focus is to preserve the workers' mental health and physical health through preventive measures such as providing safe working conditions, limiting harmful material hazardous to health and others. As Occupational Health has been discussed extensively in the previous section, this article will focus on Occupational Safety.

To have a deeper understanding on Occupational Safety, we must first define occupational and safety. What is occupational? Occupational means a person's usual or principal work or business, especially as means of earning a living or relating to a job or profession.

Then, what is safety? Safety means keeping yourself and others free from harm or danger. It means taking care not to fall or bump or run into things. It also means to avoid accidents by being careful with what you are doing.

So, what is Occupational Safety (OS)? OS is your legal right to work in conditions (including wellbeing) that are free of known dangers. The requirements of the legal, standard or certain guideline helps employers prevent the number of workplace injuries (including illnesses) and deaths resulted from work environment.

Why is safety important to you? A safe workplace protects workers from injury and illness, lower injury (as well as illness) costs, reduce absenteeism and turnover, increase productivity and quality, and raise employee morale. In other words, safety is good for business and sustainability.

Therefore, organization needs to manage OS properly. Why is it important to manage OS? Workplace safety is very important for each and every employee in the industry because every workers want to work in a safe and protected atmosphere. It is a duty and moral responsibility of the company to look after the employee's wellbeing by protecting and preventing them from any illness or injuries while working.

To date, the OSH related standards are:

1) MS 1722:2011 – Occupational Safety and Health Management Systems – Requirements:
    - This is a Malaysian Standard that provides requirements on Occupational Safety and Health Management Systems (OSHMS) and basis for the development OSH systems in an organization.

2) OHSAS 18001:2007– Occupational, Health and Safety Management System – Requirements (recognized internationally):
    - OHSAS is a standard that is developed by the OHSAS team, an association that includes government agencies, certification bodies, national standards, industry associations and consultants, and
    - OHSAS 18001 assist organizations in establishing a management system to manage and control their health and safety risks and improving their OH&S performance.

3) ISO 45001:2018 Occupational health and safety management systems - Requirements with guidance for use:
    - ISO 45001:2018 specifies requirements for an occupational health and safety (OH&S) management system, and gives guidance for its use to enable organizations to provide safe and healthy workplaces by preventing work-related injury and ill health, as well as by proactively improving its OH&S performance, and
    - ISO 45001:2018 is applicable to any organization that wishes to establish, implement and maintain an OH&S management system to improve occupational health and safety, eliminate hazards and minimize OH&S risks (including system deficiencies), take advantage of OH&S opportunities, and address OH&S management system's nonconformities associated with its activities.

Occupational Safety Scenario Worldwide

OS in Germany

The Occupational Health and Safety Act is the primary German law on OSH and is a direct transposition of European Council Directive 89/391/EEC (Framework Directive) on the introduction of measures to encourage improvements in the health and safety of workers at work. The law emphasizes the preventive approach and universal coverage of all employees in all enterprises of all sizes and in the public sector, and describes in detail the duties and rights of employers and employees with regard to safety (and health) in general.

The so-called daughter directives of the Framework Directive, focusing on individual hazards and exposures, are all transposed, largely by adaptation of previous corresponding legislation. The act on safety engineers and other occupational safety specialists sets out the duties of employers regarding the provision of occupational health services (OHS), including the minimum annual working time of occupational physicians and safety specialists for enterprises of various sizes and in various sectors (J-Stage, 2019).

OS in Japan

The Industrial Safety and Health Law enacted in 1972 has contributed much to the progress of occupational safety and health (OSH) activities. Many indicators including death (and illness) statistics showed continuous improvement up to date. The establishment of OSH organization within enterprises and 5 year administrative programs formulated by the Ministry of Health, Labour, and Welfare (MHLW) were important factors for satisfactory management. The past programs indicated that the weight of self-regulation in comparison to legal control gradually increased since late 1990s. In spite of the past achievement, many hazards such as overwork, mental stress, chemical agents and others still remain to be prevented.

The systematic risk assessment of unregulated chemicals by the MHLW proved to be an effective scheme for risk-based management and deserve continued implementation. The size of human resources for OSH was estimated at 1.5 million. In view of the adverse effect on OSH by economic, social and political environment in the future, the importance of the efficiency of OSH management was indicated. Since the efficiency depends on the competence of OSH personnel and the level of scientific basis, it was concluded that the fundamental policy for the future should give high priority to education and research (J-Stage, 2019).

OS in the United State of America (USA)

In the USA, national worker protection legislation was enacted in 1970. The legislation required that research, recommendations and guidance be developed to aid employers and workers, that workplace safety (as well as health) standards be adopted, that employer comply with those rules and that the government police employer compliance, and that assistance be offered to employers and workers to help them maintain a safe (and healthful) workplace. In the 40 year since passage of the Occupational Safety and Health Act

of 1970, worker injury and fatalities have declined but not been eliminated. Efforts to accelerate the standards adoption process are much discussed in the USA along with how to protect workers from emerging hazards like nanotechnology. New strategies which seek to eliminate not only the causes of work-related injury and illness, but also more broadly, worker's injury (and illness) are on the horizon (J-Stage, 2019).

Occupational Safety: NIOSH Malaysia's Experience

This chapter will focus on occupational safety (OS) consultancy activity only as the OS training and research was discussed in the previous section. As quoted in NIOSH FYi Disember 2017, an analysis of safety advisor role and site safety performance found that the quality of a safety personnel is more important than the quantity employed (Cameron Iain, Hare Billy Duff Roy, 2013).

NIOSH Malaysia and Department of Occupational Safety and Health (DOSH) in their research collaboration (November, 2016 to April, 2017) have conducted a study on occupational safety competent person (CP). The sampling method for this survey was random stratified sampling consisting of Safety and Health Officer (SHO), Site Safety Supervisor (SSS), Major Hazard Competent Person, Lift Competent Person, Steam Engineer, Internal Combustion Engine Engineer and Hoisting Machine Competent Person. The overall data of CPs and their category showed that most of CPs (97.2%) were employed or tied to an organization, while 1.4% is attached to Consultant Company and the remaining 1.4% of CPs work in other types of organization. The finding also showed thatmost of CPs are located or appointed by employers in construction (45.8%), manufacturing (30.8%) and services or utilities (10.3%) sectors. Majority of CPs, 96% were full-time employees compared to 4% who are working part-time. In terms of gender, 80.5% of the CPs are male while 19.5% are female which indicates that OSH career is mostly dominated by male.

"OS Competent Person in Malaysia need to improve the role and tasks of knowledge management for OSH management system documentation, able to exchange knowledge and practical experiences with colleagues at national or international level"

"Study showed also that there is a clear profession of safety competent person (advisers) in Malaysia conforming to international standards.

According to NIOSH Annual Report 1999, in the third year of its establishment, NIOSH provided four types of consultations activities to industry to overcome occupational safety related issues as shown in figure 8.1.

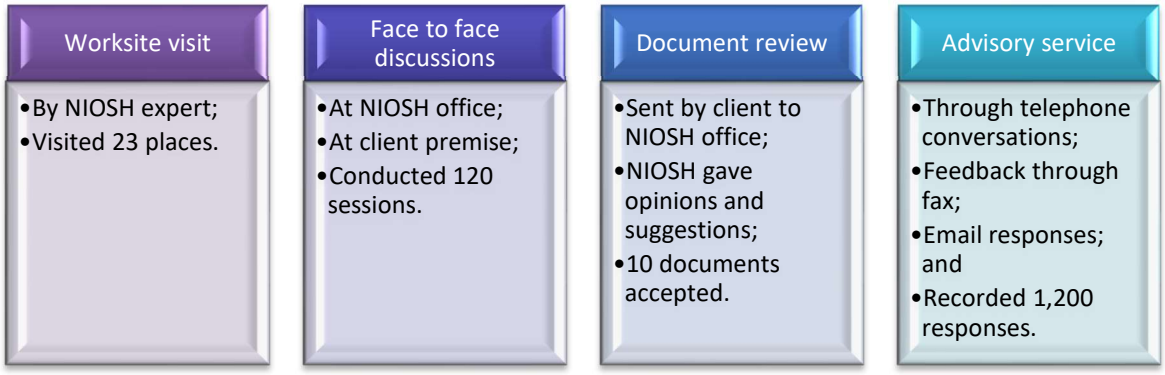


Figure 8.1. **Four Types of NIOSH Consultations Activity (Source: Adapted from NIOSH Annual Report 1999)**

In 2003, as indicated in the NIOSH Annual Report that year, the quantity of occupational safety consultancy has vastly increased. It was categorized into four types of consultation namely:

1) OSH solutions (OS) recorded 15 projects,
2) Legal compliance (LC) recorded 32 projects,
3) Laboratory service (LS) recorded 29 projects, and
4) Customized training (CT) recorded 76 projects.

Customized training was also introduced that year. Other safety consultancy services introduced in the same year included:

1) Gap analysis on OSH implementations;
2) Develop manual and procedure for emergency preparedness and response plan;
3) OSH in school program;
4) Developing trainer's module for NIOSH and SOCSO motorcycle defensive riding program;
5) Developed customized course on defensive car driving;
6) Developed customized training on safe handling of chemicals;
7) Developed customized program on transportation and handling of hazardous chemicals;
8) Developed customized training on effectiveness of Personal Protective Equipment;
9) Developed customized program on forklift driver competency;

10) Conducted OSH management program at the construction site;
11) Conducted OSH awareness program for Universiti Pendidikan Sultan Idris (UPSI);
12) Conducted OSH awareness program for Kolej Universiti Sains dan Teknologi Malaysia (KUSTEM)'s laboratory assistant;
13) Organised OSH exhibition and information dissemination between NIOSH and Island Peninsular Berhad;
14) Organised severe acute respiratory syndrome (SARS) talk;
15) Developed customized training on permit for safe work system; and
16) Developed customized training on industrial accident investigation program.

By 2008, as illustrated in NIOSH Annual Report the OS consultancy services was grouped into three which is Legal Compliance (LC), OSH Solutions (OS) and Advisory Services (AS). The number of OS activities has increased by 400% to 60 projects while AS activities (including CT) showed a decrease of 345% to only 22 projects. The change was impacted by the restructuring of NIOSH in which a new department was established known as Consultation, Research and Development Department (CRDD). Due to this, most of the customized training was conducted by the Education and Training Department (ETD).

However, the trend changed in the next few years as reported in NIOSH Annual Report 2013, a vast increase of OS consultation activities can be observed from the four categories as in Figure 8.2. The overall annual achievement surpassed the target by 129%. NIOSH conducted 95 LS projects, 129 OS projects, 316 LS projects and 59 AS projects. This showed that with the right strategy and approach, the OS consultation services can be expanded through the development of new activities or projects. NIOSH has introduced 3 clusters of consultation namely:

1) OSH Awareness workshop;
2) OSH publication; and
3) OSH technical and innovation.

Figure 8.2. **List of OS Consultancy Service Category by NIOSH (Source: Adapted from NIOSH Annual Report 2013)**

OSH awareness workshop aimed to increase workers' understanding and participation in formulating the best OSH practice in the industry. Three OSH awareness workshops were organised in 2013 namely:

1) OSH awareness workshop in football sector, collaboration with Football Association of Malaysia (FAM);
2) OSH awareness workshop in the fishery sector; and
3) OSH awareness workshop in the financial sector.

In addition, NIOSH has enhanced its publication to ensure that information related to OS can be disseminated to more people and for use as reference for the future. The OS publication in 2013 are:

1) A video entitled 'The Eleven Plus' about OSH in football – a collaboration with SOCSO, NIOSH and FAM;
2) OSH practical guide book for football – a collaboration with SOCSO, NIOSH and FAM;
3) *'Tragedi Kemalangan di Tempat Kerja, Implikasi, Kawalan dan Pampasan'* a book on accident in the workplace and its implications (lesson learned) – a collaboration between SOCSO and NIOSH.

In the same year, NIOSH has ventured into three new area with the aim to enhance the OS knowledge and experiential learning as shown below:

1) Hydrostatic & Corrosion Laboratory (HCL) – to conduct hydrostatic test, corrosion test and compressed air refilling for breathing apparatus cylinder;

2) Concept of factory simulation – to demonstrate machinery safety, noise exposure, vibration and manufacturing procesess;
3) Centralised OSH Management System project management mechanism – to display example of OSH policy, OSH documentation and record.

In 2018 NIOSH in its Annual Report indicated a few new activities to enhance its function to become the centre of excellence. For example, to be recognized as a research institute, NIOSH initiated the contract research (CR) category in which issues in OS are solved through the applied research approach. In the same period, 144 OS projects, 3 LC projects, 90 AS projects, 200 LS 200 projects and 2 CR projects were conducted.

Some of the new OS consultancy activities in 2018 are:

1) Workplace improvement for Small & Medium Enterprises (WISE)/ OSH compliance support for Small & Medium Enterprises (SMEs):
    a. A collaboration between NIOSH, SOCSO and National Council for OSH (NCOSH), Ministry of Human Resources. NIOSH managed to conduct 30 projects for SMEs around the Malaysia;

2) OSH audit at National Service Training Programme (PLKN) Camps, Ministry of Defences:
    a. The audit covered about 80 camps all over Malaysia;
    b. Audit based on OSH regulations and requirements as well as the local guidelines and international standards; and
    c. The audit scope was for OSH Documentation and physical facilities for low and high training elements.

3) Behavior Based Safety (BBS) Program with Construction Industry Development Board (CIDB):
    a. CIDB appointed 4 companies to involve in this pilot project with the recommendation of NIOSH;
    b. The program came out with *Bersama Bina Selamat* (BBS) campaign;
    c. The objectives of this project was to develop and maintain safety practices as well as to create a safe working environment; and

d. The project also includes Safe Operating Procedure (SOP) development, staff motivation and the effectiveness of management strategies.

In summary, since its establishment, NIOSH has already conducted 8 types of OS consultation services for the industry with different approaches based on workplace demand and requirements as shown in Table 8.1.

Table 8.1 Summary of Occupational Safety consultation activity, NIOSH for 1999, 2003, 2008, 2013 and 2018 (Source: Adapted from NIOSH Annual Report)

No	Consultation Category	1999	2003	2008	2013	2018
1	Visit to worksite	23	-	-	-	-
2	Discussion face to face (NIOSH or client premise)	120	-	-	-	-
3	Document review	10	-	-	-	-
4	Advisory service	1200*	-	22	59	144
5	OSH Solution		15	60	129	91
6	Customised training	-	76	-	-	-
7	Laboratory service	-	-	-	-	200**
8	Legal compliance	-	-	-	-	3

Notes:

*Includes telephone, fax and email.

**Includes breathing apparatus cylinder refilling and gas detector calibration.

Occupational Safety In Malaysia

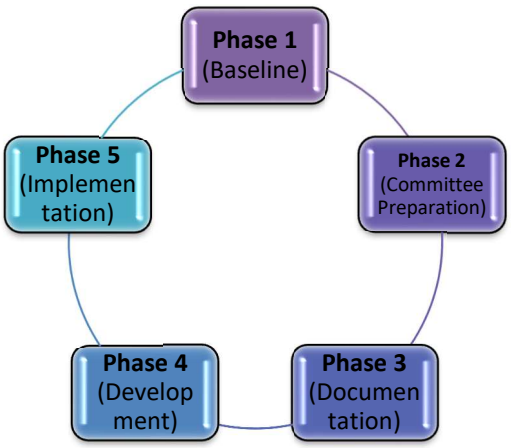
As the leading OSH organization in the country, based on industry's demand and request, NIOSH has come out with a consultancy masterlist, which consist of information related to type of program, price/ unit of services provided. The masterlist is required under the quality management system to ensure the services provided by NIOSH is documented properly with stringent quality control. Main OS consultation service required by industry (based on NIOSH consultancy masterlist program, Consultation, Research and Development Department (CRD), NIOSH 2020) consist of:

1) OSH solution category – 22 products;
2) OSH Advisory service category - 7 products; and
3) Laboratory service category – 19 products.

This chapter will focus on four OS consultancy projects conducted by NIOSH. Normally, the project will be championed by a project leader assist by a group of team members with related academic background (such as engineering and management field), vast OSH working experience and possesess related competency (such as Lead Auditor, Professional Technologist and Authorised Gas Tester for Confined Space).

Overview of OSH Management System related Development

The primary focus of the scope of work is to provide services such as consultancy for establishing OSH management system either based on ISO 45001, MS1722, OHSAS 18001 or any other OSH best management practices. OSH management system project can be categorized under advisory service (AS) consultancy project.



Developing a comprehensive OSH management systems requires a phased approach aimed at bringing about a culture change through commitment from top management, developing a culture for OSH by training and coaching and structured implementation and review of the system. Normally, there are 5 phases involve from the kick-off of the program to the end with certification ready mode.

Each phase has few activity (ies) to be conducted to achieve the objective (s) of the phase and readiness to move to the next level as explained below:

- Phase 1 - Baseline OSH Management System Implementation Assessment:
  - ✓ Initial Review Assessment/ Gap Analysis.
- Phase 2 - Working Committee Preparatory:
  - ✓ Effective Implementation of Safety and Health Committee;
  - ✓ Emergency Response and Preparedness Plan; and
  - ✓ Incident Reporting and Analysis Technique.
- Phase 3 – OSH Documentations:
  - ✓ OSH Policy & Hazard Identification, Risk Assessment and Risk Control/ opportunity;

- ✓ Legal and Other Requirements;
- ✓ OSH Objective Development, External and Internal Issues; and
- ✓ Need And Expectation Of External Interested Parties and Risk Opportunities Assessment.

 Phase 4 – OSH MS Development

- ✓ OSH Management System Documentation Development.

 Phase 5 - OSH MS Implementation

- ✓ OSH MS Internal Auditing; and
- ✓ Management Review.

Confined Space Risk Assessment (CSRA)

What is CSRA? CSRA is a program to evaluate the current OSH legal compliance of the work activities for confined space and to assess the risk of work activities for confined space. This project is categorized as legal compliance consultancy service. Only competent and trained personnel are allowed to conduct and participate in the assessment. The group must consist of Entry Supervisor/ Authorized Gas Tester for Confined Space registered with DOSH and Authorized Entrant / Standby person for confined space as well as fit to work endorsed by an Occupational Health Doctor. However, technical knowledge such as scientific or instrument equipment and working experience is also vital for the success of the project.

The assessment also recommends preventive measure to improve confined space work arrangement according to Authorized Gas Tester duties and responsibilities based on Industry Code of Practice (ICOP CS 2010) for Safe Working in a Confined Space 2010 and other related requirements such as Malaysia Standard (Example: Work in tunnelling - code of practice [MS 2363: 2010]) and international standard (Example: Humidex Comfort Ratings, Canadian Centre of Occupational Health and Safety 2008).

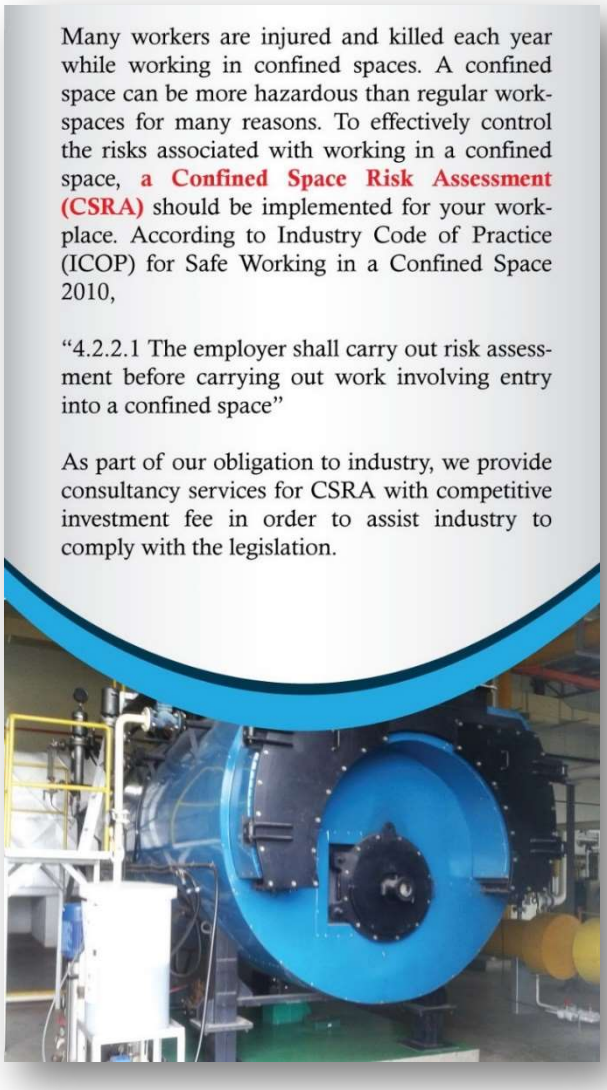
There are three distinct phases for CSRA activity as follows:

1. Document review and Legal Compliance;
2. Site inspection and interview; and
3. Risk assessment adopted from ICOP CS 2010.

The assessment or atmospheric monitoring will apply qualitative and quantitative method to measure air quality (such as total dust), temperature (T), atmospheric pressure (P), humidity (H), air flow (V_{air}) and propose ventilation flow rate for each of the confined space found in the workplace.

What is atmospheric monitoring? The atmospheric monitoring can be defined as activity to measure the atmosphere condition at workplace by competent personal using specific scientific instrument, for particular parameter such as O_2, CO, CO_2, H_2S and CH_4, H, V_{air}, T and P by applying the established monitoring method (Mohd Esa, 2016).

The report also contains the suggestion of flow rate required to be supplied in the confined space for particular duration, evaluate the current OSH legal compliance, standard conformance and best practice, risk rating and preventive measure to improve safety and health at workplace.



Behaviour Based Safety (BBS)

What is BBS? BBS is the application of science of behavior change to real world safety problems or a process that creates a safety partnership between management and employees that continually focuses people's attentions and actions on theirs, and others, daily safety behavior. BBS focuses on what people do, analyzes why they do it, and then applies a research-supported intervention strategy to improve what people do.

This project aims to assist organization in developing and implementing BBS program towards a comprehensive Safety Culture Improvement (SCI) in order to empower OSH aspect. Three main objectives of the project are:

1) To implement and sustain existing BBS practices in OSH management of your organization;
2) To reduce the rate of accidents and industrial diseases caused by the attitude / at risk - behavior of employees; and
3) To provide practical recommendations for your organization on how to maintain a pre-emptive right in the implementation of OSH programs, ultimately leading to the consistency of the OSH management system as well as safe and healthy work culture in the workplace.

The development and implementation of BBS requires five phases as below:

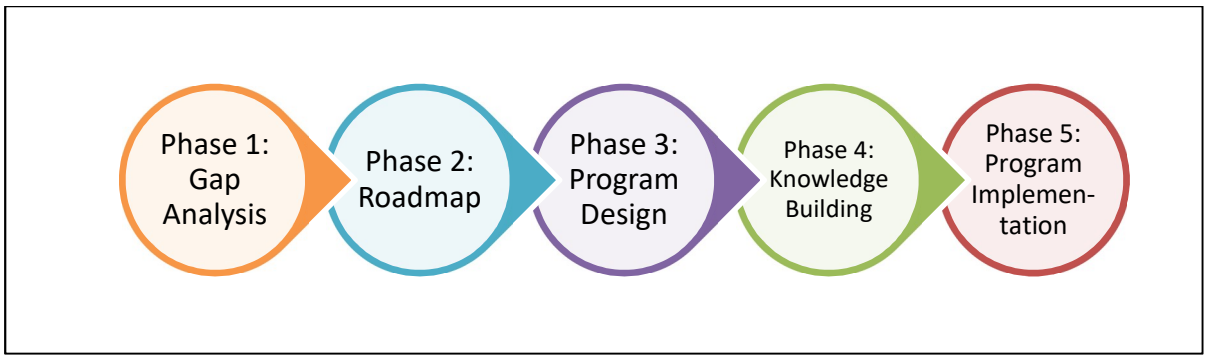


Figure 8.3. **BBS Development and Implementation Process (Source: Adapted from NIOSH module)**

However, the BBS program will undergo 3 stages:

Stage 1: Gap Analysis and Safety Climate Survey

- ✓ Review and understand existing OSH practices, documentation and initiatives; and
- ✓ Conduct safety culture survey to employees.

Stage 2: Presentation and Roadmap

- ✓ Develop an analysis report which comprises of gaps identified and recommendations for improvement; and
- ✓ Develop the Implementation Roadmap.

Stage 3: Program Design

- ✓ Establishing the implementation strategy, targets and objectives;
- ✓ Identify BBS Champions;
- ✓ Identify accountability, roles and responsibilities; and
- ✓ Support Steering committee in developing needed procedures, tools and refine implementation schedule.

Stage 4: Program Implementation

- ✓ System certification
- ✓ Document record
- ✓ Management review
- ✓ Sustainability program
- ✓ Workplace benchmarking

The deliveries of the program include manual, procedure and form or checklist, analysis about safety culture survey, roadmap planning (including barrier removal), hands on training, coaching and workshop discussion/ presentation.

Workplace Assessment / Inspection / Audit/ Baseline Assessment Study/ Initial Review

This activity known as workplace inspection, workplace assessment, audit, baseline assessment study (BAS), initial review or gap analysis. The objectives of this project are to evaluate comprehensively and objectively the company's existing:

1) OSH Management;
2) OSH Management System;
3) OSH Legislations compliance;
4) OSH standard conformance; and
5) Physical arrangement.

Example of workplace inspection conducted at veterinary clinic

Normally a company will invite person or external party who has capability in term of knowledge, experience and skill to conduct the inspection or audit. The result of the program will become basis for organization to make decisions and plan in improving the implementation of OSH at workplace. There are 3 methods employed for the activity such as:

1) Document review (manual, procedure, instruction, report, record, legislation and others);
2) Site physical inspection, walkabout or walk thorough; and
3) Interview and discussion.

The activity will end with the completion of the project report. The organization may choose to have report presentation, discussion or closing meeting. It will be followed with briefing or training to all related parties for better understanding and awareness. The organization is encouraged to discuss the report with management team or safety and health committee members or specific team to carry out the recommended control measures mentioned in the report. The planning must contain list of activities, due date, person in-charge to ensure the implementation and will include the resources in term of financial support, facilities, time and moral support. Then, the employer will organise the follow-up and review session to check for the effectiveness, compliance or conformance of the implementation.

Way Forward of OS

OSH Main Strategic Cluster

As reported in the *Pelan Pelaksanaan Strategik Penjenamaan Semula Penyelidikan & Pembangunan Keselamatan Dan Kesihatan Pekerjaan* 2017 report, there are six OSH main strategic cluster for research and development (R&D) and development of standard identified. However, from those identified, five main strategic cluster were related to OS:

Figure 8.4. OSH main strategic cluster for R&D and standard development

The findings also suggested to embark into OSH innovation through marking certification as indicated below:

1) National recognition and acceptance;
2) Effective OSH certification implementation and monitoring;
3) Empowerment of related resources and agency; and
4) Increment of awareness regarding to importance of OSH certification.

There are three potential PPE to be certified such as safety helmet, safety shoes and gas or dust mask. Whilst, hazardous machinery potentially to be certified are crane, boiler, lift and pressure vessel. In addition, protective device or equipment that has the potential to be certified were electrical insulator, scaffolds and safety parts or instrument. Therefore, there are needs to focus on the huge potential in OS field that must be plan, execute, expand and continue to monitor the progress and development in order to close the gap in the industry. Surely, it will reduce accident and injury at workplace (NIOSH, 2017).

New Technology and Policy

Industry revolution 4.0 (IR 4.0) is focused on transforming all individual processes through intelligent networking of machines and process with the help of ICT. Data digitalization in IR 4.0 allows production to monitor performance, workflow, management of all machines and access company record remotely using diversity of electronic and smart devices like smart phones, tablets, laptops, TVs and smart watches. Preparing for IR 4.0 platform in an industry is very challenging and requires the management to prepare all the nine IR 4.0 components including Big Data. The increased volume of data and tremendous growth of data directed from the increasing number of communication devices every day contributed to Big Data. This data perceives meaningful information that can be utilized by the industry to improve their product quality, sales and services. On the other hand, regulation in the country needs to be a balance between making equipment and citizens safe while ensuring innovation will not stifle. The regulatory part of the country must be at par with the technology such as in Japan. Will the OSHbe affected by the revolution?

During Asia Pacific OSH Practice webinar on August 19, 2020, Director of Wilayah Persekutuan Kuala Lumpur and Putrajaya, Department of Occupational Safety and Health (DOSH) has presented the new normal of OSH enforcement activities in construction sector using new technology and approach such as:

1. Inspection using drone i.emonitoring of tower crane condition;
2. Body camera for part of investigation data gathering;
3. Fixed camera for SPU Approach - Visual scenario for wide view for investigation;
4. Empowerment of self-regulation i.e Safety and Health Committee inspection send by online mode to DOSH every 3 month;
5. Online/ live inspection/ remote inspection; and
6. Dialog/ seminar/ advise through remote mode.

The introduction of IR 4.0 technology can be a game changer to the OS consultancy approach or method. Advisory of OSH can be consulted through online communication, workplace inspection or auditing can be done by remote audit technique, customized workshop or in-house training can be channelled by online platform as well as consultancy report or output deliverable also required changes. More innovative methodology of OS consultancy will be developed or should be developed to fulfil the industry's needs. The organization and consultancy providers have to adapt to a new normal of service. Without effecting the productivity of the organization, employer will choose fast, less cost and convenient approach. However, study need to be done to measure the effectiveness, efficiency and sustainability of the approach compared to the conventional method.

Conclusion

OS consultancy is very much crucial, relevant and needed by the industry to enhance the level of OSH at the workplace. With the introduction of new technology such as IR 4.0, the approach, technique or method will change to accommodate the needs of employer and latest technology. However, the awareness of employer will become one of the biggest factor to ensure the OSH implementation and its sustainability at workplace.

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9

OCCUPATIONAL SAFETY AND HEALTH IN CONSTRUCTION: A MALAYSIAN PERSPECTIVE

Ir. Dr. Mohd Fairuz Ab. Rahman

INTRODUCTION

The Factories and Machinery (Building Operations and Works of Engineering Construction) (Safety) Regulations 1986 (DOSH, 2020) or BOWECS Regulations divided construction work into two main subsectors, namely building operations and works of engineering construction. In terms of the work scale, the construction industry can range from mini projects carried out by Grade (G) 1 contractors to megaprojects managed by G7 contractors. The construction industry offers a great variety of career opportunities and employment to over 1.2 million workers (see Figure 9.1), with a 4-year average of 1,260,475 workers ply their trade in the industry. These include unskilled workers, skilled workers, managers, supervisors, and professionals such as architects, engineers, and quantity surveyors, representing around 9% of the national workforce.

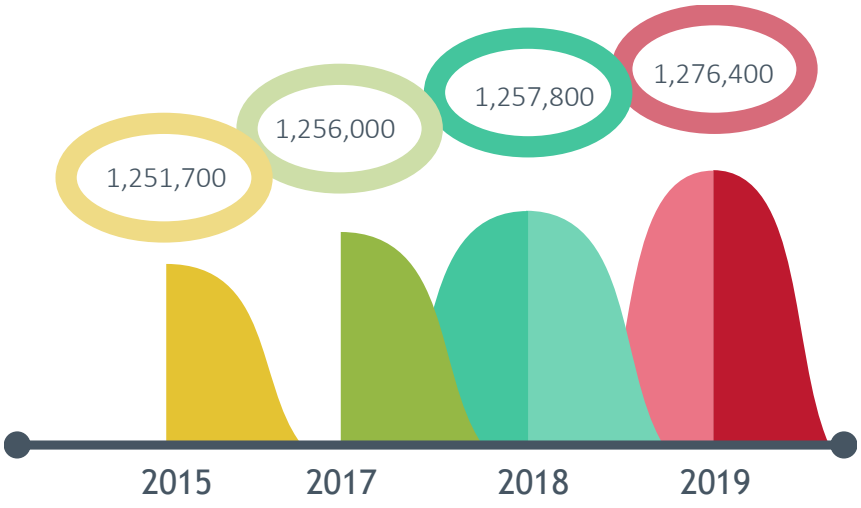

Figure 9.1. **The number of construction workers in Malaysia 2015 to 2019**

The construction industry remains one of the most dangerous workplaces, contributing about just under a quarter of all occupational fatalities. In 2019, out of 578 work-related fatalities recorded, nearly a quarter of occupational fatalities occurred in construction sites. Within the same year, 4,863 workers were involved in accidents in construction sites, which

represented about 11.92% of the total workers involved in occupational accidents in the whole country. The number of fatalities in the construction industry ranging from 1999 to 2019 showed an unconvincing trend compared to a more significant, a downward trend for the number of fatalities in all industries, as shown in Figure 9.2 The industry has an appreciably higher fatality rate, namely 10.94 per 100,000 workers, which is more than double compared to the average fatality rate across all industries, namely 4.84 per 100,000 workers.

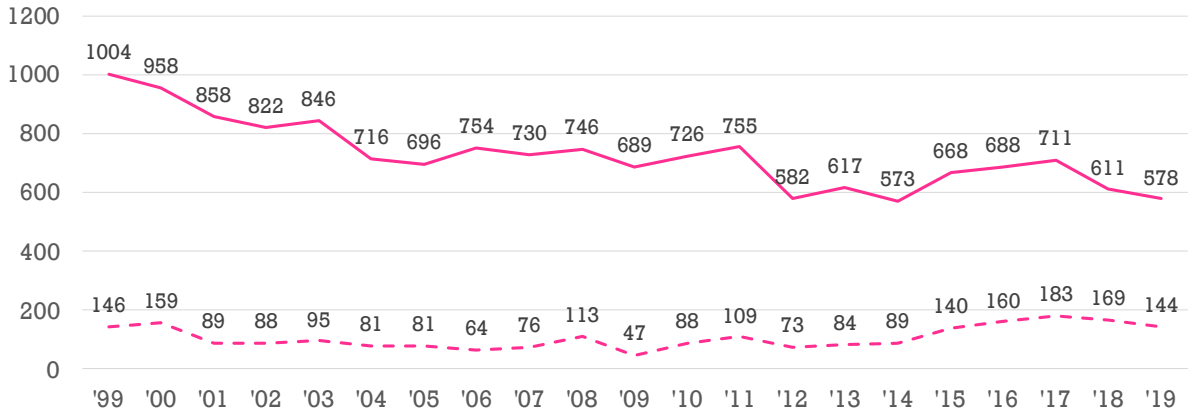

Figure 9.2. The trend over time for the number of occupational-related fatalities from 1999 to 2019

Figure 9.2 shows the trend over time for the number of occupational-related fatalities. The dash line represents the number of construction worker fatalities. The solid line represents the overall number of occupational-related fatalities.

The industry is significant to the country, accounting for about 4% of the nation's Gross Domestic Product (GDP) (MoF, 2020). The industry's economic outlook is expected to be gloomy and subdued, given several government-backed mega infrastructure construction projects were either reviewed or shelved (MBJ, 2019). As the number of projects becomes scarce more developers are taking a cautious approach to future investment, designers and contractors compete for a limited number of projects. Cost-cutting exercise for ongoing projects will also be a norm during this period of many uncertainties. This brings vicious challenges to the management of safety and health as time, money, and other resources are often limited.

Characteristics of the Industry that Contributed to the Poor Safety Performance

Some of the industry characteristics which contributed to the poor performance of safety and health are illustrated in Figure 9.3. The industry is multifaceted and fragmented, whereby many employers are working under different contractual terms and arrangements. Some of the work processes occur in stages, and each process depends on the progress and completion of other processes in a similar path. The transient nature of the worksites means people, materials, and plants are constantly in the move. Moreover, work activities and contractors involved are continually changing as the project progresses, and so are the hazards and risks. The complex and dynamic interactions between work, people, material, and plants resulted in challenging controls implementation of safety and health hazards.

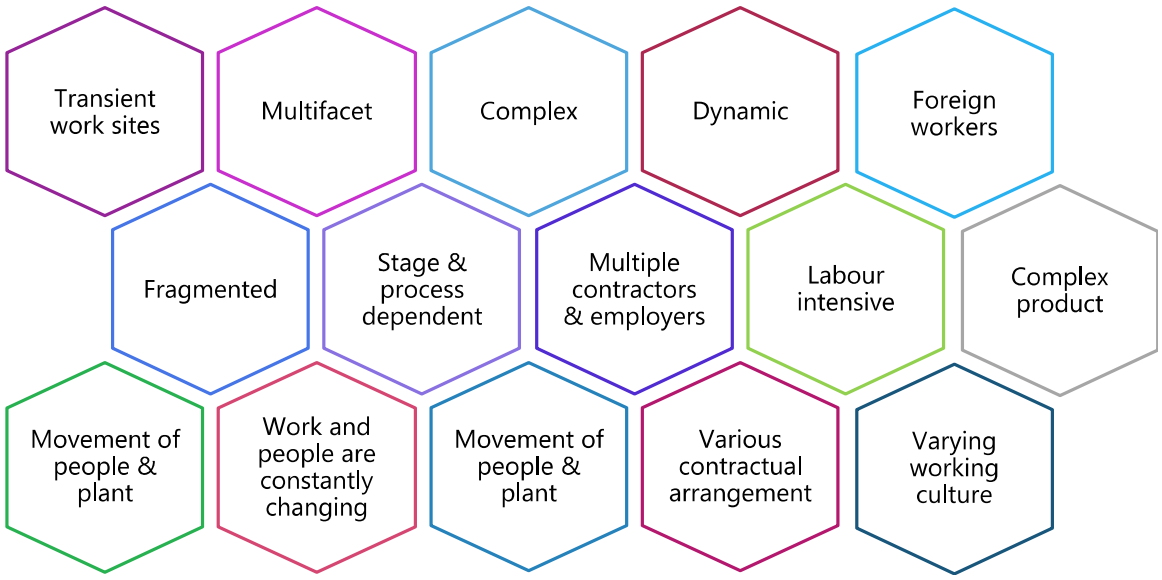

Figure 9.3. **Some oft-quoted characteristics of the construction industry.**

The industry comprises a plethora of small businesses and independent traders, usually working under contract for service. Out of 95,997 registered contractors, 77% are contractors with G1 to G3 grades (CIDB, 2018). Unlike the manufacturing industry, a factory, for example, is usually has a single employer controlling the workplace. Meanwhile, the construction project usually involves multiple employers or self-employed, engaged in complex contractual arrangements, and sharing an indefinable boundary within a construction site. The traditional procurement method, whereby the client appoints the architect to design and oversee the project, is slowly being replaced by more complicated and integrated procurement methods, which is spurred by increased complexity and scale of the project. We

are now being accustomed to the design and build method, project management consultant (PMC), or project delivery partner (PDP). For instance, the PDP method, being employed in many of our rail projects such as Mass Rapid Transit (MRT) Line 1 and 2, Light Rail Transit (LRT) Line 3, and High-Speed Rail (HSR). With these new customs, ensuring safety and health at site will necessitate good planning, managing, monitoring, and coordinating, which, however, often lack or tough to achieve.

The construction industry is also labour-intensive and engages a high number of multinational foreign workers. The industry was said to be too reliant on low-skilled foreign workers. The Bank Negara 2017 Annual Report (BNM, 2017) stated that 75% of job vacancies in 2015 and 2016 were filled up by foreigners, whom about 95% had at most a secondary school education. Economic liberalization also resulted in multinational companies invest and work in local construction projects. For example, the East Coast Rail Link (ECRL) and Forest City Johor projects are two large scale projects that result from economic and trade cooperation between Malaysia and China. Poor safety and health performance is often associated with lack of skills and competence among the low-skilled, migrant workforce, in addition to communication barriers that exist between workers of different nationalities (CIDB, 2018).

Technological and knowledge advancements have resulted in changes in construction products. Nowadays, there are more high-rise buildings with complicated architectural designs and artistic features. Constructing such buildings often require cutting-edge knowledge, technology, expertise, and materials, usually coupled with new and unforeseeable hazards or risks. For example, the Light Rail Transit (LRT) project utilized many modular construction methods (or industrialized building systems), using pre-cast concrete and post-tensioned beams or viaducts, often deploying big movers and heavy lifters. However, on the contrary of large, high-profile projects by major contractors, like Mass Rapid Transit (MRT) and LRT Projects in Klang Valley, RAPID in Pengerang, and Pan Borneo Project in Sabah and Sarawak, the project can be scaled down to a mini project by a single contractor which usually carry out cleaning task of a building and landscaping. This vast range of applied technology and knowledge within the industry reflects the differential gap in managing safety and health hazards.

Perhaps the biggest challenge in enhancing safety and health in the construction industry is transforming the major players' working culture, namely the clients, designers, contractors, and workers. The industry needs to understand that the primary responsibility for managing the safety and health risks in the construction sites lies with the business principal or the person that creates the risk. The government's role should ideally be able to encourage and advise the industry towards good safety and health practices and determine that businesses are effectually managing their safety and health risks to workers and others. As described in the preceding paragraphs, the characteristics of the industry, which lack of homogeneity, signify that there is no clear course of action that will offer solutions to solve all the issues in safety and health performance.

Roles of the Department Of Occupational Safety and Health (DOSH)

The Department of Occupational Safety and Health (DOSH) under the Ministry of Human Resources is tasked with the objective to ensure that workers' safety and health are secured, and the safety and health of members of the public are not affected by work activities. The two main Acts that govern occupational safety and health in the construction industry are the Factories and Machineries Act 1967 (Act 139) (FMA) and the Occupational Safety and Health Act 1994 (Act 514) (OSHA). There are several regulations under both acts that are directly related to the construction, but mainly are:

1. Factories and Machinery (Building Operations and Works of Engineering Construction) (Safety) Regulations 1986;
2. Factories and Machinery (Safety, Health and Welfare) Regulations 1970;
3. Factories and Machinery (Notification, Certificate of Fitness and Inspection) Regulations 1970;
4. Occupational Safety and Health (Safety and Health Committee) Regulations 1996;
5. Occupational Safety and Health (Safety and Health Officer) Regulations 1996; and
6. Occupational Safety and Health (Noise Exposure) Regulations 2019.

Besides these legal documents, there are three Chief Inspector Special Orders that compel project managers to ensure the safe use of tower crane, mobile crane, and falsework. DOSH also publishes the industry code of practice and guidelines to aid law enforcement and provide guidance to the industry on how to comply with the law. The Construction Industry

Development Board (CIDB) also enforces the CIDB Act (Act 520) and publishes guidance on quality, safety and many aspects of the construction industry.

It is noteworthy if DOSH's role should ideally be able to assess that employers are making suitable arrangements to effectively and proportionately manage their occupational safety and health risks to workers and public members. The employer is also required to ensure that these arrangements always in place and effective, namely regular review of the arrangements is inevitable. It implies that the enforcement by DOSH (such as inspection, notice issuance, or prosecution) should be focusing on influencing or triggering cultural change but then reliant on the employers' actions to make those changes themselves.

Some of the DOSH's enforcement initiatives are by establishing the Construction Safety Division in 2014, brigading a range of inspection and punitive actions, as well as developing and publishing more regulatory guidance. The most notable guidance is the Guidelines on Occupational Safety and Health in Construction Industry (Management) 2017. These initiatives are necessary to ensure the deployment of the most effective and appropriate skills and knowledge to assist or compel the industry to comply with their legal duties and influence change. DOSH remains steadfast to hold to account employers who put others at risk. Figure 9.4 shows the amount of Notice Of Improvement (NOI) and Notice Of Prohibition (NOP) issued by DOSH from 2017 to 2019. The average over three years were 3,822 for NOI and 4,534 for NOP. The notices are usually issued for a serious breach of the law, whereby the employers do not proportionately control hazards or risks.

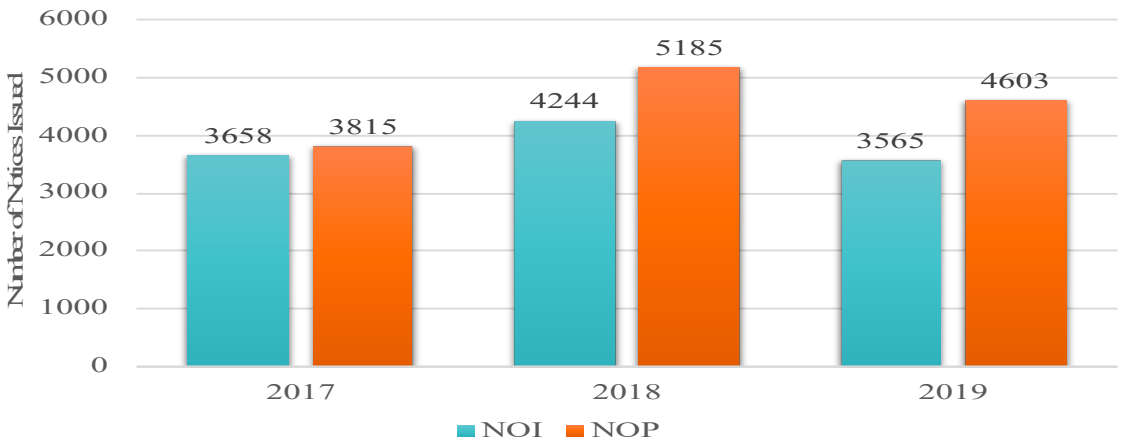

Figure 9.4. **A comparison of the number of Notice of Improvement (NOI) and Notice of Prohibition (NOP) issued to the contractors from 2017 to 2019**

Previous experience shows that traditional site-based inspections alone would never be enough to improve the construction industry's scale of poor safety and health standards. Enforcement initiatives have been expanded further, beyond the construction gate (BCG) to encourage change, for example, by leveraging influence within the industry supply chain in high risk areas, engaging with associations capable of giving widespread change, and working together with other construction authorities. Other enforcement authorities are deployed in the joint forces to conduct integrated inspection where wrongdoings by the contractors are notified to the project's client and consultant. Moreover, the development of a revised OSHA is at its final process for tabling in the Parliament. DOSH is also working closely with industry partners, such as Master Builders Association Malaysia (MBAM), to develop more guidance intended to support the existing regulatory instruments.

Roles Of the Industry

Enforcements by DOSH alone will not secure safer conditions or less harmful to health in construction environments. As advocated by OSHA, the onus to ensure workers and public members' safety and health belongs to all employers in the industry, including client, designer, and contractor. It also depends on the client, designer, contractor, and all parties through the supply chain to transform into how the construction process is planned, managed and executed. Everyone in the industry has a role to play in being part of the current dismal safety performance. Much work is already ongoing to spur change and better safety performance is recorded by the industry since 2017, as shown in Figure 9.4.

While the duties of contractors are clearly established in FMA and OSHA, the duties of clients and designers regarding safety and health under the two main legislations remain contentious and subject to many discussions. There are two main approaches usually taken by the OSH regulators worldwide to get the clients (or developers) and designers involvement.

Mandatory Approach

The most straightforward approach is to make it mandatory for the clients and designers to ensure their workers' safety and health and other people who may be affected by their business (projects). This is achieved by specifying occupational safety and health duties to the client and designer in the legislation. By implementing this, they are forced to comply

with the requirements (forced compliance). This approach has been made in many countries in Europe and Asia Pacific, as shown in Figure 9.5. For example, in the United Kingdom, duties of clients, designers, and contractors are specified in the Construction (Design and Management) Regulations, making it mandatory for duty holders to consider safety and health in managing their construction project. The Work Safe in Australia and Workplace Safety and Health Council in Singapore, however, take a quite similar approach.

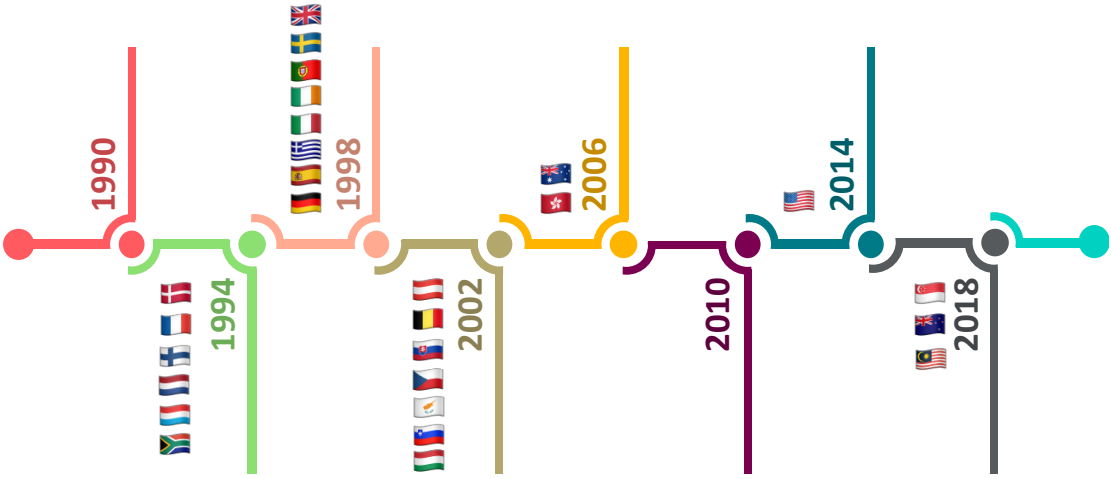

Figure 9.5. The implementation of OSH Legislation or guidance for clients and designers in construction projects

Based on Figure 9.5, some of the countries and the year of introduction, which have implemented mandatory and voluntary OSH legislation or guidance for clients and designers in construction projects (Martinez Aires et al., 2010).

Voluntary approach

The other approach is to set a voluntary standard for the client, designer, and contractor to integrate safety and health into their business activities. The normative compliance depends on the level of awareness, motivation, and knowledge of the target person. An example of the country that has taken this approach is the United States of America. The US National Institute for Occupational Safety and Health (NIOSH) has led the initiative to develop the ANSI/ASSE Z590.3. Prevention through Design to provide guidelines for addressing occupational hazards and risks in the design and redesign processes. Compliance to this standard is voluntary, and hence extensive effort has been put up by the US OSH regulator, called Occupational Safety and Health Administration (OSHA) to influence and encourage

the client, designer, and contractor to take safety and health seriously in managing their projects.

In Malaysia, a similar effort is currently taken by DOSH to educate clients, designers, and contractors on the importance of managing safety and health, especially at the early stages of the construction project. This is done partly by the publication of the Guidelines of Occupational Safety and Health in Construction Industry (Management) in 2017. The guidelines, popularly known as OSHCIM Guidelines, are developed based on the guidelines and code of practice from the United Kingdom, Singapore and Australia. It is a prelude to the new construction work regulations, which will eventually prescribe mandatory requirements to the clients, designers, and contractors.

Details of roles for each duty holders as recommended by the OSHCIM Guidelines are shown in Figure 9.6. The guidelines provide practical guidance to the management of safety and health risks of construction projects. In essence, the guidelines consist of five key elements, namely:

(a) managing the risks by applying the principles of risk management and prevention;
(b) appointing the right people and organizations at the right time;
(c) making sure everyone has the information, instruction, training and supervision they need to carry out their jobs safely;
(d) all employers in a project cooperating and communicating with each other and coordinating their work; and
(e) consulting workers and engaging with them to promote and develop effective measures to secure health, safety and welfare.

After two years of its introduction, there is marked improvement to the safety performance of the construction industry, as shown in Figure 9.7. Although it is too early to celebrate, there are positive vibe and increased awareness among the clients and designers of the construction industry on the importance of occupational safety and health of the project.

Clients
- Making suitable arrangements for managing a project
- Assembling the project team
- Appointing principal designers and principal contractors
- Maintaining and reviewing the management arrangements
- Providing pre-construction information
- Ensuring preparation of the construction phase plan
- Ensuring preparation of the safety and health file

Principal Designers
- Planning, managing, monitoring and coordinating the pre-construction phase plan
- Identifying, eliminating or controlling foreseeable risks
- Ensuring coordination and cooperation
- Providing pre-construction information
- Liaising with the principal contractor

Designers
- Making clients aware of their duties
- Preparing or modifying designs
- Providing design information
- Cooperating with other duty holders

Principal Contractors
- Planning, managing, monitoring and coordinating the construction phase plan
- Providing suitable site inductions
- Preventing unauthorised access to the site
- Providing welfare facilities
- Liaising with the principal designer
- Consult and engage with workers

Contractors
- Making clients aware of their duties
- Planning, managing and monitoring construction work
- Appointing and employing workers
- Providing supervision
- Providing information and instructions
- Preventing unauthorised access to the site
- Providing welfare facilities

Figure 9.6. **Duties of clients, designers (including principal designers) and contractors (including principal contractors) in the Guidelines of Occupational Safety and Health in Construction Industry (Management).**

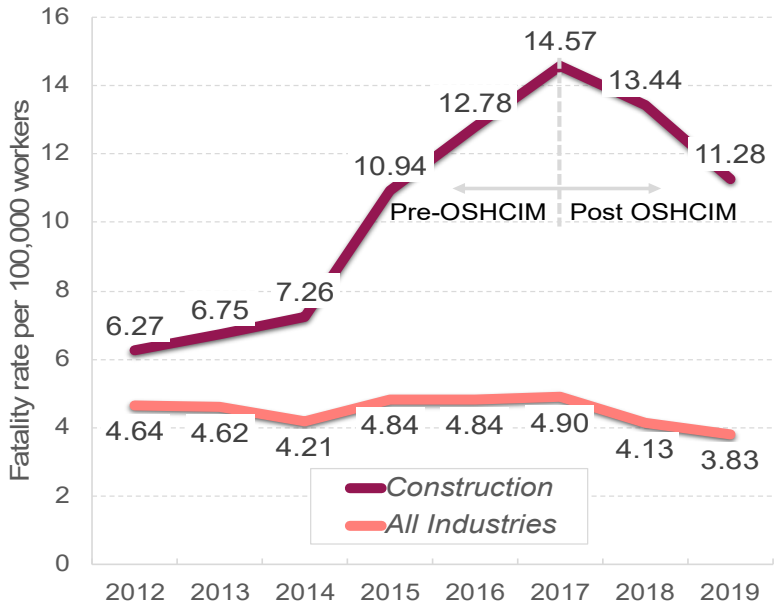

Figure 9.7. **Fatality rates of the construction industry, pre and post OSHCIM Guidelines.** ***Source: DOSH 2019***

The clients and the designers should recognize that the hazards and risks of the construction site may arise as by-products of their decision or action. More often than not, the contractors often have limited options to control these hazards from occurring in their work sites. The construction hazards can be more sustainably avoided, eliminated, or controlled in the pre-construction phase of the project, and hence the roles of clients and designers in managing these hazards cannot be understated. The industry collectively should also realize that making changes, and playing a more prominent role in improving safety and health levels can also increase profitability, increase productivity, improve worker's satisfaction and improve quality.

Conclusion

Over many years, various efforts have been carried out by DOSH to reduce the number of people who are killed as a result of construction work. Despite various safety and health initiatives by DOSH, other authorities, and the industry, the construction site remains a dangerous place to work in. What is more worrying is that almost all these deaths and injuries that occured are foreseeable and preventable.

Currently, DOSH is committed to improving safety and health in the construction industry by focusing on high risk activities. Securing safety and health in the construction industry is a huge task. Thus, all stakeholders (clients, designers, and contractors) in the industry must work hand in hand and shoulder responsibilities to bring about change and improvements in safety and health performance. The proposed guidelines are the essential driving improvement to the safety and health performance in the construction industry.

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10

EXPLOSION AND FIRE OF RECONSTITUTED FUEL OIL (RFO) STORAGE TANK

Ts. Dr. Mohd Shamsuri Khalid, DOSH.

INTRODUCTION

An accident involving an explosion and fire occurred in a storage tank of reconstituted fuel oil (RFO) on November 3, 2017. The accident killed three workers. The structure of the RFO storage tank was badly damaged on the top and side of the tank (Figure 10.1). Before the accident, three workers (one supervisor, two technicians) were doing maintenance work to install a manhole cover using a cover box and repairing and repainting the handrail at the top of the storage tank. Approximately, 617.4 m^3 of RFO was in the tank, and the tank was not emptied during the maintenance.

No documents related to work procedures and work permit were found after the accident because they were destroyed in the fire. The factory management also did not have copies of the related documents even though they have ISO 9001 and OHSAS 18001 system certification.

The current practice at the factory is that they bring the original work permit and related document to the site where the work is carried out. It was informed that there were no duplicates. Meanwhile, the Safety and Health Officer (SHO) explained that the work carried out on the day of the accident was not a routine; therefore, no work procedure was available.

Figure 10.1. **Severe damages on the top and sides of the tank**

Methodology

An approach of forensic investigation through out the accident's which involved in the fire and explosion accident:

i. **On Site investigation** – forensic investigation on the site to record the actual scene of the accident, collected data, recorded of scene of workplace and seek the mode failure of the accident, especially on the storage tank od RFO.
ii. **Document reviewing** – all documents such as Safe Operating Procedure (SOP), Safety Data Sheet (SDS), technical design of the storage tank, training record, workers data and so on.
iii. **Recorded Statements** – Statements of the witnesses will be recorded that involved directly or indirectly of the accident. The witnesses are crucial in the process of finding the root cause of the accident.
iv. **Sample RFO** –collected for further inspection and testing by the Chemical Lab.

About The Machinery

The machinery involved was an RFO storage tank (Table 10.1).

Table 10.1 Machinery Details

Item	Description
1. Owner of storage tank	Lafarge Associated Pan Malaysia Cement Sdn Bhd
2. Capacity	1000 m^3
3. Dimensions of Storage Tank	15.2 m (D) × 5.5 m (H)
4. Operating Pressure	1 atm
5. Tank Type	Closed
6. Year of Manufactured	1997

However, no technical drawings of the storage tank was provided to the investigating officer. The dimension of the storage tank was determined during the investigation.

Description of RFO

RFO was the substance involved in the explosion and fire. Based on the safety data sheet obtained from the company, the RFO is a mixture of used lubricating oil and known as light fuel oil. The RFO is used as the secondary fuel, along with the main fuel, which was coal, to initiate combustion. The resulting heat is used in the production of cement. Table 10.2 shows the chemical and physical characteristics of RFO.

Table 10.2 Chemical and physical properties of RFO

Item	Description
Form	Brown coloured liquid
Odour property	0.90 @ 150 °C
Viscosity, Cst	80 @ 500 °C
Vapour pressure, kPa @ 200 °C	Very low
Vapour density at 1 bar (water = 1)	Heavier than air
Evaporation Rate (n-butyl acetate = 1)	Very low
Flammable Limit	LEL: 0.9, UEL: 7.0 (approximate)

Observations and Findings

Observations At The Scene

The forensic engineering investigation team found the following:

i. No blast wave on the adjacent building structure was observed.
ii. The structure around the tank was not adversely affected by the explosion.
iii. No bubble or burst on the side of the tank (wall).
iv. No trace of damage at the connection between the top and wall of the tank (around the tank).
v. The top (roof) of the tank was completely detached and fell on the right side of the tank due to the explosion of the tank.
vi. The temporary platform that was installed for the rescue of the victims fell into the storage tank (Figure 10.2).
vii. The wall structure of the storage tank bent inward as a result of the fire extinguishing done (Figure 10.3).
viii. The tank had a heating coil to heat the RFO before transferred to KLIN (Figure 10.3).
ix. Personal protective equipment (PPE) such as welding shield helmet, safety helmet and shoes were scattered around the scene (Figure 10.4).
x. A photo that shows the top of the RFO storage tank and the location of the maintenance work carried out before the accident (Figure 10.5).
xi. The condition of the manhole (Point A) and the remaining RFO (Figure 10.6) in the storage tank.
xii. The top part of the storage tank suffered from fire, revealing that fire occurred inside the storage tank (Figure 10.6).

A few points on the top of the RFO storage tank were determined, and thickness measurements were made. The thickness measurements are listed in Table 10.3.

Table 10.3 Roof thickness measurements of RFO storage tank

Point	1	2	3	4	5	6
Measurement (mm)	5.61	5.59	5.70	6.30	5.63	5.90

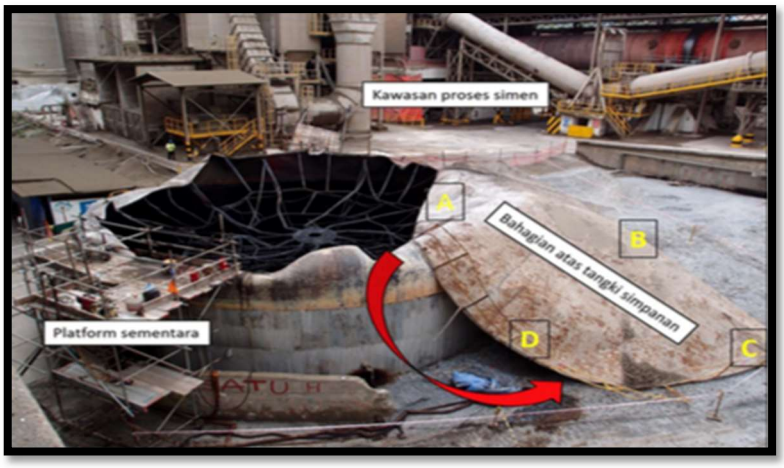

Figure 10.2. **The condition of the oil storage tank after the accident**

Figure 10.3. **The wall structure of the storage tank bent inward and the heating coil inside the tank**

Figure 10.4. **Some of the personal protective equipment found in the tank**

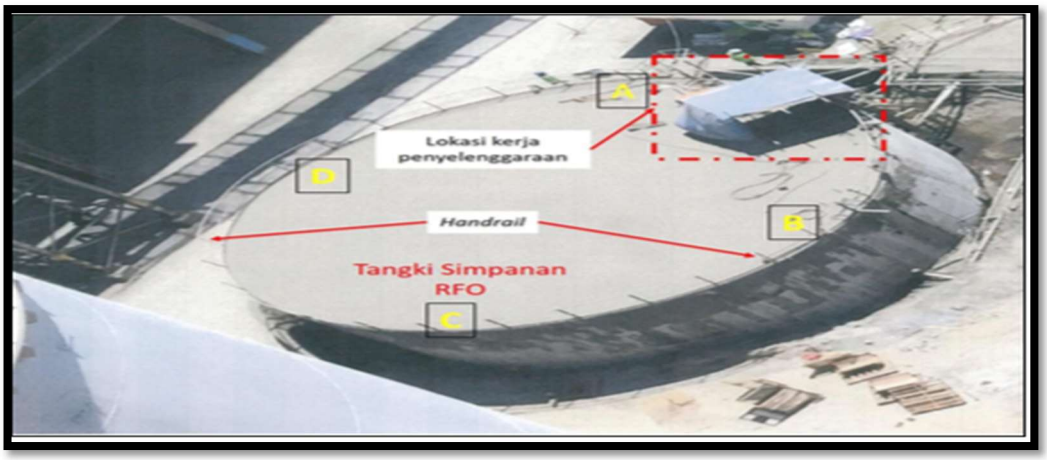

Figure 10.5. **Location of maintenance work RFO storage tank (Source: The company)**

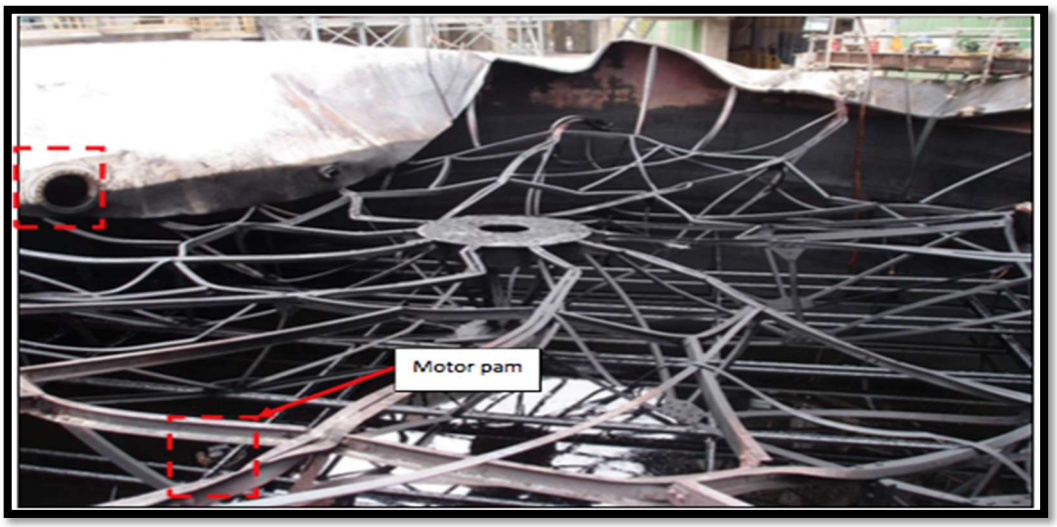

Figure 10.6. **Condition of the manhole (maintenance location) and pump motor the remaining RFO**

Figure 10.7. **Condition of the inside of the roof with the evidence of burn**

Documents Inspection

An inspection was done on the technical documents related to the RFO, especially those concerned with the storage tank. These documents relate specifically to the oil.

i. Safety Data Sheet

The document issued by the technical document specified the hydrocarbon product as flammable material. This oil will be more flammable if there is some mixture of highly volatile hydrocarbons. If this oil is heated, it will produce hydrogen sulphide, and its incomplete combustion will produce hydrogen sulphide, sulphur oxides, aldehydes and carbon monoxide. This document also specified that this product should be kept at 10 to 60 °C. The vapour pressure of RFO is heavier than air.

ii. Certificate of Analysis (COA)

Two COA were obtained, and 2 Laboratories issued them, and they were the suppliers to other 2 companies, respectively. Table 10.4shows the results of the analysis.

Table 10.4 Certificates of Analysis (COA) from two different companies

Test Parameters	Method	Company (A) Sdn Bhd.	Company (B) Sdn. Bhd.
Kinematic Viscosity@50°C	ASTM D445	59.74 cSt	49.1 cSt
Density@15°C	ASTM1298	0.8844	0.8820
Total Sulphur (%)	ASTM D294	0.412	0.24
Flash Point °C	ASTM D93	>100	194
Water by Distillation (%vol)	ASTM D95	2.9	0.04
Calorific Value (MJ/kg)	ASTM D240	43.640	10.527

iii. Records for Receipt and Use of RFO

The obtained records were for a period of one month, i.e., October 1-4, 2017. The records showed that the RFO was used almost every day during the operation with a daily average of approximately 12 metric tonnes. The highest use recorded was 60 metric tonnes per day, and the lowest was 3 metric tonnes per day. Meanwhile, the technical document related to the storage tank, namely Technical Drawing for Oil Storage Tank, showed the actual location of the manhole on the tank. However, no

other information was available to help locate the actual position of the manhole because there was no duplicate of the technical document, as the tank was over 30 years old.

Findings of Witnesses' Interview

The interviews with some witnesses were aimed to get the real insight into the use of RFO in the production of cement as well as the maintenance work carried out on the day. The witnesses interviewed are:

i. First witness - Safety and Health Officer (SHO)
ii. Second witness - Process Engineer
iii. Third witness - Mechanical Engineer

The interviews established that the RFO was used as the supporting fuel in these situations:

a. When starting the process of making cement, and
b. When there was a change in the method of RFO supplied to the cement production process.

The change in the method of RFO supplied to the cement production process:

a. Old method - the RFO flowed from the storage tank to KLIN through the outlet pipe at the lower edge of the tank. The initial flow was by gravity and subsequently pumped into KLIN.
b. The pumped RFO contained a lot of sediment, and the management changed to a new method.
c. New method - the RFO was pumped out using a submersible pump connected through the manhole at the top of the tank.

There was oxygen in the tank during the process of pumping out the RFO because the manhole was left open. The level of oxygen increased because the manhole was left open 24 hours a day, 7 days a week during the processing of cement. The maintenance work carried out on that day was to place a box cover to cover the manhole from rain. Figure 10.8 shows the box cover to be installed. Welding work was also carried out on the handrail at the top of the tank. However, there was no working document related to the activity because it was burned. Careful observation conducted on the surface of the box cover revealed no welding

mark because the box cover was only placed to cover the manhole as an additional tool rather than a permanent installation.

Figure 10.8. **Box cover to be installed on the manhole**

Forensic Engineering Investigation Results

Forensic Analysis

Analysis of exhibits was performed on the RFO samples to determine its chemical compositions.

Analysis of Exhibits

The fuel was identified as the RFO. Three samples of RFO were taken from the scene to identify its chemical compositions. Two oil samples were taken from Skid Tank (top and bottom of the tank), denoted as ST-T and ST-B, and another sample was taken from the IBC tank. According to the plant manager, the oil in the Skid Tank was the RFO obtained from the supplier before being moved in the main storage tank that was exploded and burned. Meanwhile, the oil in the IBC tank was the remaining RFO from the main storage tank that was burned on that day. The oil was removed during the rescue. The oil samples contained some water and mixed with fire extinguisher materials during the process of extinguishing

the fire and rescuing victims. All three samples were sent to the Department of Chemistry for analysis. Table 10.5 shows the results of the analysis.

Table 10.5 Results of RFO analysis

No.	Tagging	Colour	Analysis Results		
			Density @ 150 °C (g/cm^3)	Total Sulphur	Chemical Composition
1.	ST-T	Black liquid	0.8931	0.786%	Methylene chloride, 3-methyl pentane, *n*-hexane, ethyl acetate, benzene, heptane, trichloroethylene, methylcyclohexane, 3-heptane, cyclopentanone, tetrachloroethylene, ethylbenzene, *p*-xylene, styrene, *o*-xylene, nonane, 2-butoxyethanol, 2-ethyl hexanal, decane, naphthalene, undecane, dodecane, tridecane.
2.	ST-B	Black liquid	0.9854	0.09%	Methylene chloride, 3-methylpentane, benzene, heptane, cyclohexane, toluene, cyclopentanone, tetrachloroethylene, ethylbenzene, *p*-xylene, styrene, *o*-xylene, nonane, decane, napthalene, undecane, dodecane, tridecane.
3.	IBCT	Black liquid	1.0067	0.232%	Pentane, ethyl acetate, toluene, cyclopentanone, benzene, styrene, *p*-xylene, undecane, naphthalene.

Based on the analysis of exhibits from the Department of Chemistry Malaysia, there are differences in densities for the samples ST-T, ST-B and IBCT, with IBCT has a density almost the same as the density of air (1.0 g/cm^3). This is because the IBCT sample contained water during the rescue and process of extinguishing the fire. The chemical composition analysis shows that the RFO consists of approximately 26 chemicals. Almost all the components are flammable liquids with the lowest flash point of −49 °C (pentane) and the highest flash point of 88 °C (naphthalene). The flash point is the lowest temperature at which the flammable liquid will produce enough vapor to make a vapor–air mixture that will ignite

in the presence of an ignition source. Meanwhile, the lowest flammability limit of a mixture is 0.6% (dodecane). Table 10.6 lists the chemical compositions and their chemical and physical properties.

Table 10.6 Chemical components in the RFO

No.	Component	Flash Point (°C)	LEL	UEL	Boiling Point (°C)	Vapour Density m^3	Auto Ignition Temperature (°C)
1.	Pentane	−49	1.5	7.8	36.1	2.49	260
2.	3-Methyl pentane	−32	1.2	7.7	64	2.97	264
3.	*n*-Hexane	−22	1.15	7.5	69	2.97	225
4.	Cyclohexane	−18	1.3	8.4	80.7	2.98	245
5.	Ethyl acetate	−4.4	2.2	9	77	3.04	410
6.	3-Heptane	−4	1.05	6.7	98.4	3.5	223
7.	Heptane	−4	1.05	6.7	98.4	3.5	223
8.	Methyl cyclohexane	0.38	1.2	6.7	100.9	3.39	245
9.	Toluene	4.4	1.1	7.1	110.6	3.1	535
10.	Benzene	11.1	1.2	7.8	80.1	2.8	560
11.	Ethylbenzene	15	0.8	6.7	136	3.66	432
12.	Oxylene	17	0.9	6.7	144.4	3.7	463
13.	*p*-Xylene	25	1.1	7	138	3.7	463
14.	Cyclopentanone	26	1.6	10.8	130.5	2.3	445
15.	Nonane	31	0.7	5.6	151	4.41	205
16.	Styrene	31.1	1.1	6.1	145.2	3.59	490
17.	2-Ethyl hexanal	44	0.9	7.2	160	4.4	190
18.	Decane	46	0.8	5.4	174.1	4.9	210
19.	2-Butoxyethanol	61	1.1	12.7	171.5	4.07	224
20.	Undecane	65	N/A	N/A	196	5.4	204
21.	Dodecane	74	0.6	-	216.3	5.9	205
22.	Tridecane	79.4	N/A	N/A	235.4	6.35	N/A
23.	Naphthalene	88	0.9	5.9	218	4.4	525
24.	Methylene chloride	-	12	19	39.75	2.93	556
25.	Trichloroethylene	-	8	10	86.7	4.53	410
26.	Tetrachloroethylene	-	-	-	-	5.7	-

Results and Discussion

This accident involved a fire in a tank that caused the tank to explode, and the remaining oil in the tank continued to burn until it was extinguished by BOMBA. The explosion caused blast wave resulting from the rapid energy release due to the sudden change of temperature of pressure. The investigation revealed that the cause of the fire was the RFO. Based on the investigation and analysis, the blast occurred due to the combination of five sources, namely ignition source, fuel, air, confinement and dispersion. The explosion of the RFO storage tank is summarized in Table 10.7

Table 10.7 Explosion Process

ITEM	FACT/FINDING
Spark	Hot work for pipe installation carried out near the tank.
Air	The presence of air inside the tank through the open manhole to place the pipe and submersible pump in the tank to pump out the RFO into KLIN.
Fuel (Flammable gas)	1. The results of tests and analysis show that the RFO in the tank consisted of flammable liquids. 2. About 16 of the 26 flammable liquids can create a fuel–air mixture that can ignite under the ambient temperature of below 40 °C
Confinement	Closed RFO storage tank design

Based on the analysis of the Department of Chemistry Malaysia and the flash points of the chemicals in the RFO, about 16 chemicals are likely to generate flammable vapour–air mixture under the ambient temperature of 40°C. All these vapors have the density of more than the density of air that made them to build up in the tank instead of releasing to the external environment. Meanwhile, the ignition source that caused the explosion came from the hot work (welding) to repair the handrail at the top of the tank. The change in the method left the manhole open during the transfer of RFO to KLIN using a submersible pump. The old method was a closed process where the RFO was transferred via a pipeline and pumped into KLIN. The tank was previously kept at a limited oxygen level, and it changed to be a tank rich with oxygen. Based on Table 10.5, dodecane only needs 0.6% vapor–air mixture (extremely low amount) to ignite with the presence of an ignition source. However, the flash point of dodecane is quite high at 74°C, but the temperature of spark or the flamed welding rod is more than that.

Calculation Scenario

The calculation made was intended to:

a. Determine the ability of the ignited vapor to explode and cause damage to the top of the tank, and
b. Approximate the vapour volume required for the damage.

There was no suitable vapor explosion model to predict the combustion of all the flammable vapors. Therefore, the calculation was made by considering only one of the 16 flammable liquids at any given time. The selected flammable vapors were:

i. Ethyl acetate - the lowest combustion energy,
ii. *n*-Hexane - intermediate combustion energy, and
iii. Heptane - the highest combustion energy.

These three components have the flash points of lower than 40°C, and they tend to create flammable vapor–air mixture at temperatures below 40°C. The distribution of the flammable vapors is expected to be dispersed and does not take the total space. The condition of the RFO storage tank is summarized in Figure 10.9. It had only one manhole that was always open after the transfer of RFO for the production of cement was changed using a submersible pump placed through the manhole to pump out the RFO into KLIN via a pipeline.

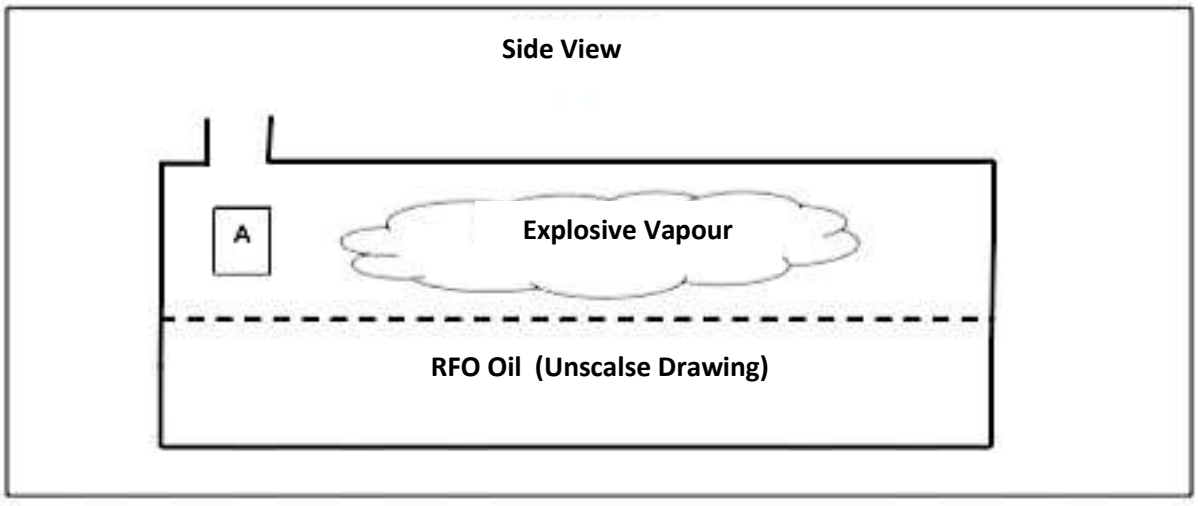

Figure 10.9. **Side elevation of the RFO storage tank (unscale measurement)**

The vapor content was uneven, most likely because of the vapor accumulated more at the vicinity of the manhole as the exit route. Therefore, it was assumed that there was an accumulation of vapor at the point. The calculation of the explosion was made based on several assumptions:

a. The volume of the top of the tank (roof) is

$$\mathbf{V = \pi r^2 h}$$
$$\mathbf{= 3.142\ x(\ 7.6x7.60x0.006)}$$
$$\mathbf{= \underline{1.089 m^3}}$$

The tank was made of mild steel with the density of 7850 kg/m^3, therefore the weight of the top of the tank (roof) is

$$\mathbf{M = 78kg/m^3\ x\ 1.089\ m^3}$$
$$\mathbf{= \underline{8547.8\ kg}}$$

b. Volume estimation of Point A

Tank volume	= 1000.6 m^3
RFO volume during incident	= 617.4 m^3
Volume of Point A	= 1000.6 − 617.4 = 383.2 m^3

c. Approximation of the amount of energy required to lift the top (roof). Assuming that h = 5 m.

$$\mathbf{PE = mgh}$$
$$\mathbf{= 8547.8x9.81x5}$$
$$\mathbf{= \underline{419.3\ J}}$$

d. The calculation of the amount of vapour required to lift the top (roof) using the heat of combustion as listed in Table 10.8.

Table 10.8 Heat of Combustion

FLAMMABLE VAPOUR	Q (kJ/kg)
Ethyl acetate	25.371
n-Hexane	48.445
Heptane	48.199

The amounts of weight and volume were obtained using the following formula:

$$M\ (kg) = PE/Q$$

Table 10.9 lists the weight and volume of the materials with the assumption of complete combustion.

Table 10.9 Weight and volume of materials

Material	Weight (kg)	Volume (m^3)
Ethyl acetate	16.53	5.44
n-Hexane	8.66	2.92
Heptane	8.70	2.49

Table 10.10 lists the percentage of flammability limits, taking into account the density of each vapor and the vapor was estimated to be at the height of 1/3 of the oil level (Point A).

Table 10.10 Percentage of flammability limit

Material	Weight (kg)	Volume (m^3)	LEL/UEL Range (%)	Flammability limit (%)
Ethyl acetate	16.53	5.44	2.2–9	4.26
n-Hexane	8.66	2.92	1.15–7.5	2.28
Heptane	8.70	2.49	1.05–6.7	1.95

The calculation and the effect of the explosion (based on the observation at the scene) demonstrate that the flammable vapors were explosive. It roughly indicated the required volume of flammable vapours to result in such damage. The total weight and volume showed that each vapour was in the range of flammability limit.

Conclusion

The findings from the engineering forensic investigation concluded that the immediate cause for the explosion was the welding works carried out in a dangerous environment (a cloud of flammable vapours). The flammable vapors exploded in the storage tank and killed three workers who were carrying out the repair work atop of the storage tank. The top management of the company shall review on the human resources in term of OSH knowledge and competency related to this high risk job. Only the competent, skilled and trained may allow to carry out the high risk job.The company also shall look into the adequacy of safe operating procedure, equipment and personal protective equipment related to the present activity to ensure the job can be done in safe an healthy manner.

The authority shall enhance the current OSH legislation and competency of the investigator to fine and find the root cause of the accident. The lesson learnt shall be communicated in a proper and simple information to the industry for future learning and way forward.

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11

OCCUPATIONAL SAFETY AND HEALTH IN THE OIL AND GAS INDUSTRY.

Ts. Mohammad Hezrie Zainol

INTRODUCTION

The discovery of oil in Sarawak in 1910 provided the basis for the development of Malaysia's oil and gas industry today and it has created opportunities for many oil majors companies to invest in thes industry and ultimately provides ample employment opportunities and skills transfer to thousands of Malaysians which in return has changed the economic landscape of the country (Noorul Haq, 2020). Ensuring the health and safety of people working in oil and gas industry is a major concern for employers, regulators, trade associations, industry groups, and local communities. The industry involves physical labour, 24 hours and 7 days operations, using heavy machinery, expose to hazardous chemicals, often-remote locations, and all weather conditions, resulting in an elevated risk of physical harm and the need for special protections to reduce the risk (Bob Palmer, 2016).

Oil & Gas Activities

Oil & Gas activities in Malaysia can be classified under three (3) main categories, namely upstream, midstream and downstream. Below are some examples of what are the scope of activities involved under each of the foregoing categories.

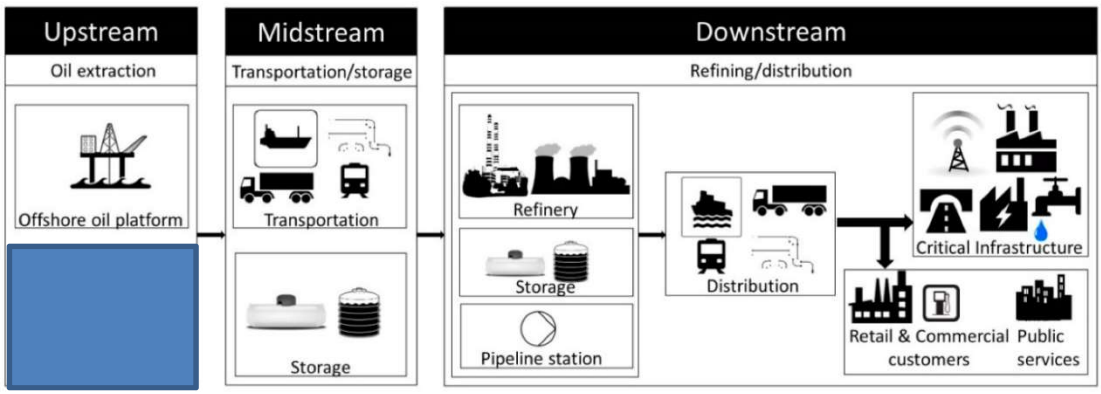

Figure 11.1. **The main categories on oil and gas activities**

I. Upstream

Exploration and Production:

- Study and explore composition, structure and other physical aspects of rock formations associated with oil or natural gas deposits through geophysical prospecting and exploratory drilling. Construct wells if an economically feasible field is located,
- Offshore and onshore activities like wellhead automation, fractionation, completion and separation to recover and prepare underground or underwater crude oil and natural gas,
- Execute drilling and servicing of oil and gas well. Activities include managing manpower, rigs, material supply and stocks to ensure difficulties onsite are resolved to avoid delay in drilling process, and
- Involves the operation of control system and equipment related to plant and facilities. This includes setting up, taking down, servicing the equipment and general clean-up of both onshore and offshore oil rig areas.

II. Midstream

Transportation and Storage:

- Activities to manage the movement of crude oil and natural gas after production from oil fields to refineries or to storage areas, where the products are stored for distribution, emergency reserves and store before the downstream process, and
- Crude oil and natural gas are transported by two primary modes; tanker and pipelines.

III. Downstream

Refining, Distribution Trading & Marketing:

- Activities to turn crude oil and natural gas into various useful final products such as gasoline, LPG, Avgas, kerosene, diesel and asphalt,
- Involves refining of petroleum crude oil and the processing and purifying of raw natural gas, as well as the marketing and distribution of products derived from crude oil and natural gas,

- Distribution of utilities, oil products wholesalers, petrol service stations and petrochemical companies. This sector of the industry is responsible to deliver oil product and ensure product quality meets stringent specifications, and
- Track industry market movements through monitoring and collecting data of oil asset in the world markets. Coordinate buyers and conduct trade with relevant parties agreeing to the product price.

Hazards in the Oil and Gas Industry

Workers in the oil and gas industry face the risk of fire and explosion due to ignition of flammable vapors and gases. Flammable gases such as well gases, vapors and hydrogen sulfide can be released from wells, trucks, production equipment or surface equipment such as tanks and shale shakers that can cause many health risks. Ignition of these items doesn't require an open flame, either frictional heat, welding tools or even just hot surfaces can create a risk of fire in any environment. The equipment used in the oil and gas industry is often very large or elevated high above the ground.

Occasionally, employees must access these platforms in order to maintain the equipment and sometimes for the use of equipment. Fall and slip protection is required at all times, and employees should always be trained on the proper use of safety measures and protective equipment before attempting use. Storage tanks and reserve pits are just a few of the constricting areas people who work in the oil and gas industry are sometimes required to enter. These spaces are often associated with many safety hazards such as asphyxiation, hazardous chemical exposure and flammable vapours and gases that can cause many health risks [4]. Before entering, workers should ensure that they are taking the appropriate procedures and assess the work environment properly before entering. This may include obtaining a permit if required and getting written consent (DOSH, 2010).

Tanks holding crude oil and clean petroleum products are common in the oilfield. Chemical exposure hazards like exposure to hydrocarbon gases and vapors happen during manual sampling. These tanks may be manually measured and sampled, which may expose workers to dangerous levels of hydrocarbon gases and vapors stemmed from these liquids. Other hazards include hydrogen sulfide gas (which occurs naturally in oil and natural gas

and is extremely hazardous when inhaled); noise (from heavy machinery); and diesel exhaust (from drilling rigs and other equipment).

The Occupational Safety and Health Act 1994

The Occupational Safety and Health Act (OSHA) 1994 is an act to make further provisions for securing safety, health and welfare of persons at work, for protecting others against risks to safety or health in connection with the activities of persons at work, to establish the National Council for Occupational Safety and Health (NCOSH), and for matters connected therewith. The Act is enforced by the Department of Occupational Safety and Health (DOSH). The Act is applicable throughout Malaysia to the industries specified in the first schedule. The oil and gas industry which includes the petrochemical manufacturing falls under the category.

The oil and gas industry must abide by the Factories and Machinery Act (FMA) 1967, which provides for the control of factories with respect to matters relating to the safety, health and welfare of person therein, the registration and inspection of machinery and for matters connected therewith. Refineries, gas processing plants and petrochemical manufacturing factories must be registered with DOSH. DOSH carries out inspection, certification and registration of all machinery prior to their installation (MPC, 2016).

Roles of Department of Occupational Safety And Health (DOSH)

DOSH is a department under the Ministry of Human Resources. The department is responsible for ensuring the safety, health and welfare of people at work as well as protecting other people from the safety and health hazards arising from the work activities. As a government agency, DOSH is responsible for the administration and enforcement of legislations related to occupational safety and health in the country, to ensure all work activities comply with all requirement of legislation related to safety and health as stated in the OSHA 1994 as well as regulation and codes of practice which have been approved.

Their other responsibilities also include preparing and preserving a workplace with a safe and health working system, to ensure all worker are provided with the necessary and relevant information, training and supervision regarding methods to carry out their duties in a

safe manner and without causing any risk to health, to conduct research and technical analysis on issues related to occupational safety and health at the workplace, to study and review the policies and legislations of occupational safety and health, to carry out promotional and publicity programs to employers, workers and the general public to foster and increase the awareness of occupational safety and health. Apart from being a secretariat for the National Council regarding occupational safety and health, DOSH also investigate all accidents, diseases, poisonous and dangerous occurrences and take any prosecution action to ensure that these occurrences will not be repeated. In fact, DOSH enforce the following legislations:

a) Occupational Safety and Health Act (OSHA) 1994 and its regulations,
b) Factories and Machinery Act (FMA) 1967 and its regulations, and
c) Part of Petroleum Act 1984 (Safety Measures) (PSMA) and its regulations.

The main Acts govern occupational safety and health in oil & gas activities are the OSHA 1994 (Act 514), the FMA 1967 (Act 139) and PSMA 1984 (Act 302). There are several regulations under this act that are directly related to the occupational safety and health (OSH) in oil & gas industry, but mainly are:

1) Occupational Safety and Health (Safety and Health Officer) Regulations 1997;
2) Occupational Safety and Health (Safety and Health Committee) Regulations 1996;
3) Occupational Safety and Health (Noise Exposure) Regulations 2019;
4) Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazardous to Health) Regulations 2000;
5) Occupational Safety and Health (Notification of Accident, Dangerous Occurrence, Occupational Poisoning and Occupational Disease) Regulation 2004;
6) Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulation 1996;
7) Occupational Safety and Health (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013;
8) Factories and Machinery (Person-In-Charge) (Amendment) Regulation 2014;
9) Factories and Machinery (Special Scheme of Inspection) (Risk-Based Inspection) Regulations 2014;
10) Factories and Machinery (Safety, Health and Welfare) Regulations 1970;

11) Factories and Machinery (Notification, Certificate of Fitness and Inspection) Regulations 1970;
12) Petroleum (Safety Measure)(Transportation of Petroleum by Pipelines) Regulations 1985; and
13) Factories and Machinery (Exemption To Petroliam Nasional Berhad) Order 2013.

Regulations from the Federal and State/ Local Goverment

Oil and gas exploration and production are governed by regulations from the federal and state governments. The regulations depend on whether the surface location of the oil and gas is owned by the federal government, state government, local government levels or by private individuals, and whether the location is onshore or offshore. Permissions and licences must be obtained from relevant regulators for businesses related to the industry.

There are a number of other statutes, ordinances and regulations applicable to the industry including but not limited to the shown in table 11.1, 11.2, 11.3, 11.4, 11.5, 11.6 and 11.8 respectively.

Table 11.1 Regulations for upstream activities in oil and gas industry [7]

ACTIVITIES	**EXPLORATION** Survey and data collection exploratory drilling
FEDERAL REGULATION	1) Occupational Safety and Health Act 1994 (Act 514) 2) Factories and Machinery Act 1967 (Act 139) 3) 3)Petroleum Development Act 1974 (Act 144) 4) Petroleum Regulations 1974 5) Petroleum Mining Act 1966 (Act 95) 6) Continental Shelf Act 1966 (Act 83) 7) Environmental Quality (Amendment) Act 2012 (Act A1441) 8) Customs Act 1967 (Act 235) 9) Immigration Act 1959/63 (Act 155) 10) Employment Act 1955 (Act 265) 11) Minimum Retirement Age Act 2012 (Act 753) 12) Workmen's Compensation Act 1952 (Act 273) 13) Exclusive Economic Zone Act 1984 (Act 311) 14) Factories and Machinery (Exemption To Petroliam Nasional Berhad) Order 2013 15) Minimum Wages Order 2012

Table 11.2 Regulations for upstream activities in oil and gas industry [7]

ACTIVITIES	**DEVELOPMENT** Drilling of well, construction of offshore infrastructure (platform), construction of onshore infrastructure/ facility/ storage, construction of offshore to onshore pipelines.

FEDERAL REGULATION	1) Occupational Safety and Health Act 1994 (Act 514) 2) Factories and Machinery Act 1967 (Act 139) 3) Petroleum (Safety Measures) Act 1984 (Act 302) 4) Petroleum (Safety Measures) (Transportation of Petroleum by 5) Pipelines) Regulations 1985 6) Petroleum Regulations 1974 7) Petroleum Development Act 1974 (Act 144) 8) Petroleum Mining Act 1966 (Act 95) 9) Continental Shelf Act 1966 (Act 83) 10) Environmental Quality (Amendment) Act 2012 (Act A1441) 11) Customs Act 1967 (Act 235) 12) Fire Services Act 1988 (Act 341) 13) Immigration Act 1959/63 (Act 155) 14) Employment Act 1955 (Act 265) 15) Minimum Retirement Age Act 2012 (Act 753) 16) Workmen's Compensation Act 1952 (Act 273) 17) Factories and Machinery (Exemption To Petroliam Nasional Berhad) Order 2013 18) Minimum Wages Order 2012
STATE	1) National Land Code (Amendment) Act 2016 (Act A1516)
LOCAL GOVERNMENT	1) Local Government Act 1976 (Act 171) 2) Town and Country Planning Act 1976 (Act 172) 3) The Street, Drainage and Building Act 1974 (Act 133)

Table 11.3 Regulations for upstream activities in oil and gas industry [7]

ACTIVITIES	**PRODUCTION** Production activity, utilization of equipment/appliances in connection with transportation, storage and handling of petroleum, transportation of petroleum by water, transportation of petroleum by pipelines, storage and handling of petroleum and wastes management.
FEDERAL REGULATION	1) Occupational Safety and Health Act 1994 (Act 514) 2) Factories and Machinery Act 1967 (Act 139) 3) Petroleum (Safety Measures) Act 1984 (Act 302) 4) Petroleum (Safety Measures) (Transportation of Petroleum by Pipelines) Regulations 1985 5) Petroleum (Safety Measures) (Transportation of Petroleum by Water) Regulations 1985 6) Petroleum Regulations 1974 7) Petroleum Development Act 1974 (Act 144) 8) Petroleum Mining Act 1966 (Act 95) 9) Continental Shelf Act 1966 (Act 83) 10) Environmental Quality (Amendment) Act 2012 (Act A1441) 11) Environmental Quality Act (Scheduled Wastes) Regulations 2005 12) Customs Act 1967 (Act 235) 13) Fire Services Act 1988 (Act 341) 14) Immigration Act 1959/63 (Act 155) 15) Employment Act 1955 (Act 265) 16) Minimum Retirement Age Act 2012 (Act 753) 17) Workmen's Compensation Act 1952 (Act 273) 18) Petroleum (Income Tax) Act 1967 (Act 543) 19) Excise Act 1967 (Act 176) 20) Merchant Shipping Ordinance 1952 21) Factories and Machinery (Exemption To Petroliam Nasional Berhad) Order 2013 22) Minimum Wages Order 2012

Table 11.4 Regulations for downstream activities in oil industry [7]

ACTIVITIES	**TRANSPORTATION** Utilization of equipment/appliances in connection with transportation of petroleum & gas, transportation of petroleum & gas by water, transportation of Petroleum & gas by pipelines, transportation of petroleum & gas by road, transportation of petroleum by railway, wastes management, oil spillage &gas leakage management.
FEDERAL REGULATION	1) Occupational Safety and Health Act 1994 (Act 514) 2) Petroleum (Safety Measures) Act 1984 (Act 302) 3) Petroleum (Safety Measures) (Transportation of Petroleum by Pipelines) Regulations 1985 4) Petroleum (Safety Measures) (Transportation of Petroleum by Water) Regulations 1985 5) Land Public Transport Act 2010 (Act 715) 6) Road Transport Act 1987 (Act 333) 7) Environmental Quality (Amendment) Act 2012 (Act A1441) 8) Environmental Quality Act (Scheduled Wastes) Regulations 2005 9) Employment Act 1955 (Act 265) 10) Minimum Retirement Age Act 2012 (Act 753) 11) Workmen's Compensation Act 1952 (Act 273) 12) Merchant Shipping Ordinance 1952 13) Minimum Wages Order 2012
STATE	1) National Land Code (Amendment) Act 2016 (Act A1516)
LOCAL GOVERNMENT	1) Local Government Act 1976 (Act 171) 2) Town and Country Planning Act 1976 (Act 172) 3) The Street, Drainage and Building Act 1974 (Act 133) 4) Building Act 1974 (Act 133)

Table 11.5 Regulations for downstream activities in oil industry [7]

ACTIVITIES	**REFINEMENT** Construction of refinery, refining activity **LIQUEFACTION** Construction of liquefaction plant, liquefaction activity **REGASIFICATION** Construction of regasification plant, regasification activity **PROCESSING** Construction of, processing plant, processing activity **STORAGE** Construction of storage facility, utilization of equipment/appliances in connection with storage of petroleum, storage and handling of refined petroleum products, storage and handling of gas, wastes management.
FEDERAL REGULATION	1) Occupational Safety and Health Act 1994 (Act 514) 2) Factories and Machinery Act 1967 (Act 139) 3) Petroleum Regulations 1974 4) Petroleum Development Act 1974 (Act 144) 5) Petroleum (Income Tax) Act 1967 (Act 543) 6) Environmental Quality (Amendment) Act 2012 (Act A1441) 7) Environmental Quality Act (Scheduled Wastes) Regulations 2005 8) Industrial Co-ordination Act 1975 Act 156) 9) Employment Act 1955 (Act 265) 10) Fire Services Act 1988 11) Immigration Act 1959 12) Customs Act 1967 (Act 235) 13) Excise Act 1967 (Act 176) 14) Minimum Retirement Age Act 2012 (Act 753)

	15) Workmen's Compensation Act 1952 (Act 273) 16) Minimum Wages Order 2012 (Activities involve Storage) 17) Petroleum (Safety Measures) Act 1984
STATE	1) National Land Code (Amendment) Act 2016 (Act A1516)
LOCAL GOVERNMENT	1) Local Government Act 1976 (Act 171) 2) Town and Country Planning Act 1976 (Act 172) 3) The Street, Drainage and Building Act 1974 (Act 133)

Table 11.6 Regulations for downstream activities in oil industry [7]

ACTIVITIES	**TRADING & DISTRIBUTION** Trading of petroleum products, retail sale of refined petroleum products and petrol station.
FEDERAL REGULATION	1) Occupational Safety and Health Act 1994 (Act 514) 2) Factories and Machinery Act 1967 (Act 139) 3) Petroleum (Safety Measures) Act 1984 4) Petroleum Development Act 1974 (Act 144) 5) Petroleum Regulations 1974 6) Petroleum and Electricity (Control of Supplies) Act 1974 (Act 128) 7) Environmental Quality (Amendment) Act 2012 (Act A1441) 8) Employment Act 1955 (Act 265) 9) Fire Services Act 1988 10) Immigration Act 1959 11) Customs Act 1967 (Act 235) 12) Minimum Retirement Age Act 2012 13) Workmen's Compensation Act 1952 14) Minimum Wages Order 2012
STATE	1) National Land Code (Amendment) Act 2016 (Act A1516)
LOCAL GOVERNMENT	1) Local Government Act 1976 (Act 171) 2) Town and Country Planning Act 1976 (Act 172) 3) The Street, Drainage and Building Act 1974 (Act 133)

Table 11.7 Regulations for downstream activities in oil industry [7]

ACTIVITIES	**GAS SUPPLY THROUGH PIPELINES** Pipeline works, installation/utilization of equipment/appliances, delivery, transportation, distribution of gas by pipelines.
FEDERAL REGULATION	1) Occupational Safety and Health Act 1994 (Act 514) 2) Gas Supply Act 1993 (Act 501) 3) Gas Supply Regulations 1997 4) Environmental Quality (Amendment) Act 2012 (Act A1441) 5) Employment Act 1955 (Act 265) 6) Immigration Act 1959 7) Minimum Retirement Age Act 2012 8) Workmen's Compensation Act 1952 9) Minimum Wages Order 2012

STATE	1) National Land Code (Amendment) Act 2016 (Act A1516)
LOCAL GOVERNMENT	1) Local Government Act 1976 (Act 171) 2) Town and Country Planning Act 1976 (Act 172) 3) The Street, Drainage and Building Act 1974 (Act 133)

Conclusion

All workers in the oil and gas industry must be committed in ensuring OSH are maintained and improved. Safety at the workplace was a never-ending task and complacency should be avoided. High safety standards can only be achieved with strong strategies, well-defined processes and clear goals to ensure work gets carried out properly and safely. Oil and gas industry have been the major contributors to Malaysia's development and continue to serve as one of the Government's main source of income. In an industry where innovation and technology development is moving rapidly, the legal fraternity should also be ready to contribute towards providing up to date legal services to support the objective of positioning Malaysia as the number one oil and gas hub in the Asian region.

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12

OCCUPATIONAL SAFETY MANAGEMENT IN THE RAIL CONSTRUCTION INDUSTRY IN MALAYSIA. ISSUES AND CHALLENGES.

Associate Professor Dr. Kadir Arifin & Mohammad Lui Juhari

INTRODUCTION

Nowadays, traffic congestion is one of the problems faced by many urban areas in Klang Valley, especially in the Kuala Lumpur area due to significant population growth. There have been many efforts to improve the public transport system especially rail-based ones such as the Mass Rapid Transit (MRT) and Light Rail Transit (LRT) in order to meet the daily needs of the urban population. Currently, Malaysia is thriving on railway construction projects such as the MRT and LRT. The MRT construction project around Klang Valley is one of the major projects under the Economic Transformation Program (ETP). This project involves the construction of rail-based public transport networks, which will integrate with the LRT, Monorail, KTM Komuter, KLIA Express and KLIA Transit system. On the other hand, the Light Rail Transit Line 3 (LRT3) project is developed in line with the Greater Kuala Lumpur/ Klang Valley (GKL/ KV) Land Public Transport Masterplan and it will be a key feature in extending rail connectivity to the Western Corridor of GKL/ KV. Moreover, Malaysia is expecting a lot of rail-based construction industry in near future, for instance the MRT Circle Line, East Coast Rail Link (ECRL) Project and Kuala Lumpur–Singapore High Speed Rail (HSR). An appropriate occupational accident management in the rail construction industry is very important because a good occupational safety management will ensure the safety of workers at the workplace.

Issues Related to Occupational Safety

The construction industry is an industry that has a high risk of occupational accidents and also labelled as the industry with the highest case of occupational accidents and fatalities. In Malaysia, the occupational accident rate in the construction industry is among the highest compared to other industrial sectors. In 2015, the occupational accident rate in the construction industry recorded a value of 2.98 accidents per 1,000 employees. The occupational accident rate continued to increase tremendously in 2017 with a value of 3.40 per 1,000 employees (DOSH, 2019). With respect to occupational fatalities, the construction industry has recorded the highest rate in Malaysia compared to other industrial sectors for the years from 2015 to 2017 (DOSH, 2019). More worrying is that the occupational fatality rate in the construction industry shows an increasing trend each year where it records a value of 10.69 per 100,000 employees in 2015; 12.78 per 100,000 employees in 2016 and 14.57 per 100,000 employees in 2017 (DOSH, 2019).

Specifically for the rail construction industry in Malaysia, a total of 57 occupational accidents consisting of 12 cases of fatal accidents, 16 permanent disabilities, and 29 temporary disabilities have been reported to the Department of Occupational Safety and Health (DOSH) Malaysia from 2012 to 2015 (DOSH, 2017). Based on the previous studies, the most common accident occurs in rail construction around the world are related to construction of elevated viaduct; shaft and tunnel excavation activities; and preparation of construction site. Therefore, efforts from all stakeholders to prevent occupational accidents should be enhanced.

Factors Affecting Occupational Accident

Factors affecting occupational accidents need to be understood clearly because it is an important step in the occupational accident prevention process. Filho et al. (2002) stated that occupational accidents are predictable phenomena, where the factors capable of triggering them are present in a workplace. Factors affecting occupational accident can be identified and can be managed accordingly to prevent accidents from happening. Khanzode et al. (2012) also has the same view and stated that the factors affecting occupational accident in the work system can be identified based on causal accident theories or models. Factors affecting occupational accident in the rail construction industry should be identified and understood in

order to manage all the associated hazards and risks in the industry effectively. As a result, a safe and healthy working environment can be created and occupational accidents can be avoided.

Previous studies on occupational accidents in the construction industry has shown that factors affecting occupational accidents are generally similar regardless of country (Aksorn & Hadikusumo, 2008). Based on earlier studies, it can be concluded that the factors affecting occupational accidents can be divided into five factors namely human (worker); workplace; materials and equipment; management; and environmental influences (Haslam et al., 2005; Stępień, 2014).

Workers Factor

According to research conducted in the United Kingdom, worker factors particularly includes attitudes, behaviors and competencies have contributed to 70% of accidents on construction sites compared to other factors. In Malaysia, human behavior is a major contributor of construction accidents. Based on previous studies, worker factors can be divided into four main aspects namely attitude; dangerous behavior; human physical and physiology; and competency.

There are some important items under the attitude aspects identified as contributing to the high rate of accidents. Among them are the issue of motivation and morale/ spirit; bad or irresponsible attitude; overconfidence; becoming idle; lack of worker's vigilance; awareness and assessment of situation; perceptions of risk; and sense of responsibility for safety issues. The dangerous behavior aspects can be categorized as errors and intentional actions. Examples of errors in this context of dangerous behavior in the construction industry are disuse or improper use of protective equipment and protection facilities; improper, chaotic or hurried execution of works; and the use of improper technologies. The intentional action in the context of dangerous behavior in the construction industry are non-adherence to rules; not noticing or lack of warnings or information about hazard; ignoring hazards; and deliberate undertaking of risk or dangerous work methods.

Physical aspects related to human physical factors are body size; height; physical strength and flexibility; and stamina. Human physiological factors associated with occupational accidents are fatigue and reduced capability of senses; poisoning and influence of medicines; health problem; and stress. Furthermore, competency aspects focused on knowledge and skills; work experience; and talents. While training; language and communication barrier; and literacy and calculation skills are among the things that contribute to occupational accidents in the construction industry.

Workplace Factor

Workplace factors or also known as construction sites are one of the factors that contribute to accidents in the construction industry. Based on previous studies, workplace factors can be divided into four main aspects namely working conditions, site housekeeping, layout / site space and working environment. Workplace conditions aspects that need to be emphasized include the uncontrolled/ unguarded/ hidden hazards, hazardous surface of construction site, improper traffic control in the workplace, open edge and warning signage. The proper welfare facility is also one of the factors to be considered at the construction site. Poor housekeeping creates workplace hazards that can lead to various accidents in the construction site such as protruding objects (nails and scaffolding components) and messy site surfaces (dirty surfaces, muddy, spilled substance or oily, wired or wired wires).

In terms of layout/ worksite space, items that need to be emphasized are limited/inadequate work space; limited space/ inadequate space for equipment, building materials and construction waste; incorrect/ inappropriate construction layout of the site; incorrect /inappropriate equipment arrangement; and equipment arrangements interfere with the pathway. The working environment aspects that need to be addressed are improper lighting; exposure to high levels of noise, excessive heat exposure, exposure to cold temperature, working in wet and humid environments; improper ventilation. Weather is one of the aspects that need to be taken into consideration in regards to working environmental risk factor.

Materials and Equipment Factor

The third factor affecting occupational accidents in the construction industry is materials and equipment. A lot of sophisticated machines and equipment was created for the use of construction work and all of this has the potential to cause occupational accidents if they're improperly handled. Engineering materials and equipment for the construction industry include raw materials, facilities, installations and semi-products used for the purpose of construction activities. Construction machinery and equipment are basic needs during construction projects. Based on previous studies, material and equipment factors can be divided into four main aspects namely the suitability of the materials/ equipment; conditions of the material/ equipment; safety protection design and knowledge of the materials/ equipment used.

Haslam et al.(2005) stated that the suitability of material and equipment has contributed to more than a quarter (27%) accident cases at construction sites. The availability of materials and equipment at a construction site may vary and require replacement with other materials and equipment where workers may not be familiar. The aspect of suitability of materials and equipment that can lead to occupational accidents in the construction industry include availability of equipment, machines or tools; the usability of construction materials; suitability of physical construction materials such as large size and too heavy; improper design and installation of equipment such as scaffolding. It was also identified that the condition of the material and equipment is also one of the important contributors to more than a quarter of the accidents cases in the construction industry. Among the aspects of materials and equipment condition that often noted by previous researchers are functionality of equipment and machines; lack of repairs of equipment, machinery and equipment; lack of maintenance of equipment, machinery and equipment; and poor condition of the construction material.

Another factor affecting occupational accidents in construction industry is the aspect of safety protection design such as equipment without safety devices; suitability of safety devices; dysfunction of safety devices; incompatible personal protective equipment design; inappropriate facilities and safety precautions for emergency response. The fourth aspect in materials and equipment factors is the knowledge of materials and equipment used by workers at construction sites. For examples improper use of materials and equipment; lack of

instructions and improper storage of materials and equipment; improper implementation and maintenance of materials; improper and insufficient of risk assessment regarding to materials and equipment; and the lack of manual on how to use the equipment correctly.

Organizational Factor

Organizational factor is also known as a management factor. This is because majority of occupational accidents can be avoided from the beginning through proactive measures that can be taken by the management. Management team of an organization have a great influence in OSH performance. This is because they have a legal obligation to plan suitable arrangements for managing safety and health. Based on previous studies, organization factors can be divided into four main aspects that cover the OSH policy; resources management; organizational safety culture; and OSH management.

OSH policy reflects the employers' commitment to provide a safe and healthy working environment. Developing safety policy guidelines is important in order to improve the safety climate of the organization. The establishments of the OSH policy is the first step in creating an OSH management system in the construction sector and assisting in formulating series of measures to improve safety performance. Some of the issues that contribute to accidents with regards to the OSH policy are it is not in writing; not signed by the top management; not explained to employees; and not updated from time to time. Resources management is an important aspect the implementation of OSH system and preventing accidents in the construction industry. Resources management can be divided into two parts, namely human resources and material resources. Among the causes of occupational accidents in the construction industry that related to material resources are the company's profitability; proper construction equipment; and low expenditure on safety aspects. Human resources, on the other hand is related to issues such as training courses; hiring and selecting proper workers; job agencies; lack of OSH staff; and time management.

Many studies have shown that there is a link between safety cultures of an organization with the safety performance, which is relevant to the construction industry as it is essential to ensure the safety of workers on site. Efforts to improve OSH performance will not be effective until the safety culture is improved. The safety culture aspects of the organization may comprise strong leadership and management of OSH; management

commitment to safety; communication; employee commitment to safety; emphasize on safety for each project; and bad management, staffing and decision making. Good OSH performance in a construction project can be achieved successfully with the establishment of good OSH management. Overall, the OSH management aspects to put emphasis on are planning elements; procedures and rules; and supervision. Among the elements that must be addressed during planning are preventive measures; safety is considered in each construction project; and work planning aimed to improve safety. The important aspect of the procedures and rules elements, that should be focused on is setting safety policy and concrete actions, tasks, duties and responsibilities; properly formulated in term of content/ language/ form; and properly disseminated and implemented. Supervision element on the other hand include proper supervision by primary contractor and sub-contractors; the effectiveness of supervision; collaboration between contractors; tolerance of departures from industrial safety regulations and rules by supervision personnel should be taken into account.

Environmental Influences Factor

Environmental influences can be associated with external factors where the organization may not have control over the cause of accidents and ill health. Indirect or external factors can increase the risk of the occurrence of occupational accidents. The environmental influence factors are political and legislative influence, social influence and market situations.

The first aspect of environmental influence factor is political and legislative. In developed and developing countries, commitment from the government is an essential element required to regulate the management process of a construction project in the context of OSH. One of the government's commitment is to establish OSH legislation in order to provide a good environment for all stakeholders for construction projects such as developers, consultants, contractors, suppliers of materials and equipment, labor, authorities and others. In this aspect, most researchers have focused on the effectiveness of legislations (clear legislation; inadequate legislation; legitimate legislation); adequacy of legislations (mandatory training courses; licensing); legal disputes; and effectiveness of government's enforcement.

Next, social influence factor, another important aspect that determine the landscape of OSH in the construction industry in a country. Problems in the construction industry such as negative cultures and traditions; social changes; placing other issues above safety; lack of exposure and safety information; and the neglect of safety issues may be related to social influence. The last factor is market situation. Two important aspects should be considered in terms of market situation namely availability of resources (i.e. people, materials, equipment) in terms of time, quality and choice; and limited economic capabilities (i.e. reduction of operating costs; company financial condition; competition for projects awards).

Challenges and Impacts of Occupational Accident

Occupational accidents are often associated with negative impact to the construction industry and at the same time delaying the completion of a project. Occupational accidents can cause loss of company production, illness or injury, equipment or property damage, and near-miss. Moreover, occupational accidents incur substantial expense to society, company and also the individual involved. The impacts of occupational accidents include death and injury, cost, productivity, quality and company image.

Workplace death and injuries are a significant consequence of occupational accidents involving construction industry workers (Reese & Edison 2006). Accidents at the construction site can result in death and injury to workers as well as the public. Other than that, cost is one of the important impact of occupational accidents in this industry. The costs that employers must bear in the event of an occupational accident include employee replacement cost, overtime pay, loss of production and productivity, cost of retraining, cost of repair work, medical costs and the cost of personal compensation.

Productivity is also one of the key factors impacted by occupational accidents. Deaths and injuries due to occupational accidents proven to have a negative effect on the productivity of the construction company as well as the national economy. A good OSH performance will contribute to a better organizational productivity. Occupational accidents can affect the worker's quality, as those who are safe and healthy are more productive and work at the best level. Managing accident cases at the construction site will cause a delay to construction project, which also affected the workers' quality due to time constraint.

Companies in the construction industry must put emphasis on the enhancement of their image by ensuring high quality of the deliveries. Therefore, a strong OSH performance will benefit in enhancing the companies' image. According to a study conducted by the ILO (2003), most companies are paying close attention to the social and environmental performance including the OSH elements t in measuring their company's economic performance to achieve more profits. They build reputation by embracing their social responsibility, which result in better and improved image of the company. In summary, the occurrence of occupational accidents in a company's premise especially fatal accident will affect and tarnish the company's image and reputation.

New Safety Management Approach: OSH Intervention Practices

There's a need to rectify issues of occupational accidents in the rail construction industry in Malaysia,in order to manage all hazards and to prevent any occupational accidents. By implementing the correct and appropriate OSH intervention practices, occupational accidents at the workplace can be reduced significantly. Therefore, OSH intervention practices in the rail industry should be adopted by all stakeholders in the industry. OSH intervention practices are aimed at controlling work processes, equipment, environment and workers to reduce incidents and accidents in the workplace. They have been recognized as one of the effective measures for improving safety performance and reducing workplace hazards.

OSH intervention practices involve various levels of safety systems in the workplace namely management, human and technical. Theoretically, all three components of OSH intervention practices are considered to have a direct impact on safety outcomes, for example employee safety behaviors. Figure 12.1 illustrates the summary of OSH intervention practices for management, human and technical in construction industry.

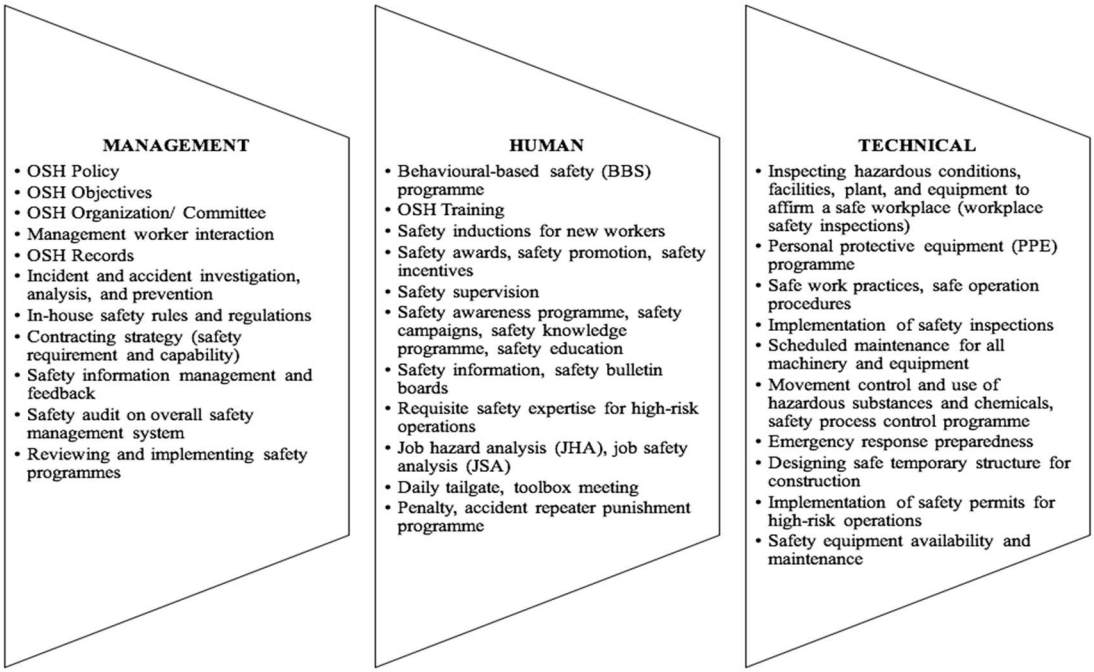

Figure 12.1. **OSH intervention practices for management, human and technical**

Conclusion

In Malaysia, the rate of occupational accidents and fatality in the construction industry generally and the rail construction industry particularly is high. There are various factors that contribute to occupational accidents such as human (worker), workplace, materials and equipment, organizational and environmental influences. There have been numerous efforts by various parties to improve OSH performance in order to reduce occupational accidents in this industry.

Occupational accidents in the rail construction can be prevented by implementing the correct and appropriate OSH intervention practices for management, human and technical.

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13

A REVIEW ON AMMONIA REFRIGERANT SYSTEM ACCIDENTS CASES IN MALAYSIA.

Ir. Tajul Ariffin Mohamed Nori

INTRODUCTION

Large scale refrigeration systems used in the industry that involve the storage, processing, or manufacturing of foods or products for daily consumption require a large amount of cooling capacity. For that purpose, ammonia is widely used as a heat transfer medium for high-capacity industrial cooling systems due to its natural availability in air. Ammonia offers superior thermodynamic qualities which require less heat transfer surface, adequate for smaller pipes and results in less energy consumption compared to other refrigerants (Walter S. K, 2013). This gas has a strong odor smell that can be detected by anyone who comes close to it but may cause serious health effects if exposed to high concentrations of ammonia. Some of the typical effects to human health are respiratory distress or failure from immediate burning of the nose, throat and respiratory tract, while nose and throat irritation leading to coughing if lower concentrations of ammonia are inhaled (New York State Department Of Health, 2004). Despite all of its serious threat to human life and negative effects, it is much cheaper to get and not so flammable compared to other refrigerants.

In refrigeration systems the ammonia liquid is stored in closed pressurized vessels and piping. Any release of the pressure will make ammonia gases evaporate with rapid formation of vapor clouds that can harm humans. This is due to its lower boiling point (approximately -28^{o}F). There are many cases which involved ammonia accidents in Malaysia and the aim of this article review is to determine the causes and effects of the accidents due to anhydrous ammonia refrigerant system operation and maintenance. Some of the cases has affected the safety and health of workers and the worst case has also involved fatalities. Any organizations that partake in ammonia refrigeration businesses must be aware of their legal liabilities and obligations on the workplace risk to safety and health.

Operational Ammonia Released Accident Cases

Case 1: The Effect Of Ineffective Maintenance On Serious Operational Ammonia Accidents

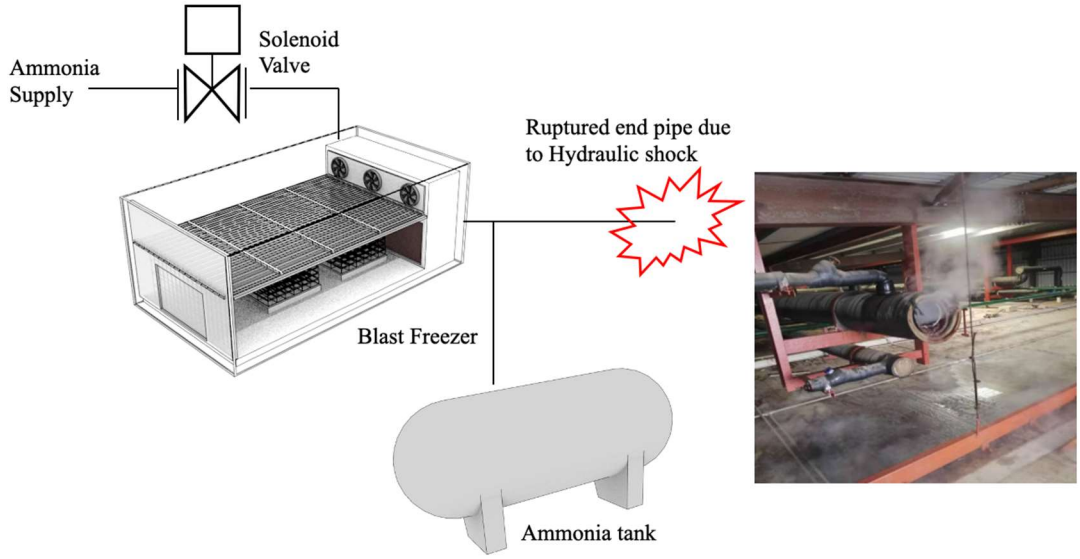

Figure 13.1. The simple diagram of pipeline connection of the related components involved with the accident and the visible ammonia at cloud at the end pipe after the accident even though several attempts have been conducted to shut all the supply valves (Source: DOSH 2019)

On September 13, 2019 in Merlimau, Melaka, an anhydrous ammonia release due to a phenomenon known as hydraulic shock was reported in a raw food processing industry. 31 workers suffered breathing difficulties from the accident, including 3, were admitted to intensive care units since they have problem with the respiratory system. All the critical patients were involved with the poultry processing activity adjacent to the ammonia blast area. Just a few minutes after the explosion, the atmosphere was immediately filled with a large amount of ammonia vapor cloud and workers were evacuated immediately. Fire and Rescue Department (BOMBA) used water spray to disperse the ammonia vapor cloud and ensure the dilution process of released gases. However, it took several hours to completely dissipate the gas from the atmosphere before the source of release is identified and closed.

The source of the release was identified, a ruptured pipe end due to a hydraulic shock event. On the day of the accident, the fractured pipe end was welded to stop the continuous release of the hazardous gas after several attempts to halt the supply by closing the system valves failed.

The factory has several blast freezers from an ammonia refrigeration system for the cooling of fresh poultry products process. Failure analysis by the DOSH Forensic Engineering Division found that the occurrence of hydraulic shock in the pipelines system of a blast freezer had caused one of the piping systems to rupture. The hydraulic shock was induced by the rapid pressure rise in the pipeline system. Rapid pressure rise is caused by the combination of high-pressure hot gas from the defrost process and the introduction of cold liquid ammonia in the blast freezer due to process offsets.

Prior to the accident, the blast freezer was in the process of defrosting after the freezing stage but liquid ammonia continued to be supplied to the blast freezer. This happened due to a malfunction solenoid valve at the blast freezer inlet pipe, to avoid any excessive ammonia from accumulating in the blast freezer system after the operator stopped the ammonia supply. The disturbance to the system had offset process parameters which in turn created a hydraulic shock which affected outlet piping system. Continuous hydraulic-shock hitting one of the end pipes had created some sort of hammering effect, which finally fractured the pipe and released the ammonia to the atmosphere. The malfunction solenoid valve has been dismantled from the system for the forensic analysis. It was discovered that the small rubber seal inside the valve was damaged and leaked. The rubber seal was heavily damaged by dirt and particles found inside the valve when it was opened. Such dirt should not be accumulated inside and must be reduced as much as possible. The system was also equipped with a strainer filter to avoid excessive dirt from getting inside the piping system and affected critical components such as solenoid valves. However, during inspection, the strainer is found in a bad condition with a thick slug observed during the dismantling process.

This indicated that proper maintenance of the strainer component was not adequate or missing. The hydraulic shock phenomenon in anhydrous ammonia refrigerant is one of a common causes of failure and the most catastrophic scenarios when it occurred. Some similar events happened in the past in the US, in 2007 and 2010 (CSB Safety Bulletin, 2014), (Bent. W, 2008).

Case 2: Ammonia Leaks From A Defective Refrigeration System

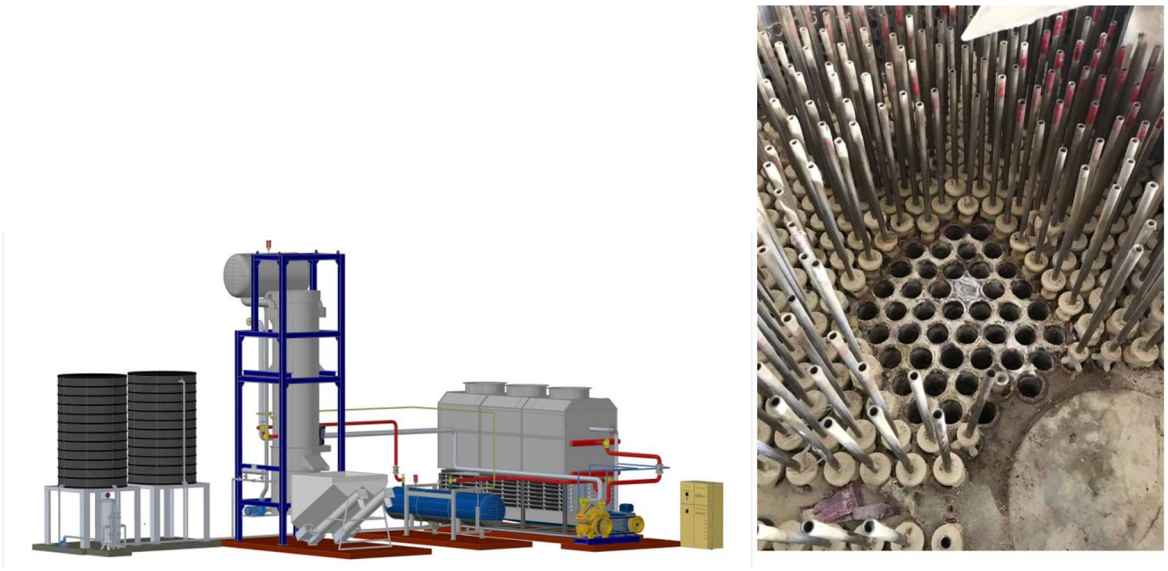

Figure 13.2. Typical ice making refrigeration system (left) and the plugged tube that cause the accident (right). (Image retrieved from www.salakorn.com)

On Jan 14,2020, at around 1.00 am, a dangerous occurrence involving a mass release of ammonia vapor cloud from an ice cube manufacturing factory to the surrounding residential area was reported, which took place in Penang. No injury has been reported from the accident. The amount of ammonia gas continued to increase after several hours, even though the factory owner has quickly ceased the freezer operation of the ice making machine. The Fire & Rescue Department (BOMBA) arrived at the scene at around 7.00 am, responding to complaints from residents living nearby who smelled high concentration of unpleasant gas. It took another few more hours to successfully reduce the ammonia concentration to a safe level, approximately at 11.30 am. Following the accident, DOSH was called to conduct a detailed investigation on the accident. The source of release was identied as a freezer tower machine used to generate ice cubes from the condensation process of the ammonia refrigerant system. The ice manufacturing plant operated two units of ice making machines with a capacity to produce approximately 130 tonnes ice cubes.

The refrigeration system consists of some components that require design approval and certificate of fitness (CF) to operate such as the ammonia receiver and ice tube freezer. These components fall under the unfired pressure vessel (UPV) category under the Factory and Machinery Act (FMA) 1967. However, no valid CF was found from the premise and the owner admitted that the machinery had never been registered for the operations. In fact, all of

the maintenance and repair work was done by a third party that did not fit with the DOSH requirement as a registered competent firm.

The freezer used to generate ice consists of vertical tubes inside the vessel. The ammonia gas will enter the freezer vessel and water supply will pass through the tubes to form the ice cubes through heat transfer. After the accident, a nitrogen gas has been pumped into the vessel to identify the location of the leak. The results of the soap test revealed that the leak was coming from a plugged tube that has been welded from previous repair works. The repair work was done by an illegal service provider and the authority was not notified on the rectification works.

The owner of the factory has serious safety non-compliance issue, making the incident inevitable. Some of the violations by the factory owner include failure to conduct chemical health risk assessments as well as the general risk assessment. Hence, there were no safe operation procedures, emergency response plan and gas detectors as a safe barrier that can sense the high level of ammonia presence in the surrounding atmosphere. To make it worse, improper worker's dwellings adjacent to the factory building exist. Keeping up with all the regulations might be a challenge to some owner, but they must comply with the mandatory requirements to avoid such accidents in the future.

Case 3: Defective Ice Making Refrigerator Accidental Ammonia Leaks

In August 2018, another similar ammonia release occurred in an ice making factory in Shah Alam, caused by the refrigeration system failure. The incident happened at 5.12 am due to a leak in the freezer piping system. Gas monitoring was conducted at the scene of the accident right after the accident, the ammonia reading at the scene was 500 ppm while the surrounding area of the factory area was 150 ppm. The ammonia level can only be reduced to 30 ppm after 5 hours.

All of the affected workers were sent to a hospital for further treatment due to serious breathing difficulties. From the 18 victims, 2 victims were pronounced dead at the scene. On the day of the accident it was reported that 15 employees were operating the ice producing machines while 20 employees were sleeping in the hostel within the factory premise. There is no isolation between the production room and the workers dwelling area.

The investigation found that the freezer tower which is suspected as the source of leak, with the plugged of its ice tubes at the top of the freezer head welded. The nitrogen gas and bubble test has revealed that there was a leak in the welded tube. There was also no records ofmaintenance for over a year . This case was identical to the Penang case.

Accident During Maintenance Work

Case 1: Ammonia Released in Food Manufacturing Industry During Maintenance Work

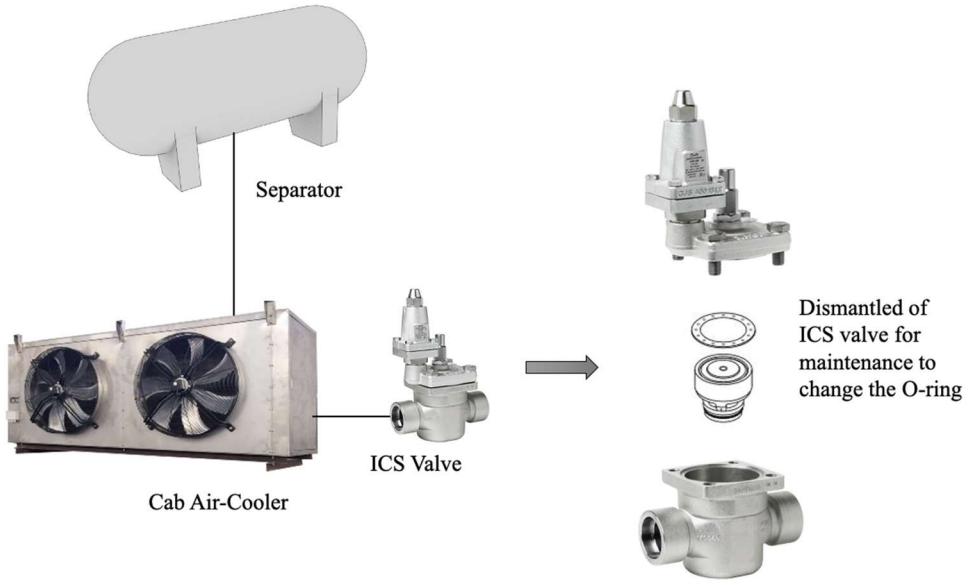

Figure 13.3. **Dismantling of ICS Valve for O-ring changes at CAB Air Cooler. (Source: DOSH 2020)**

Another ammonia accident took place on September 10, 2020 at around 1.00 pm, near Taman Perindustrian Sri Plentong, Masai, Johor. A release of ammonia gas from a production area of a factory involved with food processing and packaging activities has been reported. Due to continuous release of the anhydrous ammonia, a full evacuation of all the factory employees was done approximately at 2.45 pm after the ammonia level has reached beyond 50 ppm. There were no casualties reported from the dangerous occurrence.

On the day of the accident, a team of maintenance personnels were tasked to conduct maintenance works on one Cab Air Cooler unit in a freeze-dry area of the factory. The workers were in the process of changing a valve o-ring of the Cab Air Cooler following a problem with the cooler fan breakdown. During the process of changing the components, a

small leak of ammonia was detected and the workers quickly responded to the event by trying to dilute the ammonia with water to dissolve the ammonia from the valve, however they was unable to do so due to water shortage. The leaking gradually increased and the room was immediately filled with ammonia vapor cloud and made the process to curb the release more difficult. The gas has dispersed to the whole surrounding area and the emergency response team (ERT) promptly activated the building evacuation system. The valve can only be closed after several attempts by Fire & Rescue Department (BOMBA) before the scene was declared safe.

A day before the accident, a main valve for the ammonia piping supply was shut-off to allow the purging process to remove any remaining ammonia gas in the refrigeration system. The ammonia in the refrigeration system was pumped-down by a compressor pump to the reservoir. Before the commencement of maintenance work in the Cab Air-Cooler room, the maintenance team have checked the pressure gauge to ensure no ammonia remains in the pipe and the valve is safe for maintenance.

The company has established a proper emergency response plan but there were issues in their reactive system to trigger the plan. There were gas detectors at the facility to warn the workers in the case of emergency, but were not activated during the accident. Findings revealed that the detectors were tested for functionality. There are no permit to works (PTWs) issued for the respective task even though it was a non-routine task and the activities involved hazardous chemicals. The company failed to conduct risk assessment and provide safe work procedure with regards to maintenance work.

Case 2: Released of Ammonia from Incomplete Maintenance Work after A Festive Season

Another case reported in Cheng, Melaka on January 28, 2020, involving an ice making factory which has affected the surrounding residents. From the findings, it was revealed that the cause of such incident was due to the ammonia leaking from the compressor pump, which was under a major overhaul and was left without closing it back properly. The Ammonia escaped through the cylinder head of the pump compressor without the cover head (dismantled for overhaul). Besides, there are no maintenance manuals to guide the owner on safe maintenance procedure.

The factory has been in operation for almost a year without initiating any safety measures. The owner who acquired the used refrigeration system was not aware of the related legal requirements for using such machinery. Consequently, the system does not have any CF to operate and has never been registered with DOSH. The person who did the maintenance work is a general machinery mechanic and is not familiar with refrigeration systems.

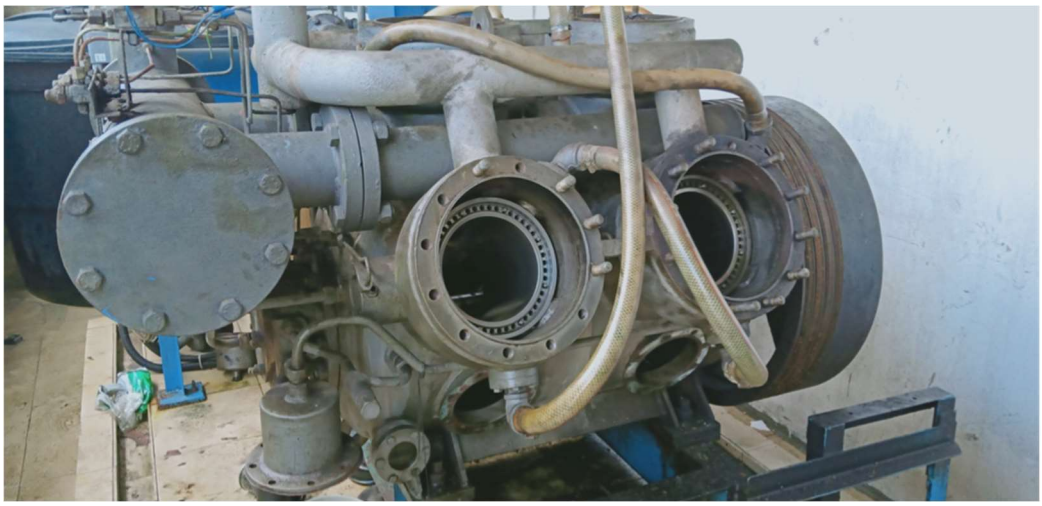

Figure 13.4. **Abandon compressor pump before the complete maintenance at the factory causing the residual ammonia to release at the opening. (Source: DOSH 2020)**

Lesson Learnt from Ammonia Accidents

From the cases mentioned previously, we can review the contributing factors that lead to the accident. The summary of ammonia accident cases from 2015 to September 2020 is illustrated in Table 13.1.

Table 13.1 Summary of ammonia accident cases from 2015 till September 2020 in Malaysia. (Courtesy data from the Department of Occupational Safety and Health, Malaysia)

Date and Location	Accident Description	Severe Impact
26 September 2020	Food Processing and packaging factory ammonia leakage	6 workers hospitalized due to serious breathing difficulties
18 September 2020	Ammonia leakage from an abandoned ice making factory	No injury reported
10 September 2020 Permas, Johor	Food Processing and packaging factory ammonia release	Dangerous occurrence

2 February 2020, Kulim, Kedah	Ammonia leakage from an electronic production factory	60 workers vomited and experienced dizziness 12 workers were brought to the hospital and others got treatment from the hospital paramedic at the incident's location.
28 January 2020, Cheng, Melaka	Ammonia leakage from an ice making factory	Affected surrounding residents
14 January 2020, Butterworth, Penang	Ammonia leakage from the freezer part at an ice making factory	No injuries as workers realize the leakage early
3 September 2019, Merlimau, Melaka	Ammonia leakage from a poultry processing factory	26 workers experienced breathing difficulties and were brought to nearest hospital
2 September 2019, Serkam, Melaka	Ammonia leakage from a poultry processing factory	120 students from nearby school (about 1.5km from the incident location) were evacuated
11 May 2019, Kajang, Selangor	Ammonia leakage from the main ammonia tank at an ice making factory	1 public exposed to the ammonia gas during shopping at a grocery shop in front of the factory
16 August 2018, Shah Alam, Selangor	Ammonia leakage from an ice making factory	4 students from nearby school vomited and experienced breathing difficulties, then were brought to hospital.
14 August 2018, Kuala Perlis, Perlis	Ammonia leakage from an ammonia tank at an ice making factory	4 workers from nearby factory experienced breathing difficulties and 2 of them were hospitalized
13 August 2018, Shah Alam, Selangor	Ammonia leakage from an ice making factory	2 workers died, 18 workers injured and were brought to nearest hospital
11 Nov 2017, Bukit Mertajam, Pulau Pinang	Ammonia leakage from an ice making factory	3 workers from fuel station nearby vomited and were brought to nearest hospital
10 October 2017, Kota Kinabalu, Sabah	Ammonia leakage from an ammonia tank at an ice making factory	1 worker fainted

25 April 2017, Kuala Kangsar, Perak	Ammonia leakage from an ice making factory	3 people were brought to the hospital
18 May 2016, Kuching, Sarawak	Ammonia leakage from a food processing factory	3 people were sent to the hospital
14 December 2015, Selayang, Selangor	Ammonia leakage from an ice making factory	No information
27 May 2015, Pantai Remis, Johor	Ammonia leakage from an abandoned ice making factory	15 people from 4 families has been ordered to evacuate the area

Maintenance management will help factory owners keep their manufacturing productivity effective as well as prevent any disturbance to their system that can harm their workers and have the potential to temporarily stop the production. In addition, critical components that require part replacement or thorough checking need to be identified through manufacturer manual or recommendations. It must be established systematically by using a checklist so any risks from critical parts are manageable. Most importantly, knowing the lifecycle of any critical component of the system can help the owner to plan for proper preventive maintenance especially the safety instrument of the system such as solenoid valve that acts as barriers to prevent unpredictable accidents. The owner of any industrial refrigeration systems with ammonia base refrigerant who want to engage with external service providers to maintain such systems should ensure that they are competent to undertake such activity.

It is important to remember that the process of accident prevention also includes awareness of factory owners of the hazards that are not known to him. Similar incidents are occurring again and again as the majority of organizations failed to learn from previous incidents. Knowledge sharing is important especially among those involved with similar nature of work rather than solely depending on learning experience which will result in the same accident to happen repeatedly. Proper education and awareness programs especially among the persons that are involved in similar industries or having the same nature of work may be shared through industry trade association or group as one of the industrial sources of information.

Apart from awareness programs on safe handling of hazardous substances, knowledge on mandatory and voluntary requirements may help owners dealing with safety and health risk with the appropriate management. Owners must be aware that any pressure vessel to be used in Malaysia should have a valid certificate of fitness and registered with DOSH as specified in the FMA 1967. Furthermore, these machinery shall not be repaired without any notification and consent from the department. Safe handling of ammonia-based refrigeration systems is an important aspect for every owner to be included in their risk management. This is to ensure the safety and health of their employees who work and operate the ammonia cooling system is not affected by accidents caused by failures in the system. The owner should take proactive measures to protect their workers against serious harm before any accident takes place.

According to Murphy's law, 'what can go wrong will go wrong' is a very useful piece of advice in emergency management. Established preparedness efforts may mitigate the risk of more severe effects to workers. Thus, a good, effective and well maintained emergency response plan including it's triggering system may save more life when things go wrong in the ammonia refrigeration industry. Once a mass amount of ammonia is released to the environment, it will take several hours to reduce the residual ammonia intensity level in the air. This will not only affect the workers involved but may also cause others at the surrounding area. Table 13.2 illustrates the possible cause of accidents from the case study that lead to ammonia release.

Table 13.2: Summary of Factors Contributing to Ammonia Release Incidents of The Study

Contributing Factors
Component or equipment failure
Inadequate or lack of preventative maintenance program
Preventive procedures not properly develop
Maintenance plan strategy was missing
Illegal repair works and unregistered machinery
Lack of competency for maintenance personnel
Valve not secured when new component was installed
Residual ammonia are not fully emptied out from system during maintenance activity

Conclusions

Most of the cases discussed have maintenance related issues for both operation or maintenance stage. No matter how good the system has been designed or how perfect the installation process was done by the equipment or instruments expert, it will still fail if it is not properly maintained. Maintenance personnel normally will be constrained by time to perform thorough maintenance work. From the cases, it is obvious that the main hazard from the ammonia refrigeration system is the ammonia gas itself as one of the hazardous chemicals to human health. Storing of anhydrous ammonia required a system with pressure suppression to manipulate the ammonia phase which is very useful in the manufacturing process.

However, everything that deals with a pressurized system has a high degree of residual risk when the control measures are missing or can not be maintained properly. Safety barriers are very important to ensure that no risk of injury to workers such as safety instruments (i.e. safety valve), gas detection and alarming system, preventive maintenance in accordance to the manufacturer recommendation, chemical health risk assessment, and general risk assessment as a proactive measure to prevent any unnecessary dangerous occurrences during work activity. Accident factors will escalate when the owner neglects important barriers and takes things for granted.

The company shall look into the applicability of new system approach such as process safety management to manage the high risk of operations properly as well as competency of the worker, enhancement of safety features and new technology. The authority may publish guidelines pertaining to the issue as a guide to industry to practise best OSH implmentation.

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PART III
OCCUPATIONAL HEALTH

14

DEVELOPMENTS OF OCCUPATIONAL HEALTH & INDUSTRIAL HYGIENE IN MALAYSIA.

Ts. Nor Mohd Razif Noraini.

INTRODUCTION

In Malaysia, exposures in the workplace are regulated under the Factories and Machinery Act (FMA) 1967 and also under the more comprehensive Occupational Safety and Health Act (OSHA) 1994. The philosophy of legislating safety and health in the workplace changed from one that was very prescriptive and containing detailed technical provisions under FMA 1967 to one that is more flexible and encourages self-regulation under OSHA 1994. OSHA 1994 is supported by regulations, codes of practices and guidelines to further clarify the provisions in the Act. FMA 1967 emphasis on safety while OSHA 1994 gives equal emphasis on addressing health hazards in the workplace. (K.G. Rampal, J. Mohd Nizam, 2006)

Department of Occupational Safety and Health (DOSH) as the enforcer of FMA and OSHA is responsible on the development of legislation in promoting IH and OH. The illustration below shows the years of IH and OH were formulated in DOSH.

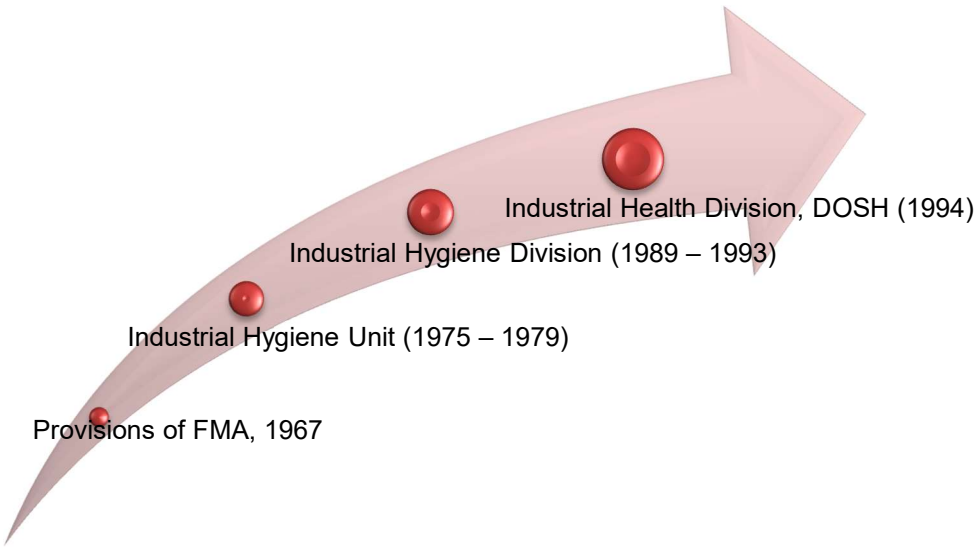

Figure 14.1. **DOSH OH and IH development**

Occupational hygiene is the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace, and which could impair the health and well-being of workers, also taking into account the possible impact on the surrounding communities and the general environment (ACGIH). Definition of occupational hygiene may be presented in different ways; however, they all have essentially the same meaning and aim at the same fundamental goal of protecting and promoting the health and well-being of workers, as well as protecting the general environment, through preventive actions in the workplace.

For the last 20 years, NIOSH has setup two divisions known as Industrial Hygiene Division (IHD) and Occupational Health Division (OHD). The divisions led by Mr. Fadzil Osman and Dr. Sulaiman Mohd Nawawi respectively as the pioneers in 1999. Five categories of consultation and advisory services were offered by NIOSH at the time as illustrated in figure 14.2.

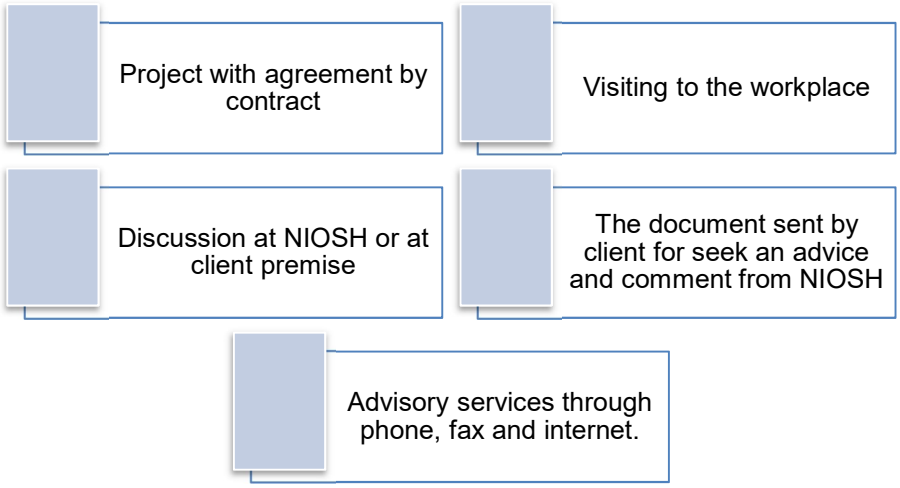

Figure 14.2. **Categories of Consultation Offered by NIOSH during year of 1999**

The demand for consultation services offered by Industrial Hygiene Division (IHD) and Occupational Health Division (OHD) showed an increase in 2004, up to 164 activities. Industries in Malaysia have started to embraceIH and OH due to Use and Standard of Exposure of Chemical Hazardous To health (USECHH) Regulations. This is showcased by the increasing demand for related services from year to year. In 2015, the divisions recorded 237 projects for private and governmental sectors in Malaysia. By 2019, 265 projects were recorded as regulatory compliance (RC). RC is the new cluster introduced under Consultation, research and Development Department.

Benchmarking NIOSH with Global Standard

Named as the Capacity Building of NIOSH, the collaboration with Japan International Cooperation Agency (JICA) in 1995 was initiated to upgrade the capacity (technical support, human resource development, collection and dissemination of information) of NIOSH Malaysia. The development of NIOSH IH and OH experts through this project is illustarated in table 14.1

Table 14.1 Development of NIOSH experts in IH and OH

NO	NAME	DIVISION	AREA OF EXPERTISE	TRAINING YEARS
1	Mr. Sulaiman Kabolani	Industrial Hygiene	Working environment measurement	2001
2	Mr. Mohd Arif Baba	Industrial Hygiene	Biological Monitoring	2002
3	Ms. Suhaily Amran	Industrial Hygiene	Working environment measurement	2002
4	Ms. Nor Hafizalena Osman	Industrial Hygiene	Biological Monitoring	2003
5	Mr. Mohd Suhaimi Mohd Mokhtar	Industrial Hygiene	Measurement of Mineral Dust, X-Ray diffract meter and Laboratory Management	2002
6	Ms. Norhamimi Mohd Yusof	Industrial Hygiene	Design, Maintenance and Inspection of Local Exhaust Ventilation System (LEV)	2002
7	Mr. Richard Tan Chin Hwee	Industrial Hygiene	Biological Monitoring on Heavy Metals	2004
8	Mr. Hazizul Azlin Razali	Industrial Hygiene	Environmental Risk Management in the workplace	2003

9	Ms. Zakiah Fatemah Malim	Industrial Hygiene	Environmental Risk Management in the workplace	2005
10	Mr. Umar Ab Aziz	Industrial Hygiene	Personal Protective Equipement (PPE)	2004
11	Ms. Norbrilliant Mokhtar	Industrial Hygiene	Analysis with HPLC	2005
12	Mr. Hanif Yahya	Occupational Health	Total Health Promotion and Rehabilitation	2005
13	Hj. Dr. Agus Salim Mohd Banon	Occupational Health	Occupational Health Administration	2003
14	Mr. Yuzainie Yusof	Occupational Health	Technical services from occupational health organizations to enterprise	2003
15	Dr. Azrul Rozaiman Dato' Hj. Abdullah	Occupational Health	Diagnosis and Prevention of Health disorder due to heavy metals	2004
16	Ts. Mohd Esa Baruji	Occupational Safety	Noise control	2005

To further enhance the capacity of IH and OH staff, NIOSH has conducted in-house training and development on Occupational Hygiene Courses by Occupational Health Training Association (OHTA) in 2014. Gully Howard Technical experts from United Kingdom (UK) were invited to conduct Occupational Hygiene (OHTA) modules for about 25 NIOSH staffs in Bandar Baru Bangi office. The courses conducted are as shown in table 14.2

Table 14.2 Courses conducted under OHTA Requirement

No	Course
1	W507 – Health Effects Of Hazardous Substances
2	W505 – Control of Hazardous Substance
3	W501 – Measurement of Hazardous Substances (Including Risk Assessment)
4	W201 – Basic Principles in Occupational Hygiene

Figure 14.3. **Experts trainer from Gully Howard Technical deliver lecture**

Consultation services By NIOSH

NIOSH has conducted a lot of consultation services with the number of projects increasing from year to year. Among the services offererd by NIOSH are: Awareness Program for USECHH Regulations 2000, CPL Regulations 1997.

- LEV Assessing and Testing
- Noise Exposure Assessment and Monitoring
- Benzene Exposure Monitoring
- Chemical Exposure Monitoring
- Individual Monitoring for lead exposure
- Urine Analysis
- Lung Function Test and x-ray
- Medical Assessment for hearing impairment for SOCSO
- Medical assessment and health monitoring

Occupational Medicine Centre (OMC)

The Occupational Medicine Center (OMC) was set up in 2003 under the occupational health division. The center offered a whole range of health surveillance service which included pre-employment, periodic and after employment medical examination for workers. With the objective : f by performing a thorough medical examination, any occupational diseases can be detected and verified by certified occupational health doctor (OHD).

Medical Surveillance (MS)

Medical Surveillance (MS) involve monitoring of a person to identify changes in health status due to occupational exposure to chemicals hazardous to health. It is done to detect adverse health effects resulting from occupational exposures at the earliest stage possible.

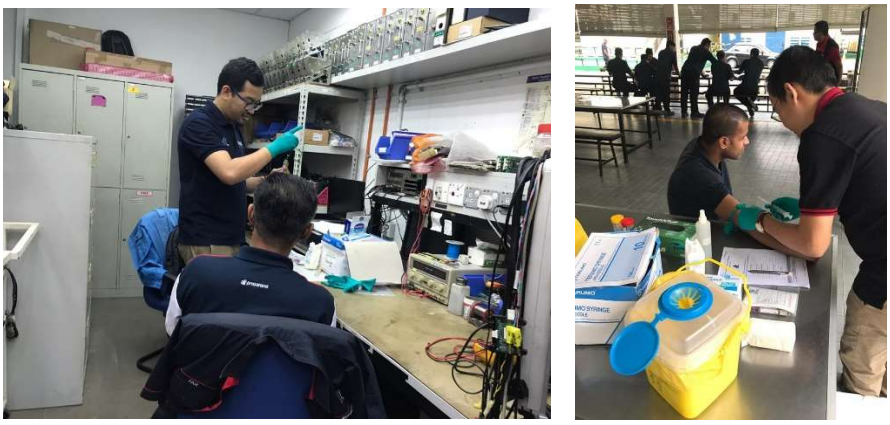

Figure 14.4. **NIOSH OHD conducted MS in the client workplace**

Medical Surveillance enable the organization to detect and manage exposure to chemical at the workplace through:

- Early detection for any significant exposure of the chemicals to the worker
- Prevention and management of chemical-related symptoms and disease
- Providing recommendation for workplace hygiene improvement.
- Providing appropriate training and chemical hazardous to health

Lung Function Testing Analysis (LFTA)

Lung Function Test (Spirometry) is used to evaluate workers respiratory health in Medical Surveillance Programs and to screen workers on their ability to perform certain tasks.

Figure 14.5. **LFT procedures practise by the workers**

Lung Function Test (LFT) enables organization make a smart decision on effective management of lung disorder by:

- Providing appropriate training modules related to hazard thru inhalation and lung disease.
- Providing respirators to relevant and appropriate personnel;
- Handling disability assessment and work compensation claim.

Audiometric Testing Analysis (ATA)

Audiometric Testing Analysia (ATA) is conducted with the aim to protect and conserve workers hearing from exposure to excessive noise in the workplace. After the noise risk has been identified, a comprehensive hearing evaluation test, which includes ear examination and audiometric test shall be conducted to measure the level of hearing of the worker.

Figure 14.6. **Audiometric program and facilities by NIOSH**

Audiometric Testing Analysis enable the organization to detect and manage exposure to chemical at workplace by / for:

- Providing appropriate training modules related to noise;
- Providing Personal Hearing Protectors to relevant and appropriate personnel;
- Prevention and management for future hearing disorder; and
- Provision of clear directives for employers, employees and service providers on the process and procedures.

Risk Assessment

In protecting workers from the adverse effect of chemicals, employer must ensure all chemicals used in the workplace is assessed via Chemical Health Risk Assessment. Through this assessment, all chemicals risk will be identified, evaluated and provided with control measures.

Figure 14.7. **CHRA performed by a competent person**

CHRA enables the organization to have an effective chemical management by making a smart decision on:

- Providing appropriate control measures;
- Induction and training of workers;
- The necessity of exposure monitoring program; and
- The necessity of medical surveillance program

Chemical Exposure Monitoring (CEM)

Under the Occupational Safety and Health (Use and Standard of Exposure of Chemicals Hazardous to Health) Regulations 2000, where an assessment of risk to health indicates that monitoring of exposure is required, or it is a requisite to ensure the maintenance of adequate control of the exposure of employees to chemicals hazardous to health, the employers shall ensure that the exposures of chemicals hazardous to health is monitored in accordance with an approved method of monitoring and analysis.

Figure 14.8. **Monitoring of hazardous chemical in the workplace**

CEM enables the organization to have an effective chemical management by making a smart decision on:

- Current exposure level of chemical at the workplace
- Efficiency of existing control measure (i.e. engineering control)
- The necessity of medical surveillance program guided by CHRA assessment

Indoor Air Quality (IAQ) Assessment

Indoor Air Quality (IAQ) refers to the air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants. Understanding and controlling common indoor pollutants can help reduce risk of indoor health concerns. Health effects from indoor air pollutants may be experienced soon after exposure or, possibly, years later.

In protecting workers from indoor hazards, it is one of the general duties as prescribed under the Occupational Safety and Health Act 1994 [Act 514] for the employer and an occupier (including building owner and building management) to provide a safe workplace to their employees or other person than his employees (occupant).

Figure 14.9. Indoor air quality assessment

IAQ assessment and monitoring enables the organization to have an effective indoor air management by making a smart decision on:

- Fact and figure on indoor contaminants exposures;
- Investigation on building occupants complaint;
- Indoor air building forensic;
- Evaluation of indoor air control practice;
- Providing appropriate control measures;
- Induction and training of workers;

Noise Risk Assessment (NRA)

The Noise Regulations requires employers to carry out workplace noise monitoring also known as Noise Risk Assessment (NRA) as an essential part of their Health and Safety strategy to help employer to control the effects of workplace noise pollution on employees. Through this assessment, all source of noise will be identified, evaluated and provided with control measure.

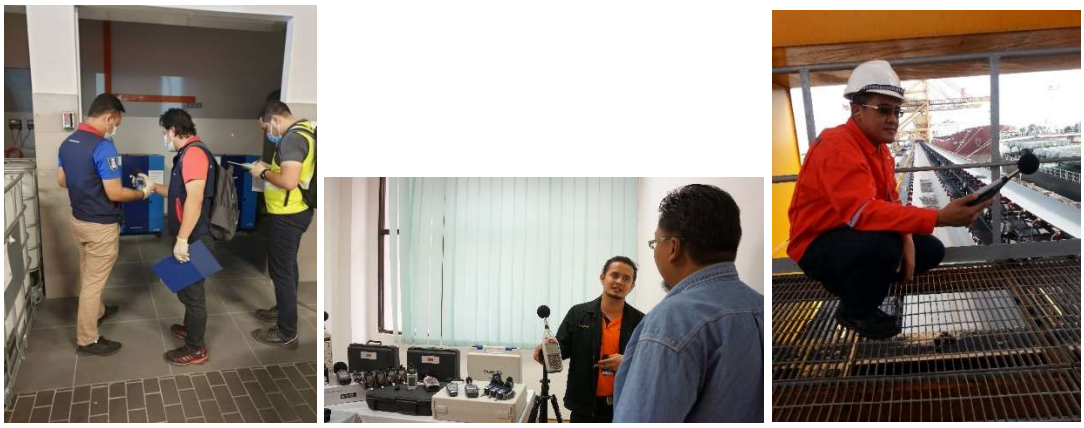

Figure 14.10. **Monitoring of noise exposure**

NRA enables the organization to have an effective Hearing Conservation Program (HCP) by making a smart decision on:

- Identifying the noise hazard and evaluating the risk involved;
- Implementing noise reduction measures, such as engineering control and administrative control;
- Providing suitable Personal Hearing Protector (PHP) and ensuring the proper use of the PHP by persons exposed to excessive noise;
- Training and educating persons involved in the HCP to raise their awareness on noise hazard;
- Conducting audiometric testing for detecting Occupational Noise Related Hearing Disorder (ONRHD);
- Keeping records of the measures taken to protect employees from noise hazard; and
- Evaluating the HCP to determine its effectiveness and identifying areas for improvements.

Local Exhaust Ventilation (LEV) Inspection and Examination

Any engineering control equipped and functioned to reduce the exposure level of employees to chemicals hazardous to health to the lowest practicable level must be inspected, examined and tested for its effectiveness.

Figure 14.11. **Inspection, testing and examination of ventilation system**

LEV enables the organization to emphasize on suitable and effective engineering control through

- Providing appropriate recommendation on type of system; and
- Induction and training of workers.

Participations and Contributions in the International and National Agenda

NIOSH is actively involved in emergency situation such as disasters, outbreak and pandemic. Strategic collaboration with government bodes, international companies and agencies are implemented by providing technical advices on IH and IH specialties. NIOSH has proven their role as the leader of OSH by providing experts and advisory services to the nation.

Figure 14.12. Indoor air monitoring in one of 'His Majesty's Ship' (Kapal DiRaja, KD) owned by Royal Malaysian NAVY

Figure 14.13. **Risk assessment for Royal Malaysia Police under Narcotic Crime Investigation Department**

Figure 14.14: Supporting emergency response team during national chemical disasters at Sg. Kim Kim Johor, chemical river pollution

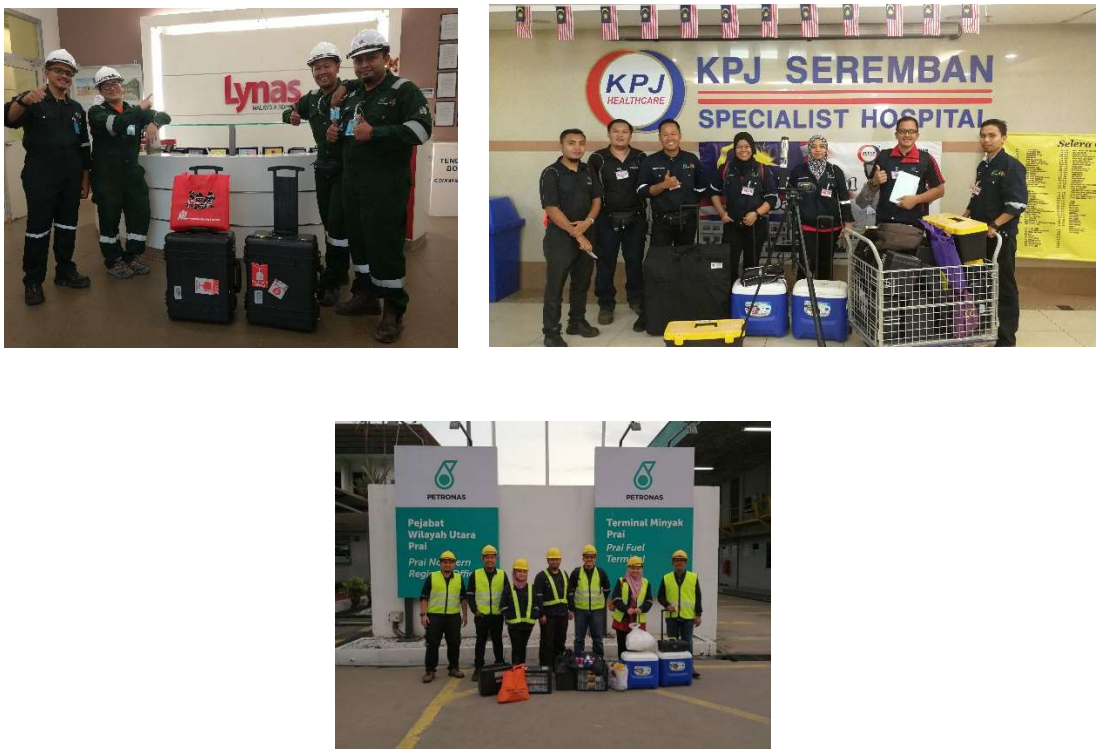

Figure 14.15. **Advisory services in IH for private companies**

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15

MANAGING ERGONOMIC RISK ASSESSMENT AT THE WORKPLACE.

Fauziah Kamarudin.

INTRODUCTION

Ergonomics or human factor is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance (International Ergonomics Association, 2015). Ergonomics is a system of work that suits the circumstances of the worker. In other words, ergonomics is the study of the relationship between humans and the equipment used, machinery or machinery, work procedures or the work environment.

Ergonomics consists of three main domains namely physical, cognitive and organizational. Physical ergonomics is about the human body's responses to physical and physiological work demands. Cumulative trauma disorders from repetition, vibration, force and posture are the common types of issues, and thus have design implications. Physical ergonomics is related to the objective of Occupational Safety and Health Act 1994 (OSHA 1994), that is to promote occupational environment for person at work which adapted to their physiological and psychological needs.

Adjustment in the aspects of ergonomics is very important to avoid the occurrence of injuries due to long-term load and tension known as Occupational Musculoskeletal Disorder (OMSD). This disease is caused by the use of muscles, joints and tissues of the body that experienced thirst and fatigue that can cause a person to be unable to use the limbs for a long time. Based on Figure 15.1, statistics on occupational diseases and poisoning reported to Occupational Health Division, Department of Occupational Safety and Health (DOSH) (2008) [1] showed an exponentially increasing trend of reported cases from year 2005 to year 2018. Nevertheless, the trend was postulated due to the increase in awareness among Malaysian employers and employees as the reporting rate increases.

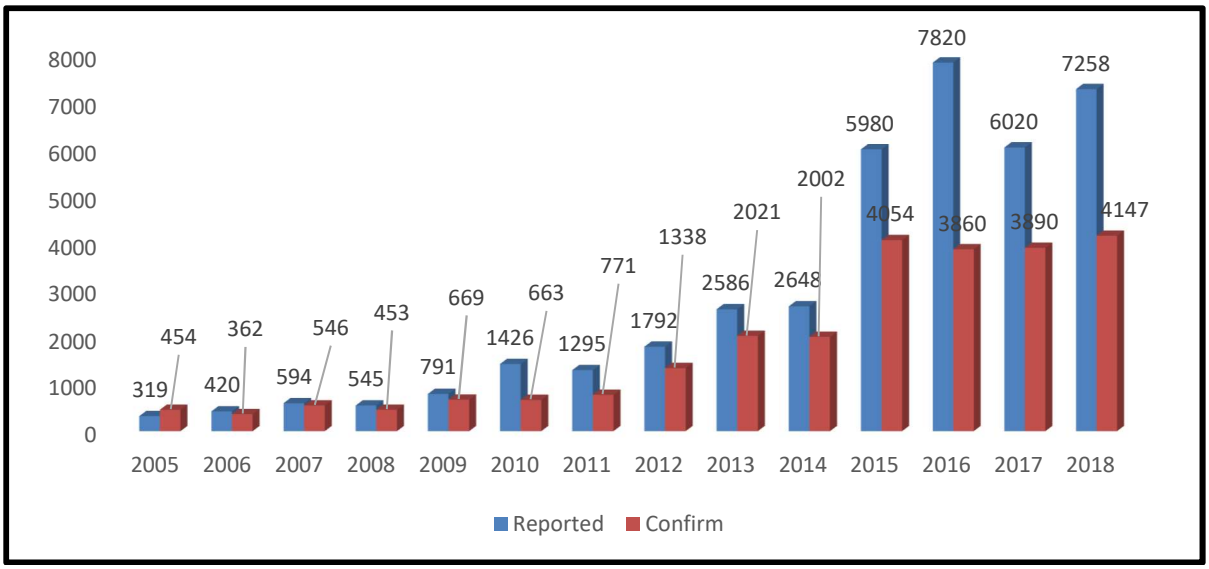


Figure 15.1. Reported occupational disease and poisoning from 2005 to 2018

In 2018, analysis of occupational diseases and poisoning by type of disease revealed that noise induced hearing disorders are the most common occupational disease experienced by workers, 6372 cases (86.4%) from a total of 7258 cases as compared to other diseases. This was followed by occupational musculoskeletal diseases with 258 cases (3.6%) and occupational skin diseases with 242 cases (3.3%). In 2019, statistics revealed the main sectors that contributed to the most number of OMSD cases were the manufacturing sector, 106 (59%) cases, followed by the hospitality sector, 16 (9%) cases, and the financial sector,12 (7%) cases as shown in Figure 15.2.

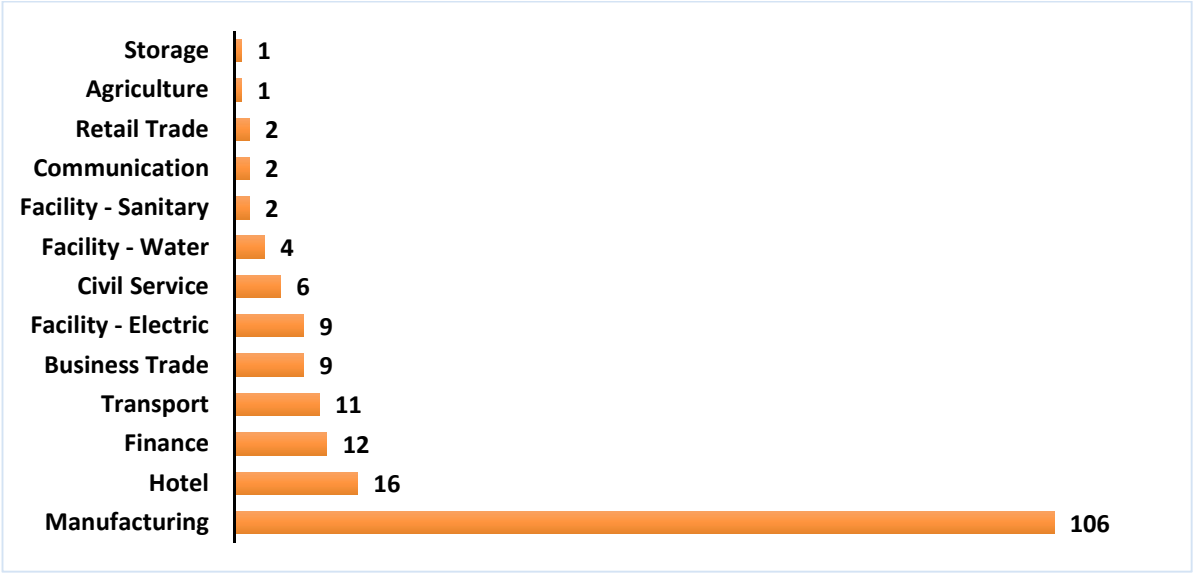


Figure 15.2. **Type of industries with OMSD cases year 2019**

Legal Requirements

The Department of Occupational Safety and Health (DOSH) under the Ministry of Human Resources is tasked to ensure that workers' safety and health are secured, and the safety and health of others members are not affected by work activities. The two main Acts that govern occupational safety and health in ergonomics aspects are the Factories and Machineries Act 1967 (Act 139) (FMA) and the Occupational Safety and Health Act 1994 (Act 154) (OSHA). There are several regulations and guidelines under both acts that are directly related to the ergonomics, namely:

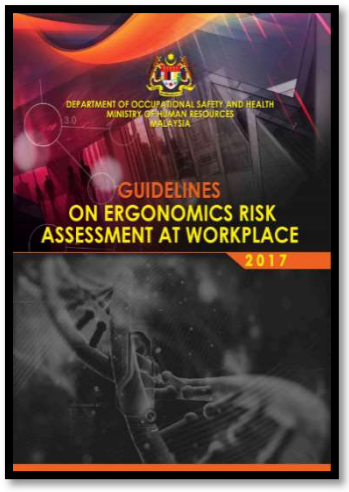
i. Occupational Safety and Health (Noise Exposure) Regulations 2019;
ii. Guidelines on Manual Handling at Workplace 2018;
iii. Guidelines on OSH for Lighting at Workplace 2018;
iv. Guidelines on Ergonomics Risk Assessment at Workplace 2017;
v. Guidelines on Heat Stress Management at Workplace 2016;
vi. Guidelines on OSH for Working With VDUs 2003;
vii. Guidelines on OSH for Seating at Work 2003;
viii. Guidelines on OSH for Standing at Work 2002.

Besides that, Occupational Safety and Health Master Plan 2020 (OSHMP 2020) [2] has outlined five (5) strategies to achieve the vision of cultivating safe and healthy work culture for the well-being of employers, employees and the country. The objective of the OSHMP 2020 is to enhanced quality of working life of the nation's most important asset through prevention of accidents and diseases at the workplace. A safe, healthy and conducive work environment leads to healthy, productive and innovative workers who will contribute to increased productivity and competitiveness of the organization. Thus, through Strategy 4: Mainstreaming of Industrial Hygiene under the Program 2: Comprehensive Health Risk Assessment where the importance of protecting employees from the effects of hazards resulting in the workplace as well as ergonomics hazard is the responsibility of employers to be implemented. To fulfill this responsibility, health risk assessment including ergonomic risk assessment in the workplace needs to be conducted to identify, assess and subsequently control ergonomics risks resulting from workplace activities.

Managing Ergonomics Risk Assessment by applying Guidelines on Ergonomics Risk Assessment at Workplace 2017

Exposure to ergonomic risk factors is a common hazard at the workplace which requires serious attention. Therefore, health risk assessments through evaluation of ergonomic risks at the workplace ought to be carried out to boost the safety, health and comfort of workers by taking into consideration ergonomic factors, namely design of work stations, equipment and a work environment that is appropriate, safe and not hazardous to workers. Implementation of a comprehensive health risk assessment is necessary at the workplace to ensure the health of workers can be improved, thereby creating a work environment that is safer, healthier and more conducive.

Managing ergonomics risk means minimizing the exposure to ergonomic risk factors. An ergonomics risk factor is any attribute, characteristics or exposure that may contribute to a musculoskeletal injury. Examples of common ergonomics risk factors are awkward posture, static and sustained work posture, forceful exertions, repetitive motions, vibrations and environmental risk factors. Repeated and prolonged exposure to above can strain the body part to the level of discomfort and pain, sub-chronic and chronic level of injuries over period of time (days, months or even years).



Guidelines on Ergonomics Risk Assessment at Workplace 2017 [3] is mainly to provide a systematic plan and an objective approach in identifying, assessing and controlling ergonomics risk factors associated with the work tasks and activities in the workplace. These guidelines will be of interest to employers , employees and safety and health practitioners to assess the level of ergonomics risk at their workplace in order to implement more effective control measures based on identified risks. Ergonomic risk assessment (ERA) includes the process of identifying, assessing and controlling ergonomic risk factors found in the workplace. It should be performed by Ergonomics Trained Person (ETPs), who are trained with the procedures laid in the ERA Guidelines. The ERA method consists of two (2) levels:

i) Level 1 – Initial ERA

- Initial ERA is a method of assessment that is based on observation of tasks performed by workers to document ergonomic risk factors and duration exposure on tasks using a prescribed checklist.

ii) Level – Advanced ERA

- Advanced ERA is a method of assessment that use ergonomics assessment tools (such as RULA, REBA, MAC, ROSA & etc.) to further assess and analyze the task to evaluate the ergonomics risk level.

Process for Conducting Ergonomics Risk Assessment

The process for conducting Initial ERA consists of musculoskeletal assessment and ergonomics risk factors assessment. The musculoskeletal assessment should be conducted for all types of risk factor in order to identify and validate the affected body parts. For the musculoskeletal assessment, the trained person may use any available forms such Cornell Musculoskeletal Questionnaire. For the ergonomics risk factor assessment, it depends on the types of ergonomics risk factors identified. The exposure duration of each work posture may differ depending on the professional judgement of the trained person. The framework of ERA implementation is shown in Figure 15.3 below.

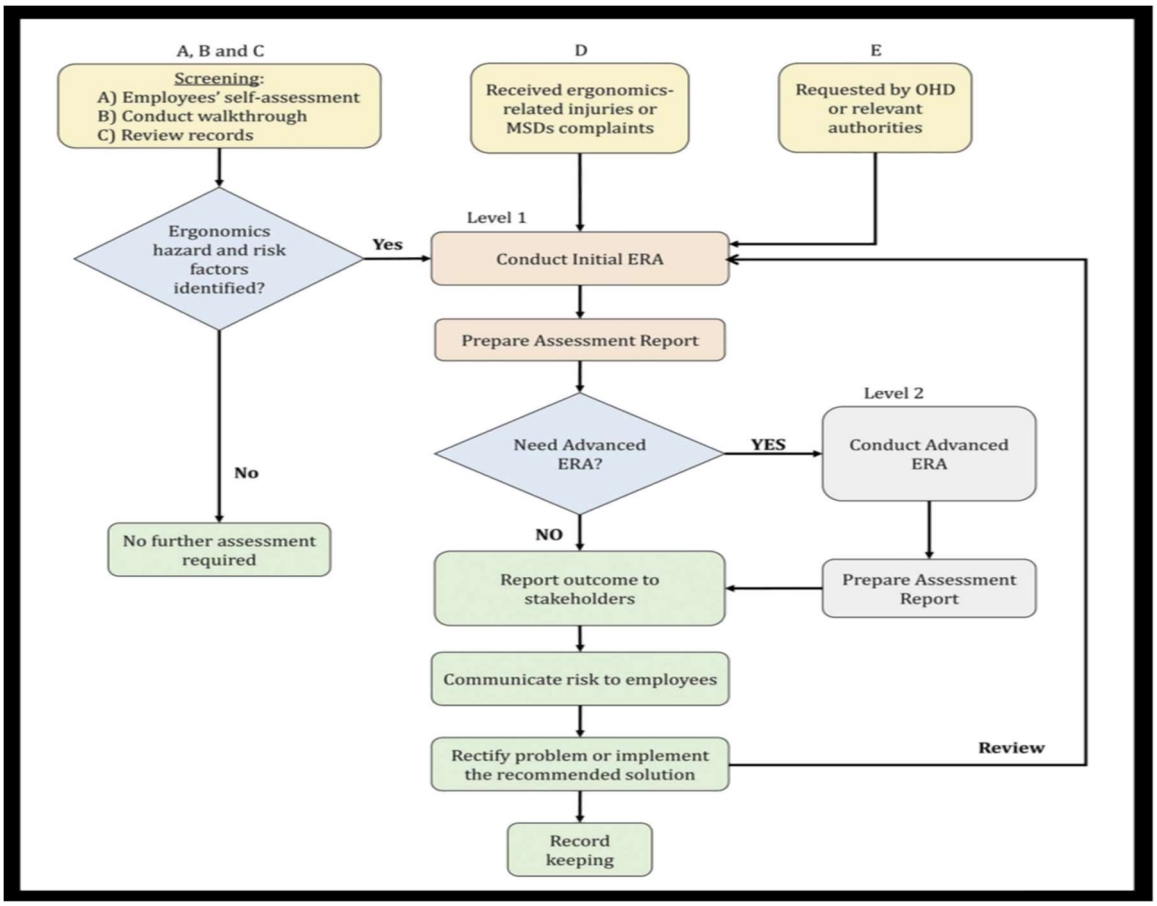


Figure 15.3. **Framework for ERA**

The results from an Initial ERA should enable a trained person to focus on the specific workplace that has been identified as having significant ergonomics risk factors. Next, an Advanced ERA is conducted based on an assessment method that is appropriate for ergonomics risk factors in order to evaluate the ergonomics risk level. A summary of Initial ERA is shown in Figure 15.4 below.

A	B	C	D	E	F
Risk factors	**Total Score**	**Minimum requirement for advanced assessment**	**Result of Initial ERA**	**Any Pain or Discomfort due to risk factors as found in Musculoskeletal Assessment (refer Part 3.1) (Yes/No)**	**Need Advanced ERA? (Yes/No)**
Awkward Postures	13	≥ 6		YES / NO	
Static and Sustained Work Posture	3	≥ 1		*If YES, please tick (√) which part of the body*	
Forceful Exertion	1	1			
Repetitive Motion	5	≥ 1			
Vibration	4	≥ 1			
Lighting	1	1			
Temperature	1	1			
Ventilation	1	1			
Noise	2	≥ 1			

Neck	
Shoulder	
Upper back	
Upper arm	
Lower back	
Forearm	
Wrist	
Hip/buttocks	
Thigh	
Knee	
Lower leg	
Feet	

Figure 15.4. **Summary of Initial ERA**

Implementation of Ergonomics Risk Assessment at Workplace

Enforcement activities are one of the main activities carried out by DOSH. The purpose of this activity is to ensure the safety, health and welfare of people who are working and others from the hazard posed by work activities. Enforcement activities are also a mechanism to ensure that all policies, legislation and programs carried out by the Department are complied with, for the formation of a prevention culture among the industries. This is important to enhance compliance with aspects of occupational safety and health and to reduce occupational diseases in the workplace.

In 2018, a total of 2,764 workplaces were subjected to industrial hygiene enforcement activities. This includes enforcement on noise exposure, confined space and ergonomics to assess the level of compliance with legal requirements. Ergonomic enforcement focuses on the manufacturing sector which contributes to the most number of

OMSD. In 2018, DOSH has conducted ergonomic risk assessment enforcement based on developed guidelines. In total, out of 450 workplaces inspected in year 2018-2020, 319 (70%) have achieved satisfactory grades (Grades A, B and C) as shown in Figure 15.5. At this stage, the workplace is found to have at least carried out the initial ergonomics risk assessment at workplace. This indicates an increase in awareness among the employers and employees on the important of ergonomics management as well as ergonomics risk assessment at the workplace. While 30% of workplaces show an unsatisfactory level of compliance where ergonomics risk assessment have not yet been implemented. Notice of Improvement were issued to the workplace, especially the workplace that received the level of compliance with Grades D and E. The notices are usually issued for a serious breach of the law, whereby the employers do not take adequate measures control ergonomics risks.

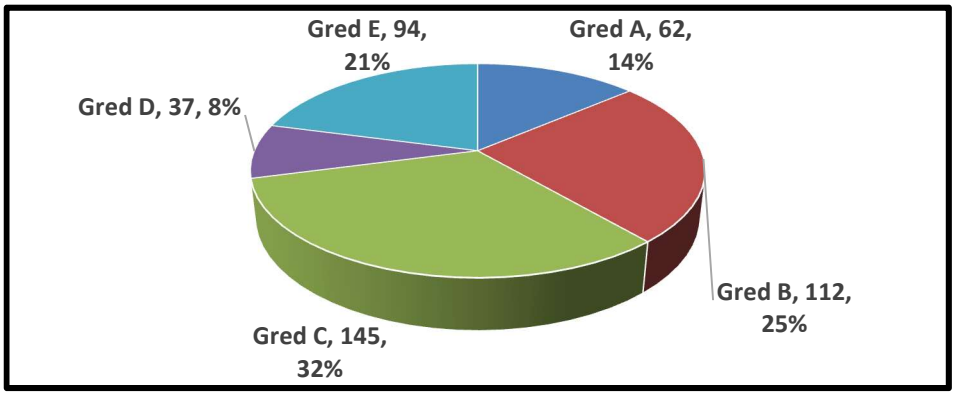


***Figure 15.5*. Level of compliance based on ergonomic risk assessment enforcement**

Managing Ergonomics Risk Assessment at Front End Stage, Intermediary Stage and Rear End Stage

Managing ergonomic risk can be done at any timeline when the workplace is intended to be such at design stage, or after the workplace setup is in place and operational. Most industry is more reactive toward ergonomics and would implement ergonomics when the workplace is at the operational stage. It is a good industrial practice to manage ergonomics risk at earlier stage as possible (during design and planning of the workplace) due to high cost impact to retrofit the workplace that may require major investment in term of re-design and analysis. In order to be confident that work activities have been designed and planned to minimize the risk of injury, it is essential that ergonomics risk factors are identified through risk assessment process [5]. There are three approaches that any industry can take to manage

the ergonomics risk in the workplace namely Front end stage, Intermediary stage and Rear end stage as shown in Figure 15.6 below.

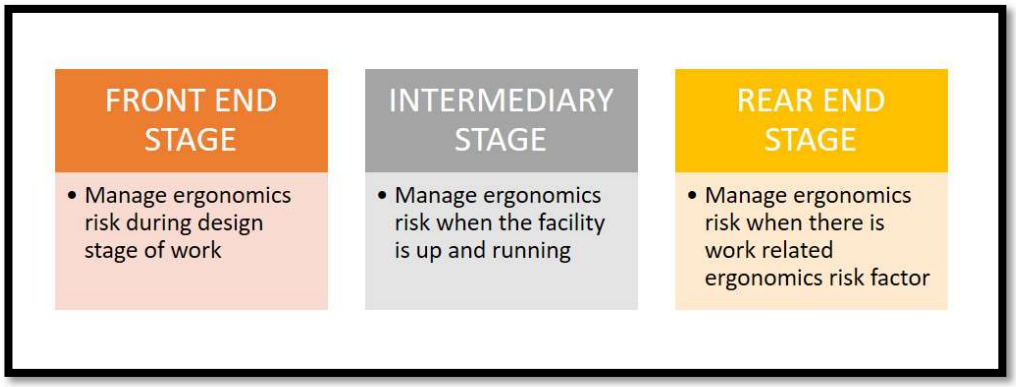


Figure 15.6. **Managing Ergonomics Risk Stages**

Managing Ergonomics Risk Assessment at Front End Stage

Front end stage is a method to predict and minimize ergonomics risk during design stage mainly through work simulations and task analysis from 3D model of the workplace, prior to actual construction and operation of the workplace. In essence, the goals of front-end approach are:

i. to identify potential ergonomics risk factor exposure that may co-existed due to design; and
ii. to eliminate or reduce those potential exposures through the design process.

Many existing 3D modelling software can be use to assist the front-end approach. The proposed workplace design shall be reviewed according to ergonomics best practices and compliances to relevant guidelines and procedures. During this stage, employers roles such as design engineers or leaders is important in the implementation of front-end ergonomics approach to manage risks.

Managing Ergonomics Risk Assessment at Intermediary Stage

The process of managing ergonomics risks at the Intermediary Stage occurs after the workplace has been designed, in place and is in operational mode. The goals of the intermediary approach are:

i. to gauge the level of ergonomics risk in the current workplace operation; and
ii. to control the identified risks through ergonomics interventions and improvements.

One of the most common activities to embark in an ergonomics program at the intermediary stage is conducting an ergonomics risk assessment (ERA). The main objectives of the program are:

i. to identify most ergonomics risk factors that may cause harm to employees;
ii. to determine the likelihood of harm arising from exposure to the ergonomics risk factors; and
iii. to recommend appropriate control measures towards risk reduction.

At the end of this process, the management will have list of tasks that can fall into risk level that are either low, medium, high or critical. Prioritization and planning program to minimize the risks can then take place, based on the assessed risk level. During this stage, responsibilities and roles of employers, employees and Ergonomics Trained Person are important for the overall management of the assessment.

Managing Ergonomics Risk Assessment at Rear End Stage

Rear End Stage method is when it is established that worker is injured at severe chronic level due to work-related ergonomics risk and affecting the abilities to perform work as expected. This is the most difficult aspect of managing ergonomics risk because there are two parts that must be controlled simultaneously to reduce the risk level. Those are reducing the exposure to ergonomics risk factors or eliminating the ergonomics risk factors all together and managing injured person to path of recovery and return to work. Therefore, employees that have been identified as suffering from severe chronic strain injuries due to work must be monitored during recovery period. Thus, improvement of workplace to reduce exposure to risk factors is required. During this stage, important person to be involved are employers, employees, Management Team, Occupational Safety and Health (OSH) Practitioner, Physiotherapist as well as Ergonomist.

Managing Ergonomics Risk Assessment Towards Ergonomics Enforcement Strategic Plan 2020-2021

Current technological advancements have indirectly impelled DOSH to take necessary measures to promote a healthy work environment through effective ergonomics enforcement. Thus, Ergonomics Enforcement Strategic Plan 2020-2021 [6] was formulated to further boost the level of occupational health, especially ergonomic management in the workplace to a higher and excellent level. Excellent level of occupational health will improve the workers' quality of life, contribute to increased productivity and in turn transform the workplace into a safe and healthy environment. The Ergonomics Enforcement Strategic Plan 2020-2021 focuses on workplaces that have ergonomics risks factors. This plan was developed to increase awareness and compliance with ergonomic aspects to reduce cases of occupational diseases and poisoning due to ergonomic risks.

In an effort to support OSHMP 2020, this Ergonomics Enforcement Strategic Plan 2020-2021 lays down the vision of Preventive Culture in the Workplace and its mission is to Empower Ergonomic Management in the Workplace. It outlines five key strategies based on efforts to increase stakeholders' awareness, responsibility and commitment to ergonomic management. The five strategies in the Ergonomics Enforcement Strategic Plan 2020-2021 will then be supported by various programs and activities focused on the formation of a prevention culture among employers and employees in an effort to strengthen ergonomic management in the workplace. To ensure its success, in addition to the commitment of employers and employees, this strategic plan also outlines the duties and responsibilities that need to be performed by all stakeholders such as Government, associations, OSH Practitioners and other parties who have a relationship with employers. These five strategies are Government Leadership, Collaboration with Agencies, Ergonomics Management Compliance Support Program, Empowering Ergonomics Knowledge and Awareness and Effective Ergonomics Enforcement. The Model of the Ergonomics Enforcement Strategic Plan 2020-2021 is shown in Figure 15.7.

Figure 15.7. **Model of Ergonomics Enforcement Strategic Plan 2020-2021**

Strategy 1 emphasizes on the Government Agencies that can serve as role models for industries through the practice of ergonomics management by public servants. The strengthening of ergonomics management in these agencies will not only ensure the health aspects of public servants but also serve to persuade the industries to jointly support the plan. Strategy 2 explains the involvement of other parties such as agencies and NGOs who play the important part of assisting the management in implementing ergonomics management at the workplace through various methods including promotions, information and education.

As in Strategy 3, the Ergonomics Management Compliance Support Program is important to assist Small and Medium Enterprise (SMEs) to manage ergonomics issues and subsequently increase the compliance and awareness among SMEs. While in Strategy 4, it emphasizes on the important of ergonomics knowledge and awareness where the employers and employees must be equipped with related knowledge and skills which wil1 enable them to identify, assess and take appropriate measures to manage the ergonomics risks. Under the Strategy 5, the effective ergonomics enforcement is an important program as it can serve as the mechanism to ensure that the industries comply with the ergonomics legislation and programs.

Conclusion

Effective management of ergonomics risk assessment in occupational setting is a multidisciplinary effort. It requires collaborative approach from all stakeholders, which are the Government, associations, OSH Practitioners and relevant parties with influence over employers and employees. Currently, DOSH is committed to improve occupational health aspects in the industry as well as ergonomics aspects by focusing on industry with increase OMSDs cases. The involvement and cooperation of all parties are the crux of success in ergonomics management to reduce occupational disease related to ergonomics, enhanced workers' quality or working life whilst increase organizational productivity and competitiveness.

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16

IMPLEMENTATION OF INDOOR AIR QUALITY FOR OFFICE IN MALAYSIA.

Mohd Norhisyam Omar; Hazlina Yon; Mohd Hairul Mat Husin; Mohd Radzi Rozihad

INTRODUCTION

Indoor Air Quality (IAQ) is one of the areas in Occupational Health that has often been overlooked and will only catch attention when there is a case or an issue. Human will spend almost 90% of their time indoor (S.C. Lee et al. 2000) and a study show 80% of human life is spent in buildings either at work or at home (Yang. C.H et al. 2007). Many studies have found that indoor air contaminant is worse than outdoor (Montgomery et al. 1989). The main cause of indoor air contaminant is a combination of a few factors such as physical, chemical and biological, and the adequacy of ventilation in the environment. Indoor air pollutant sources are from the outdoors, heating ventilation air conditioning (HVAC) system and building equipment, furnishings, and human activities (S.C. Lee et al. 2000) while major outdoor air pollution comes from traffic, industrial, construction, and combustion sources (Wark and Warner, 1981). A study conducted by the U.S. Environmental Protection Agency in the United States shows that indoor air contaminant ranks in the top five for environmental health risks, while the World Health Organization reports that indoor air pollution contributes 2.7% to the total burden of disease globally (A. Norhidayah et al. 2013).

IAQ is influenced by physical and chemical characteristics which will be usually determined through a number of predefined parameters. Biological characteristic will also be assessed in getting a full picture of IAQ. World Health Organization (WHO) defined IAQ as "The physical and chemical nature of indoor air, as delivered to the breathing zone of building occupants, which produces a complete state of mental, physical and social well-being of the occupants, and not merely the absence of disease or infirmity" (HK IAQ Management Group, 2019).

Malaysia has hot and humid climate and the air conditioning plays an important part in the office building system. Previously, mechanical ventilation air conditioning (MVAC) systems were installed in offices or multi-storey buildings where offices were located, but

now, almost all places, especially those involving public such as post offices, schools and police stations, have also been equipped with MVACs. As buildings have become better sealed to increase economic matters and the efficiency, it has also increased contaminants being released from indoor sources. Indoor air problems can occur because of poor building design or improper maintenance programme of the building. The common causes of IAQ problems in buildings are:

i. Poor maintenance of ventilation or MVAC system;
ii. Not enough/ no air fresh intake;
iii. Dampness and moisture;
iv. Insufficient air circulation;
v. MVAC system not working as per design;
vi. Existing outdoor contaminated air;
vii. Error in construction or remodelling; or
viii. Activities in the building deviated from dedicated/ specific purpose.

Poor indoor air quality can result in significant adverse impacts on health and environment. Moreover, these impacts will carry a significant cost burden to the economy and also legal implications as happened in United States America (ASHRAE, 2009).

Legislation and Application

In Malaysia, matters pertinent to occupational safety and health (OSH) is under the jurisdiction of Department of Occupational Safety and Health (DOSH), one of the agencies under the Ministry of Human Resources. Legislation of IAQ was enforced since early 2005 when DOSH launched a Code of Practice on Indoor Air Quality (2005), which primarily aimed to ensure that employers work voluntarily in assessing risks of IAQ in the workplace. In August 2010, DOSH introduced an extensive legislation known as Industry Code of Practice on Indoor Air Quality 2010 (ICOP), which was gazetted under the Occupational Safety and Health Act 1994 and approved by the Minister on August 30, 2010, replacing the 2005's version. Therefore, legal action can be taken if any offences related to indoor air occurs within the scope of the ICOP take place.

The ICOP states that all buildings, or any part of a building or a totally enclosed area, that are served by mechanical ventilating and air conditioning (MVAC) systems, including split units, must apply this ICOP if there are people working inside the building. However, this ICOP does not apply to:

i. domestic buildings;
ii. any area or any part of a building which is constructed, used or intended to be used for domestic or industrial purposes;
iii. any area or part of a building where any chemicals hazardous to health are used for analytical, research or preservation purposes; or
iv. removal and disposal of asbestos containing materials.

There are also instances where only one building or office may need to partially comply with ICOP. For example, in a building that may have a laboratory on the first floor and a regular office on the second floor, only the office on the second floor is covered in the scope of ICOP. There is also confusion in the determination of application of IAQ within industry. As ICOP does not apply to workplaces that had been in use or intended to be used for industrial purposes, people must have overlooked that there are offices in industrial buildings that usually place their administration section or human resource personnel. It is more crucial as most of these offices are more prone to potential sources such as dust, mist and fumes.

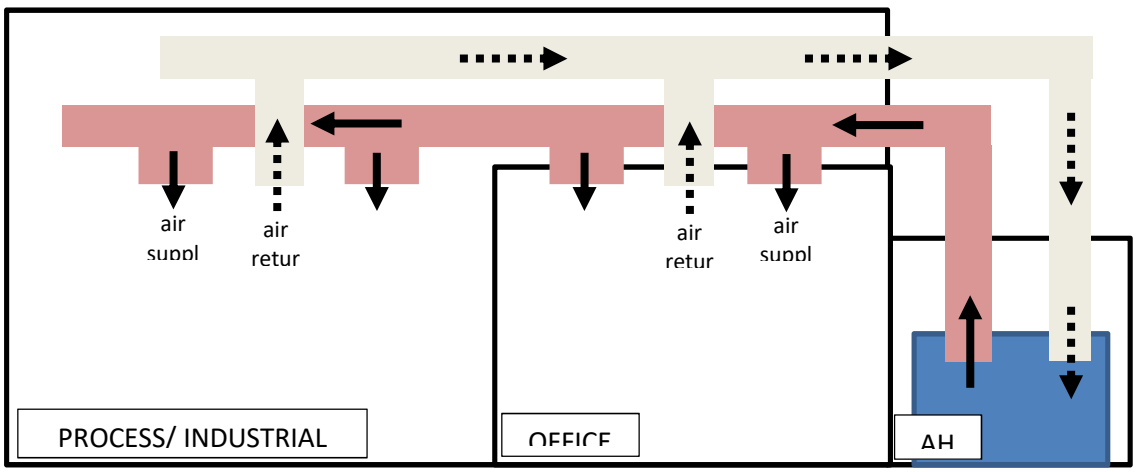

Figure 16.1. **Possible Mistake for MVAC Air Distribution for Industrial Office**

For the worst case scenario, there are probabilities that offices that may been located in factories or industrial buildings would not realize that their air-conditioning or MVAC system for office is shared with the same air handling unit (AHU) for process / industrial area. Perhaps, it happens to factories or buildings that have undergone multiple renovations, improper expansion plans, changed of partition / workstation or deviation from the original purposes. Using contractors who are not competent or registered with the authorities would most likely contribute to this situation. From Figure 16.1, air from the process area or industry and office returns to the AHU where it will be mixed together, filtered and distributed back through the respective diffuser.

Office and process / industrial area needs to use different AHU or other options to make sure both areas will have a total separation. Common design for factory or industrial building is the size of process/ industrial area is usually bigger than the office, and it would not be worthy to have the second AHU which the use of split system unit or fan coil unit system is more justified in terms of economic and system maintenance.

ICOP does not apply to factories, industrial buildings, laboratories and researches that use chemical hazardous that is dangerous to health or any asbestos or asbestos containing material abatement activities because all of these activities will have very specific standards or procedures with specific control approaches, covered by other legislations such as Occupational Safety and Health (Use and Standard of Exposure Chemical Hazardous to Health) Regulations 2000 (USECHH Regulations). Each legislation was drawn up to set an acceptable limit for a predefined parameter. Non-IAQ scope will have higher value than ICOP.

In the ICOP, eleven (11) parameters are listed in the ICOP IAQ 2010 as potential indoor air contaminants. These parameters are divided into two main categories: physical parameters and indoor air contaminants. The parameters for indoor air contaminants are categorized into three (3) different groups: chemical contaminants, biological contaminants and ventilation performance indicators. All these parameters are shown in Table 16.1 below.

Table 16.1 Indoor Air Parameters in ICOP IAQ 2010 (DOSH 2010)

Physical Parameters	**Acceptable Range**		
(a) Air temperature	23 – 26°C		
(b) Relative humidity	40-70%		
(c) Air movement	0.15 – 0.50 m/s		
Indoor Air Contaminants	**Acceptable Limit**		
	ppm	**mg/m^3**	**cfu/m^3**
Chemical Contaminants			
(a) Carbon monoxide	10	-	-
(b) Formaldehyde	0.1	-	-
(c) Ozone	0.05	-	-
(d) Respirable particulates	-	0.15	-
(e) Total volatile organic compounds (TVOC)	3	-	-
Biological Contaminants			
(a) Total bacterial count	-	-	500
(b) Total fungal count	-	-	1000
Ventilation Performance Indicator			
(a) Carbon dioxide	C1000	-	-

The ICOP is a reference standard for IAQ in workplaces based on scope stated before and at the same time acts as a legal instrument to DOSH, an authority for OSH in Malaysia. Most of the contents in ICOP are guides for building owners or management on how to maintain good IAQ control in their buildings, steps to carry out an investigation and monitoring. However, there are also some provisions that have been spelled out in ICOP as compulsory requirements.

DOSH IAQ Survey for Office in 2019

DOSH through Industrial Hygiene Section put IAQ as one of the main activities to obtain status of compliance for compulsory requirement under the ICOP that need to be performed by owner or management of office buildings. The expected output is as follows:

i. The number of offices that have complied by monitoring their place with acceptable range for physical parameters;
ii. The number of offices that have regularly conduct a maintenance program;
iii. The number of offices that have established complaints procedures; and
iv. The number of offices that have established complaint procedures and met the requirements of ICOP.

In addition to the output above, this survey will also look at the number of offices that have carried out an IAQ assessment, which is not a compulsory requirement under ICOP, but play an important role to evaluate the conditions of IAQ in the office.

For survey (a) as above, equipment has been used to obtain readings for each physical parameter as listed in Table 16.1 for comparison with acceptable range in the Schedule. The equipment used are:

i. Anemometer TSI VelociCalc Model 9555; and
ii. Air Quality Monitor QUEST AQ 5000 or GrayWolf IAQ Monitor.

Each DOSH state offices are well-equipped with one of the above and they are well-maintained and calibrated. The selection of workplaces involved in this study is based on criteria as follows:

i. To use air-conditioning system either centralized or split-unit system;
ii. Has maintenance team or personnel for matters pertinent to air-conditioning system;
iii. Numbers of workers is 5 or above; and
iv. Office as a workplace in the scope of ICOP

From the criteria's above, office that uses general ventilation or small-office-home-office (SOHO) is not included in this study. 15 DOSH states offices have been involved in this

study to conduct auditing and surveying in the selected offices all over Malaysia. The number of offices visited are as follows:

Table 16.2 Number of Offices Participated

States	Number of Offices
Perlis	20
Kedah	11
Pulau Pinang	19
Perak	20
Selangor	18
Kuala Lumpur	21
N.Sembilan	18
Melaka	20
Johor	20
Terengganu	23
Pahang	18
Kelantan	11
Sabah	20
Sarawak	19
Labuan	20
Total	**278**

The total numbers from all over Malaysia is 278 with the highest participations from Terengganu and the lowest from Kelantan and Kedah. Results as per predefined output :

Table 16.3 Status of Compliance for Compulsory Requirement Under the ICOP

No	Output	Results	
		Yes	No
1	The number of offices that have complied with an acceptable range for physical parameters	123	155
2	The number of offices that have established a complaints procedure	46	232
3	The number of offices that have established a complaints procedure and met the requirements of ICOP*	16	30
4	The numbers of offices that have regularly conduct a maintenance programme	156	122
5	The number of offices that have carried out IAQ assessment (not a compulsory requirement under ICOP)	30	-

*Note: Results from the 46 offices that have established a complaints procedure

ICOP set three (3) physical parameters that need to be maintained regularly by owners or management of office buildings, which are temperatures, relative humidity and air movements. From the survey, 123 offices performed their responsibilities and 155 offices did not or partially performed. This has proven that 44.24% from 278 offices complied with the requirements which made up the total number of compliance to below half of the sampling numbers. Most of the reasons given by owner or management included they were not aware of the requirement, insufficient facilities or monitoring equipment and lack of man power to conduct the measurement.

In ICOP, the owners or management need to establish complaint procedures for occupier if there is any problem or matter arises. ICOP sets a few criteria as the minimum requirements for compliance. From 278, 46 of the offices have established procedures while the remaining 232 offices either have partially developed them or nothing at all. The findings show that the rate of compliance is very poor because only 16.55% of the sampling rate complied with this requirement. The reasons of not complying are due to the lack awareness on the requirement or they have performed a different communication method. From 46 offices that have established the procedures, 16 offices or 5.76% met the criteria's as stipulated in ICOP.

Inspection and maintenance are among the important requirements as stipulated in ICOP. Scheduled maintenance of system shall be in accordance with the manufacturer's recommendations to ensure that the equipment operates efficiently. If it is not specific to any equipment, the ICOP would provide a brief guidance to them to comply with. A few examples of the guidance are:

i. The building and its MVAC system shall be inspected at least every six months with regards to the functions which are significant for the IAQ;
ii. The components of air-handling units shall be cleaned at least every six months;
iii. Trays shall be cleaned at least every one month; and
iv. Its is recommended to use non-chemical water treatment for the cooling tower. (DOSH 2010)

From 278 offices, 156 offices or 56.12% met the minimum requirements as stipulated in ICOP. The remaining 122 offices have either partially implemented or run the maintenance program not according to the requirements by ICOP. Based on this number, the compliance of this requirement still in the medium level as it is just above half of the sampling.

Procedure of investigation for IAQ problems on how to determine the condition of IAQ in the office as spelled in the ICOP, owner or management buildings can hire IAQ assessor to conduct assessment if they can't solve the problems. Assessor will conduct an assessment according to the guidance from ICOP which covers aspects that consists a measurement or monitoring airborne for parameters listed in Table 16.1, workers' health survey for sickness symptoms and observation of physical condition of the workplaces. 278, 30 offices conducted assessments as part of their programme or to solve an IAQ problems. These small numbers do not represent non-compliance because this requirement is an additional step in solving the problem or obtaining an overview of air quality conditions based on the parameters set out in the ICOP IAQ.

Overall, it can be seen that compliance with the minimum requirements outlined in the ICOP is weak and requires improvement or intervention action from the owners or management of the building responsible to the office. Among factors that contribute to poor performance are:

i. lack of awareness about ICOP;
ii. did not established complaints and investigation procedures;
iii. poor maintenance of program and execution;
iv. did not follow recommendation from ICOP for control of IAQ; and
v. did not comply with manufacturer's recommendations or the minimum requirement set up by ICOP for MVAC system.

Conclusion

Offices and workplaces as specified in the scope of the ICOP application are subjected to the provisions set forth in the ICOP. The results of the survey on 2019 showed an unsatisfactory results of compliance for compulsory elements as stipulated in the ICOP. In ensuring that the achievement of compliance is enhanced, among the improvement measures that may be able to increase the level of compliance are:

i. To increase awareness among owners or management of buildings through new platforms as traditional ways like seminars, workshop or training have not given huge impacts as expected;

ii. To upgrade ICOP into Regulations under the Occupational Safety and Health Act. However, these measures need to be refined as priority in other aspects of OSH need to be considered;

iii. To change the mode of enforcement; and

iv. Take punitive action on workplaces that fail to comply with ICOP's compulsory requirements to be set as an example or precedents case to others.

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17

MANAGING OCCUPATIONAL NOISE EXPOSURE AT WORKPLACE.

Elaini Wahab

INTRODUCTION

Statistics released by the Department of Occupational Safety and Health (DOSH) showed a significant increase in the number of occupational diseases cases such as occupational lung diseases, occupational muscular skeletal disorder and occupational noise related hearing disorder from 2005 to February 2019. In 2018, a total of 7258 cases of occupational diseases have been reported as compared with 6020 cases reported in 2017 (see Figure 17.1).

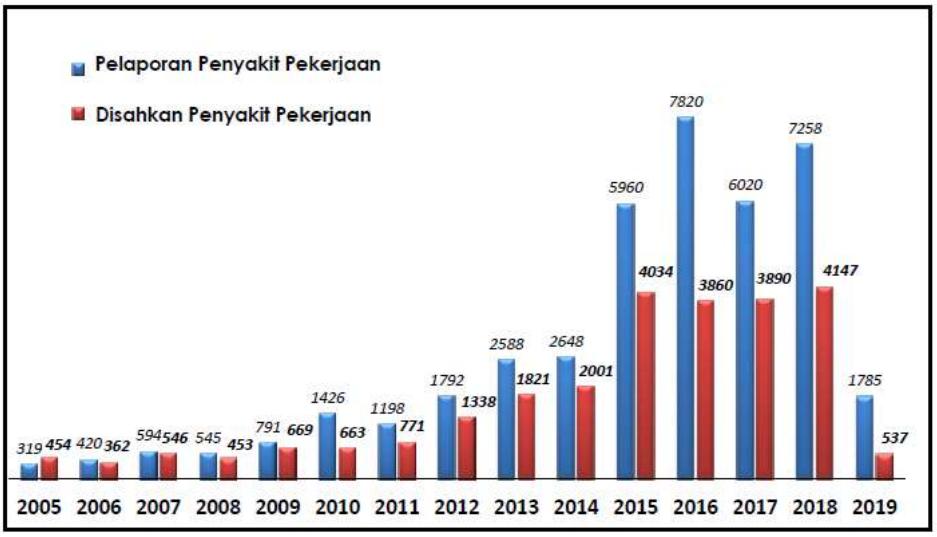

Figure 17.1. **Statistic of Occupational Health Diseases 2005 – Februari 2019 [4].**

Occupational noise related hearing disorders (ONRHD) are the most common occupational disease experienced by workers (88%) as compared to other diseases in 2017 and 2018. A total of 2478 cases were confirmed as occupational noise-induced hearing disorders (Noise-induced Hearing Loss, Hearing Impairment, and Permanent Standard Threshold Shift) in 2017 and the number increase to 4506 in September 2018 (see Figure 17.2) [4].

Further analysis of ONRHD cases investigated by DOSH in 2016 until 2019 revealed that the manufacturing sector recorded the most number of cases, a total of 15488 cases (91.1%) while the other sectors recorded 1529 cases (8.9%) (see Table 17.1).

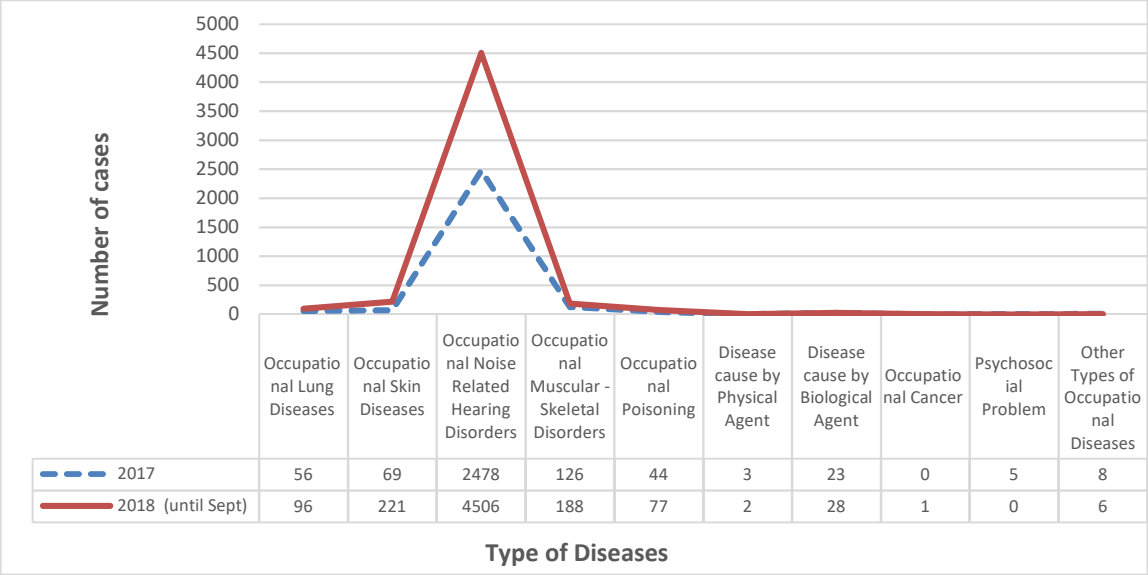

Figure 17.2. **Occupational Diseases Reported in 2017 and 2018 (until September)**

Even though the percentage of ONRHD in other industrial sectors were relatively low, the cases for each sector gives the indicator that noise problems do not only arise in manufacturing sectors.

Table 17.1 ONRHD cases investigated by DOSH 2016 – 2019

Sector	2016	2017	2018	2019
Manufacturing	5142	2299	3531	4516
Mining and Quarrying	78	70	52	143
Construction	1	3	1	11
Agriculture, Forestry and Fishing	19	51	57	60
Utilities : Electricity, Gas, Water & Sanitary Services	362	17	81	119
Transport, storage & communication	24	19	149	62
Wholesale and Retail Trades	0	0	2	14
Hotel & Restaurants	0	0	3	0
Finance, Insurance, Real Estate and Business Service	50	15	26	25
Public Services & Statutory Authorities	1	5	5	4

Factories and Machinery (Noise Exposure) Regulations 1989 has come into force on February 1, 1989. It is the legislation for noise exposure management and control for industries in Malaysia. However, the Regulations only applied to workplace defined as a factory in the context of the Regulations.

Neglecting the effort to manage occupational noise exposure and ONRHD cases will create substantial impact to the economic growth and productivity. Study conducted by Si, Si et al. conclude that occupational noise-induced hearing loss imposes a substantial burden on the Australian economy via productivity loss and the loss of general well-being. The total loss in Australian working population due to occupational noise-induced hearing loss (NIHL) was estimated to reach AUD 29.7 billion, with the majority of loss being attributed to productivity loss (72%). [13].

The impact worsened with the fact that ONRHD is not only experienced by elder workers who exposed to high noise in long working period. Most of the hearing loss occured during the first ten years of noise exposure [9]. Study conducted by Keatinge and Laner found that most of the hearing loss occurred during the first three years of employment [9]. Categorization of ONRHD cases investigated by DOSH in 2016 to 2019 according to age showed that the highest cases for the past four years (1535, 712, 1129, 1386 cases respectively) occurred in the group age of 30 to 39 years. In 2019, the group age of 20 to 29 years was second followed by the age group of 40 to 49 years (see Figure 17.3).

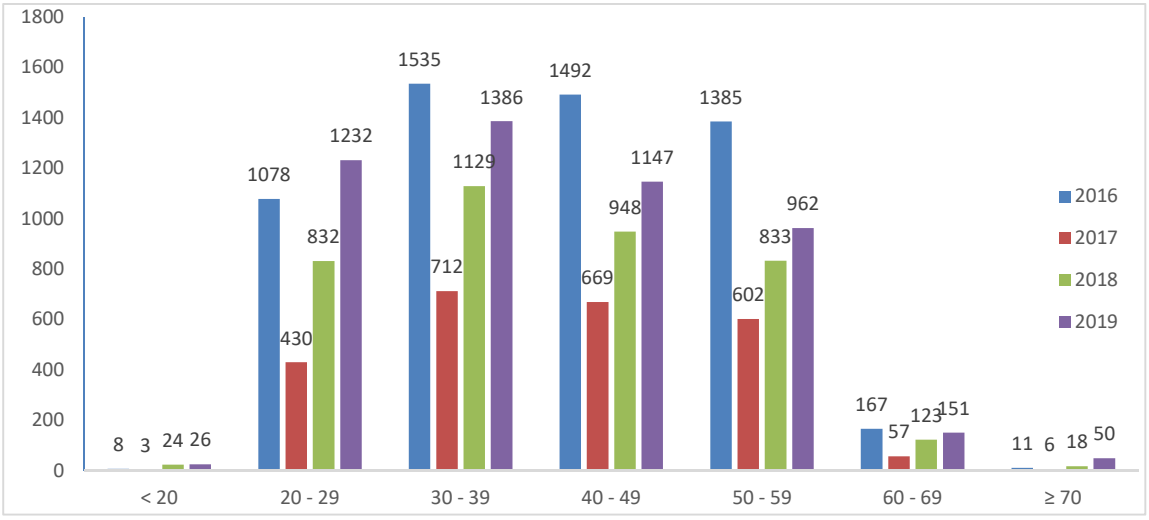

Figure 17.3. **Occupational Noise Related Hearing Disorders by Age in 2016 - 2019**

These alarming result should be a major concern by all relevant parties. 25 to 39 years old is the productive working age with participation rates of 86.1 for age 25 - 29, participation rates of 85.9 for age 30 - 34 and participation rates of 84.1 for age 30 - 34 (see Figure 17.4).

Kumpulan Umur *Age Group*	Jumlah *Total*		
	Jumlah *Total*	Lelaki *Male*	Perempuan *Female*
Jumlah *Total*	68.0	80.1	54.7
15-19	18.1	22.5	13.2
20-24	65.2	73.6	55.9
25-29	86.1	95.8	74.8
30-34	85.9	97.4	73.0
35-39	84.1	98.0	68.5
40-44	82.1	96.8	66.4
45-49	78.9	96.4	61.1
50-54	72.8	91.9	52.6
55-59	58.5	77.1	39.0
60-64	36.5	50.9	21.9

Figure 17.4. **Labor Force Participation Rates by Age Group, Stratum and Sex, 2017 [11]**

Studies conducted by Nelson et. al indicate that occupational noise is an important risk factor of hearing loss in workers at most ages, ranging from 7% to 21% (averaging 16%) of the adult-onset hearing loss around the world. The burden of hearing loss caused by exposure to occupational noise has multiple consequences at both the individual and societal levels. While multiple factors contribute to the occurrence of occupational NIHL, lack of prevention is the major contributor. [12]

Roles of Government

Due to the rising number of ONRHD cases in industries other than manufacturing sector, DOSH has enacted the Occupational Safety and Health (Noise Exposure) Regulations 2019 [P.U. (A) 60/2019] (*hereinafter referred as Noise Regulations 2019*) to widen the current regulation's enforcement to all sectors under Occupational Safety and Health Act 1994 [Act 514] [3]. Referring to the distribution of employment according to industry sector in Malaysia [10], this initiative was in line with the DOSH mission "To ensure Safety and Health at Work". The total employment in manufacturing industry made up only 17.4% from

the average of 14 million workers in 2014 to 2018. The highest was in services industry which comprises 61%, followed by manufacturing 17.4%; 11.4% in agriculture, forestry and fishing industry and 8.7% in construction industry (see Figure 17.5).

Industry[1]	2014	2015	2016	2017		2018[4]
					share (%)	
Total employment[2]	**13,852.6**	**14,067.7**	**14,163.7**	**14,450.0**	***100.0***	**14,628.9**
Agriculture, forestry and fishing	1,694.2	1,753.9	1,609.9	1,631.6	*11.3*	1,608.3
Mining and quarrying	84.7	104.4	96.3	97.0	*0.7*	95.2
Manufacturing	2,372.5	2,322.7	2,390.6	2,509.1	*17.4*	2,535.6
Construction	1,277.7	1,309.9	1,251.7	1,256.0	*8.7*	1,290.0
Services	8,422.1	8,575.1	8,814.3	8,956.3	*62.0*	9,099.9

Figure 17.5. **Employment by Industry in Malaysia, ('000 persons) [10]**

In line with Activity 2, Program 1, Strategy 4 of Occupational Safety and Health Master Plan 2020 (OSHMP 2020) to sustain the management of noise issues in the workplace, Industry Code of Practice for Management of Occupational Noise Exposure and Hearing Conservation 2019 (*hereinafter referred as ICOP 2019*) is promulgated under Section 37 of Act 514 as a guidance to comply with the provisions of Noise Regulations 2019.

Nelson et. al. concluded that complete hearing loss prevention programs that include noise assessments, noise controls, audiometric monitoring of workers' hearing, appropriate use of hearing protectors, worker education, record keeping, and program evaluation are needed to effectively reduce the global burden of occupational NIHL. The same concept is being emphasized in the ICOP 2019 with the collaboration and collective responsibilities of all relevant parties including employer and employee; designer, manufacturer and suppliers of machinery and equipment; and competent person and firm.

Role of Employers in the Management of Occupational Noise Exposure

In line with the philosophy of Act 514 that responsibility for safety and health in the workplace lies with those who create the risks (employers) and those who work with the risks (employees) [2], it is employer's duties under Section 15 (b) of Act 514 to make

arrangements for ensuring absents to risk of health in connection with the use, operation, handling, storage and transport of plant and substances. “Plant” is defined as any machinery, equipment, appliance, implement or tool, any component thereof and anything fitted, connected or appurtenant thereto.

Therefore, employer shall protect employees who are exposed to excessive noise from the adverse health effects of noise in the workplace. Occupational Safety and Health Administration, United State Department of Labor required employers to implement a hearing conservation program when noise exposure is at or above 85 decibels averaged over 8 working hours or an 8-hour time-weighted average (TWA). Similarly, in Malaysia every place of work shall implement a comprehensive hearing conservation program (HCP) to prevent ONRHD among its employees over their entire working lifetime [3]. There are five components in HCP as shown in Figure 17.6.

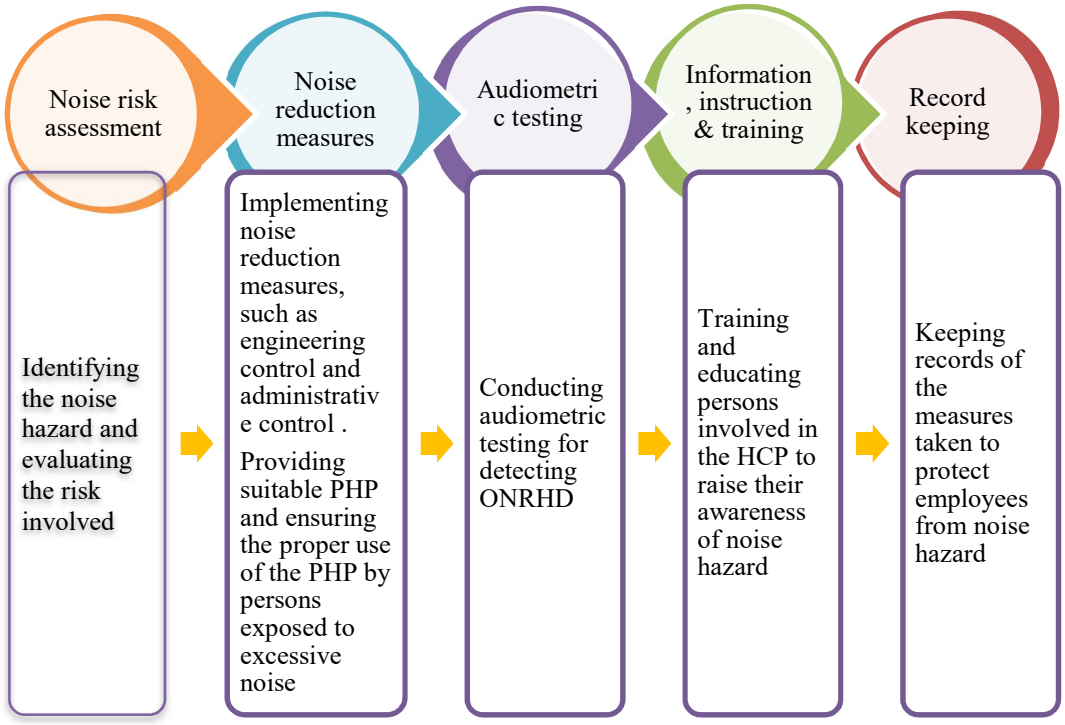

Figure 17.6. **Components of Hearing Conservation Program**

Employer shall ensure none of his employees is exposed to noise exposure limit (NEL) i.e. the daily noise exposure level exceeding 85dB(A) or daily personal noise dose exceeding 100%; maximum sound pressure level exceeding 115dB(A) at any time; or the

peak sound pressure level exceeding 140dB(C) [6]. To fulfil this duty, employer shall identify whether his employee maybe exposed to excessive noise in the work place. Regulation 3 of Noise Regulations 2019 and Paragraph 6 of ICOP 2019 give further elaboration on the requirement. Employer shall conduct identification of excessive noise for each area in the workplace by nature of activities / work process using checklist provided in Appendix 1 of the ICOP. If result of the identification shows the possibilities of exposure to excessive noise, the employer shall appoint a noise risk assessor within one month of the identification of excessive noise as required by Regulation 4 of Noise Regulations 2019. If the identification result shows no exposure to excessive noise, employer shall re-identify excessive noise not more than one year since the last identification of excessive noise.

Result of noise risk assessment (NRA) will help employer to determine further actions required to manage the noise exposure. Group of employees likely to be exposed to excessive noise above NEL can be identified, source of noise that may contribute to the development of ONRHD can be determined, effectiveness of existing measures can be evaluated and noise reduction measures at the appropriate noise source can be prioritized. Nelson et. al concluded that most occupational noise exposure can be minimized by the use of engineering controls to reduce the generation of noise at its source.

The intervention of secondary sources of noise production in work environments creates complicated audio fields. Some of these sources are airborne noise, structure-borne noise, noise refraction on the edge of machines, and noise reflection from the floor, wall, ceiling, and the surface of machines. Thus, noise generating sources should be identified and ranked prior to taking any controlling measures [7]. Although controlling and reducing the identified noise is crucial if NRA result show exposure to NEL, not all reduction measures can be implemented to all noise source due to financial setbacks in various industries. Therefore, it is essential to prioritize noise reduction measures and implement the most effective ones.

Besides, noise reduction measures to be implemented, employer shall conduct audiometric testing annually and provide information, instruction and training for all workers exposed to NEL; and demarcate hearing protection zone. Figure 17.7 illustrates the overview of employer's main responsibilities in managing noise exposure at the workplace based on Noise Regulation and ICOP 2019.

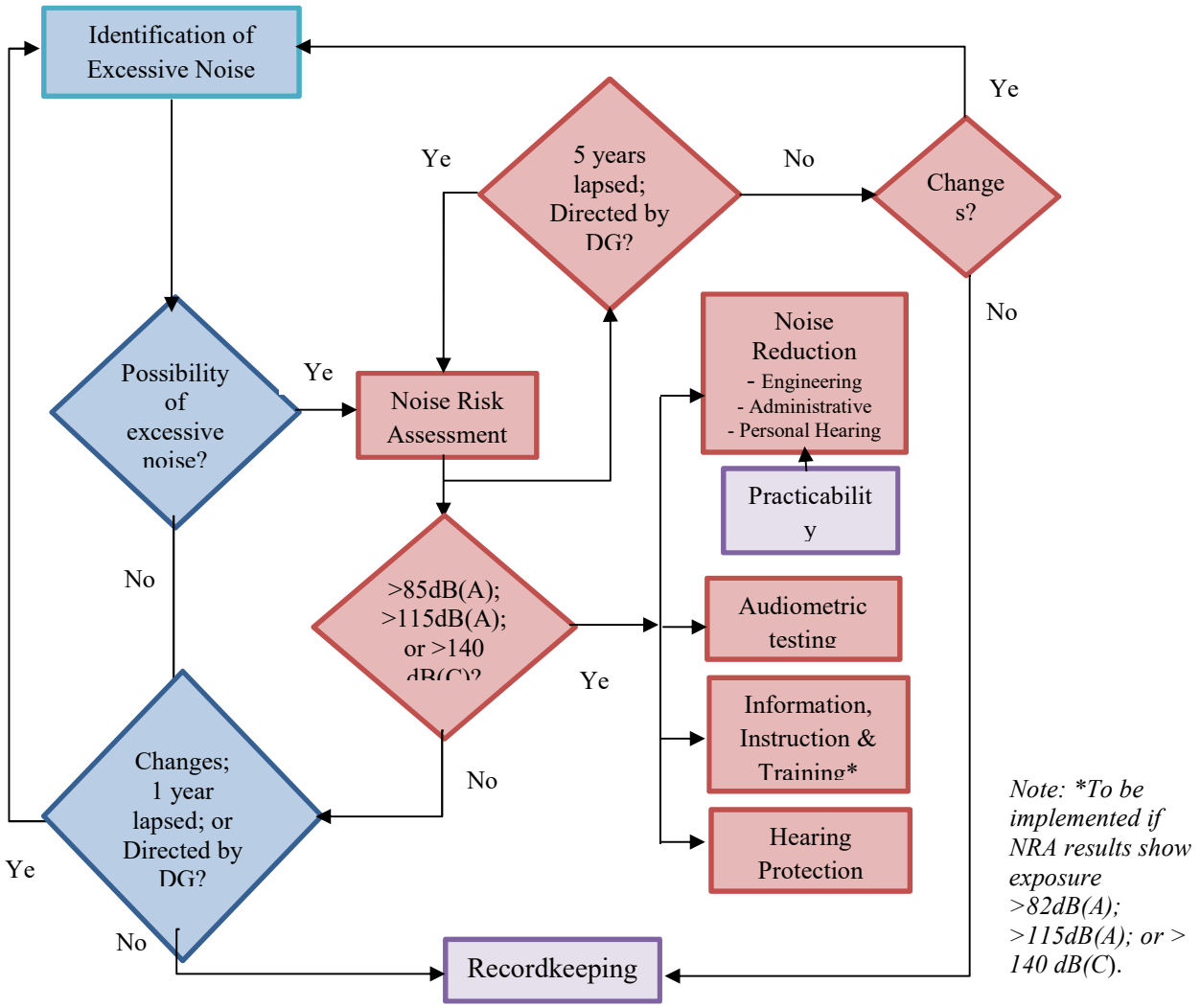

Figure 17.7. **Main responsibilities of employer based on Noise Regulation and ICOP 2019.**

Employees' Duties and Responsibilities

An effective HCP can eliminate or minimize noise hazard and prevent ONRHD. Full commitment by the management and active involvement by the workers are critical for the success of the HCP [3]. ICOP 2019 highlighted that employees shall comply with all statutory requirements and work procedures; and cooperate with employer in all activities related to protection of hearing and prevention of ONRHD. Table 17.2 tabulated the summary of general duties of employee under Section 24 of Act 514 [4] and example of their relevant duties under ICOP 2019.

Table 17.2 Employees' Responsibilities in Implementing Hearing Conservation Program at Workplace

Required Duties under Section 24 of OSHA	**Duties Based on ICOP 2010**
Take care for the safety and health of himself and other persons who may be affected by his acts or omission at work	• Attend training program conducted by employer • Understand: ▪ Occupational Safety and Health (Noise Exposure) Regulations 2019. ▪ their responsibilities. ▪ the risks of noise exposure and the adverse effects to health resulting from excessive noise exposure. ▪ purpose and procedures of audiometric testing, including pre-test and audiometric results. ▪ social disadvantages of ONRHD and the best practices to conserve hearing if have abnormal audiogram.
To co-operate with his employer or any other person in the discharge of any duty or requirement imposed on the employer or that other person by the Act and regulation;	• co-operate with the employer, Hearing Conservation Administrator, Noise Risk Assessor, Audiometric Testing Centre and Occupational Health Doctor. • avoid exposure to loud noise 14 hours before audiometric testing. • undergo medical examination promptly after receiving abnormal audiogram result.
To wear or use at all times any protective equipment provided by employer	• understand the purpose of PHP, the advantages, disadvantages and attenuation of various types of PHP. • wearing appropriate PHP when enter hearing protection zone. • inspect PHP regularly to detect, and report damage or deterioration.
To comply with any instruction or measures instituted by employer	• comply with any instruction or measure on risk of noise exposure. • implement the noise control plan and program at place of work • follow procedure for reporting defects in plant or the place of work that are likely to cause exposure to excessive noise and signs of hearing damage • follow arrangement by employer to protect the hearing from further deterioration if identified abnormal audiogram. • follow instructions on PHP selection, fitting, use and care.

Prevention through Design - Roles of Designers, Manufacturers, Importers and Supplier

Advanced planning and introducing a suitable purchasing or hire policy are essential to reducing the level of noise at work. Considering at an early stage how the new work process or new machinery would work without exposing the workers to excessive noise is the most cost-effective and long-term measure businesses can take to reduce overall noise levels [8]. With regard to the noise produced by a particular machine or process, experience strongly suggests that when control takes the form of understanding the noise-producing mechanism and changing it to produce a quieter process, as opposed to the use of a barrier for control of the transmission path, the unit cost per decibel reduction is of the order of one tenth of the latter cost [1]. Clearly, the best controls are those implemented in the original design.

National Institute of Occupational Safety and Health (NIOSH) US initiated "Buy Quiet" as part of the broader Hearing Loss Prevention Program and a specific application of a broader NIOSH initiative of Prevention through Design (PtD). The PtD initiative seeks to prevent or reduce occupational injuries, illnesses, and fatalities through the inclusion of prevention considerations in all designs that impact workers. "Buy Quiet" addresses this vision by eliminating noise hazards early in the lifecycle of equipment and machinery, thus reducing the risk of occupational hearing loss among workers who use these tools. "Buy Quiet" promoted by Health and Safety Executive (HSE), UK helps manufacturers, importers, suppliers and users of equipment to work together to reduce the risk of NIHL in the workplace. It supports users in their duty to avoid high noise equipment when suitable lower noise equipment is available and manufacturers in their duty to minimize noise by technical means.

General duties of designers, manufacturer, importer and supplier of plant in Malaysia is stated in Section 20 of Act 514. Designers, manufacturer, importer and supplier of plant shall ensure plant is designed and constructed without risk to health when properly used and carry or arrange such testing and examination for that purpose [5]. Paragraph 15.1 to 15.3 of ICOP 2019 describes specific duties of designers, manufacturer, important and supplier of plant to enhance their roles in reduction the adverse effect of noise generated by the plant which they supplied or installed at workplace.

Roles of Trained Person, Competent Person and Firms

In managing noise exposure at workplace, employer shall collaborate and cooperate with trained persons such as Hearing Conservation Administrator (HCA) and audiometric technician; competent persons such as noise risk assessor and occupational health doctor and competent firms such as audiometric test center. Employer shall appoint HCA to assist the employer for the purpose of administering and supervising hearing conservation program. Noise risk assessor shall be appointed by the employer to conduct noise risk assessment while audiometric test center shall be appointed to carry out audiometric testing. Audiometric testing at audiometric test center shall be conducted by a trained audiometric technician and audiogram interpretation and medical examination shall be carry out by OHD.

Prior pursuing their respective duties; registration and approval of noise risk assessor, OHD and audiometric test center is required under the Noise Regulation 2019 to ensure their credibility, competency and professionalism in assisting the implementation of HCP program by employer. To ensure effective implementation of noise management in workplace, ICOP 2019 determined the specific duties of these trained person, competent person and firms.

Conclusion

Managing occupational noise exposure at workplace is crucial in order to prevent further development of ONRHD in the country. Noise Regulation 2019 and ICOP 2019 provide details and comprehensive requirements and guidance of Hearing Conservation Program to manage the occupational exposure at workplace. Compliance to these both legislations by all relevant parties including employer; employee; designers, manufacturer, supplier, and importer of equipment; competent person and firms will significantly help to reduce the substantial impact and burden of noise exposure.

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18

MAINSTREAMING INDUSTRIAL HYGIENE : THE INFINITE GAME.

Norhazlina Mydin CPIH, CIH, MIHA

INTRODUCTION

I am thrilled with the book and the recent conversation we've had with author and leadership guru, Simon Sinek on The Infinite Game (Sinek, 2019). Based on this concept, I would like to frame the focus of this article as ***Mainstreaming Industrial Hygiene: The Infinite Game***. According to Sinek, the game in business fits the very definition of an infinite game. We may not know all the other players and the new ones can join the game at any time. All the players determine their own strategies and tactics and there is no set of fixed rules to which everyone has agreed, other than the law.

They can change how they play the game any time, for any reasons. Infinite Game have infinite time horizon. Because there is no finish line and no practical end to the game, there is no such things as "winning" an infinite game. In an infinite game, the primary objective is keep playing, to perpetuate the game.

In the perspective of Occupational Safety and Health (OSH), different companies, business entities, governmental bodies or even non-governmental organizations have their own ways to manage their OSH strategies and initiatives, within respective legal bindings. Nevertheless, we also acknowledge that due to multiple reasons, the levels of OSH implementations vary across the industries. It is my best hope that through this article, I am able to put forward and rally all OSH professionals to come together and play the "Infinite Game". IH Infinite Game played by a stronger, diverse team that collaborates based on trust, aligned vision and psychological safety will protect workers' safety and health.

Five distinguished mindsets that organizations playing Infinite Games must have includes the following:

1. Just Cause
2. Trusting Team
3. Worthy Rival
4. Capability of Existential Flexibility
5. Courage to Lead

Just Cause

"Just Cause" gives our work and life meaning. Just Cause is a specific vision of a future state that does not yet exist; a future state that is so appealing that people are willing to make sacrifice in order to help achieve that vision. Saving lives or preventing the occurrence of occupational diseases is a Just Cause.

According to the recent estimates released by the International Labour Organization (ILO), each year 2.78 million workers died from occupational accidents and work-related diseases (of which 2.4 million are disease-related) and an additional 374 million workers suffered from non-fatal occupational accidents. It is estimated that lost work days globally represented almost 4% of the world's GDP, and in some countries, this rises to 6% or more (ILO, 2019). ILO also quoted that the poorest, least protected, least informed and least trained as the most affected. Diseases caused by chemicals, physical agents, biological agents, musculo-skeletal disorders and mental and behavioral disorders have been showing the increasing trend, though, it is likely to be under reported.

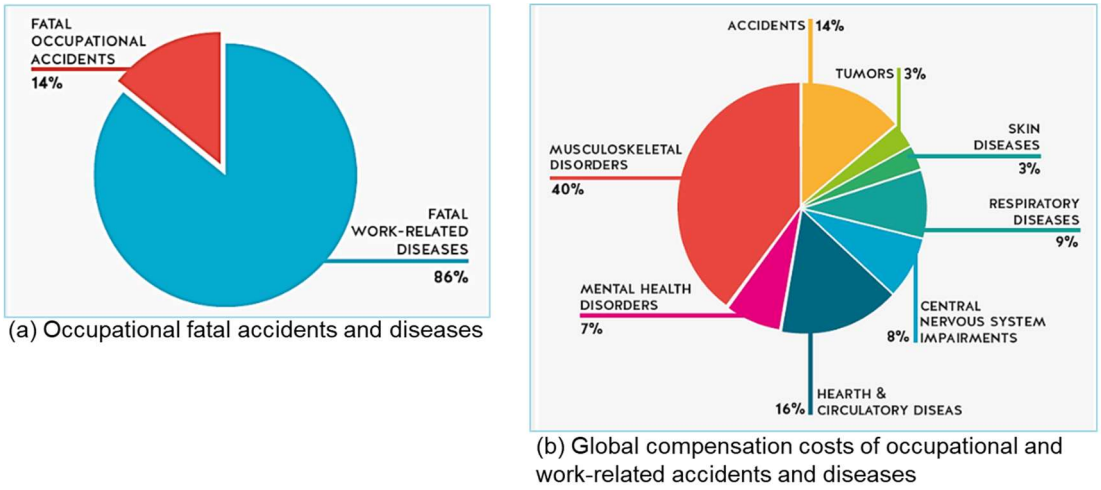

Figure 18.1. **ILO Report: Global Trends on Occupational Accidents & and Diseases, 2015**

Globally, 1,000 people are estimated to die every day from occupational accidents and a further 6,500 from work-related diseases. The aggregate figures indicate an overall increase in the number of deaths attributed to work: from 2.33 million deaths in 2014 to 2.78 million deaths in 2017 (ILO, 2019).

Figure 18.2. **Daily death due to occupational accidents and work related diseases**

Estimates suggest that circulatory system diseases (31%), work-related cancers (26%) and respiratory diseases (17%) contribute to almost three-quarters of the total work-related mortality. Diseases are the cause of the great majority of work-related deaths (2.4 million deaths or 86.3%), in comparison to fatal occupational accidents (which make up the remaining 13.7%). Together, these account for 5 to 7% of deaths globally (ILO, 2019).

Closer to home, in Malaysia, the Department of Occupational Safety and Health (DOSH), recorded 272% increase of occupational disease cases reported in 2019 (9860 cases) compared to 2014 (2648 cases). The top three (3) cases reported were predominantly occupational noise related hearing disorders (91%), followed with occupational musculoskeletal disorders (4%) and occupational skin diseases (1%). Figure 18.3 shows the increasing trend of total number of occupational disease and poisoning cases from 2005 till 2019 in Malaysia and the overall types of occupational disease and poisoning cases in 2019 is shown in Figure 18.4 ((DOSH), 2020).

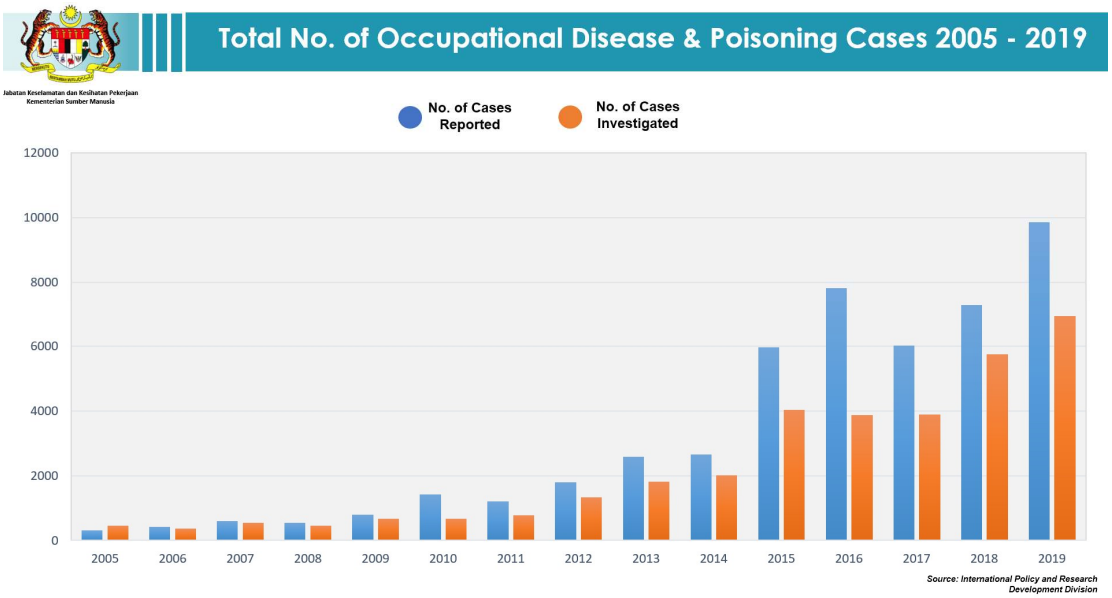

Figure 18.3. **Total number of Occupational Diseases and Poisoning Cases in Malaysia, 2005-2019**

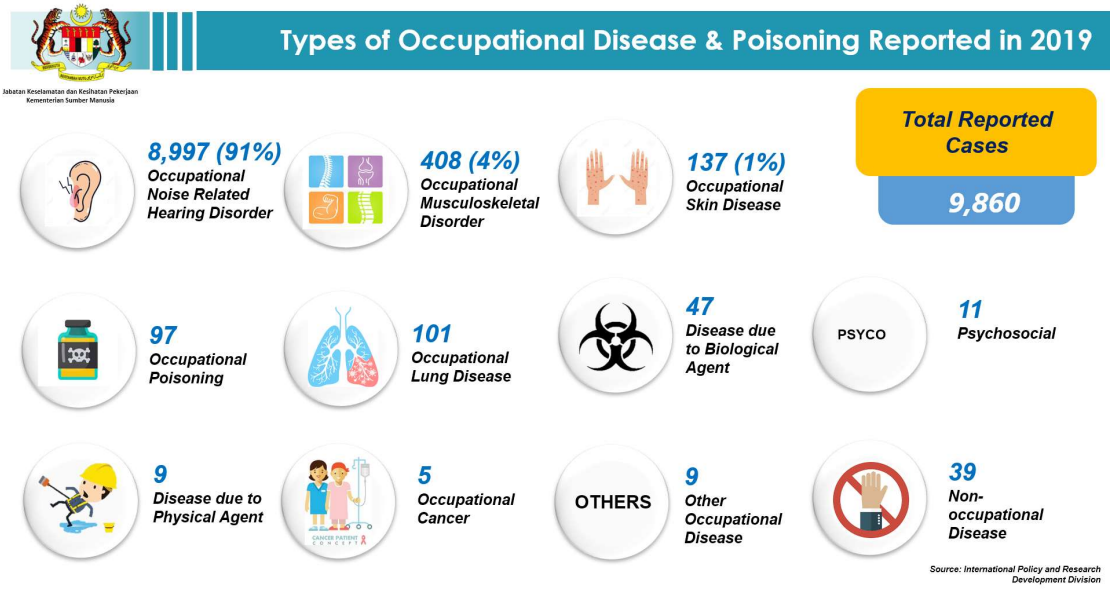

Figure 18.4. **Types of Occupational Disease and Poisoning Reported in Malaysia in 2019**

Build Trusting Team

Building a trusting team in OSH is such a vital mindset in Infinite Game. Trusting teams are built on two principles, namely:

1. Aligned team vision
2. Psychological safety

In the context of Industrial Hygiene, the OSH professionals, business owners, regulators, workers unions, universities and others involved in shaping the OSH culture must have an aligned team vision. OSH vision cannot just be the purpose for the OSH professionals, yet, not supported by the others.

For example, in Malaysia, our aligned vision is driven by the 5-year strategic National OSH Master Plan 2016 – 2020 (OSHMP 2020). The OSHMP 2020 is expected to contribute to the reduction rate of occupational accidents and fatality cases and thus, assist the government in raising the quality of life of the people. The quality of working life is one of the elements contributing to the well-being of Malaysians.

Realizing the increasing trend of occupational diseases and poisoning reported and the growing concern on worker's health risk at workplaces over the years, the Department of Occupational Safety and Health (DOSH) of Malaysia has included 'Mainstreaming Industrial Hygiene (IH)' as one of the main strategies under OSHMP 2020 to heighten the IH management practices in the country ((DOSH) D. o., 2016). There are 5 programs registered under Mainstreaming IH strategy as shown in Figure 18.5.

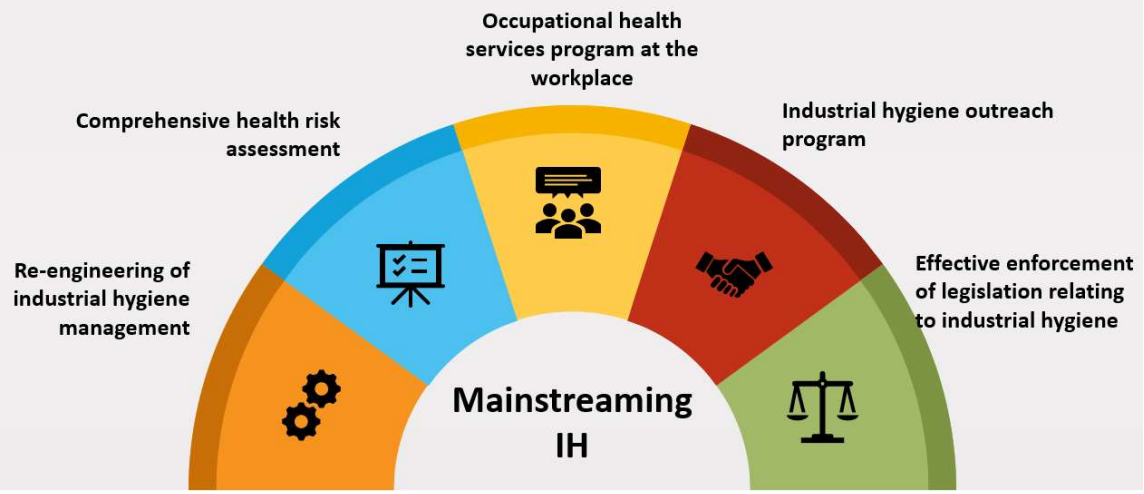

Figure 18.5. **Strategies of Industrial Hygiene Mainstreaming part of OSH Master Plan 2020**

The programs aimed to achieve the following objectives:

- Enhance level of IH management at the workplace
- Enhance awareness, knowledge and commitment among employers, employees and OSH practitioners on IH
- Enhance awareness and commitment to report occupational disease and poisoning
- Intensify effective enforcement of legislation relating to IH

One of the main OSHMP 2020 key performance indicator (KPI) is to increase reporting of occupational diseases and poisoning of workers by 30% and according to DOSH, we have achieved 65.43% increase in 2019. The high impact programs contributed to this results included the formation of Industrial Hygiene Catalyst Committee (IH2C), Basic Occupational Health (BOH), Ergonomic Risk Assessment (ERA) Tools, Systematic Occupational Health Enhancement Level Program (SOHELP), SOHELP Do It Yourself (DIY) and Noise Exposure Regulations 2019 ((DOSH) D. o., Pencapaian OSH MP 2020, 2020). It is hopeful the new OSH MP 2021-2025 will further drive the IH reform especially in the areas requiring attentions.

The second principle of building a trusting team is creating Psychological Safety. According to Professor Amy Edmondson (Edmondson, 2018), it is a belief that the context is safe for interpersonal risk taking that speaking up ideas, questions, conversations or mistakes will be welcomed and valued. In short, people feel that environment is safe for them to speak up regardless of their positions or status in an organization.

In mainstreaming IH in Malaysia, various parties such as the Department of Occupational Safety and Health (DOSH), National Institute of Occupational Safety and Health (NIOSH), Social Security Organization (SOCSO), Malaysian Trades Union Congress (MTUC), Malaysian Industrial Hygiene Association (MIHA), Malaysian Federation for Occupational Safety and Health (MyFOSH), National Council of Occupational Safety and Health (NCOSH), Federation of Malaysian Manufacturers (FMM), universities, and other OSH associations play a pivotal role. Creating psychological safety in various engagements is important so that different parties can come together to implement IH effectively. Those who less conversant on the subject of IH should feel safe to ask questions or raise their concerns without being fear of shame or punished.

OSH is more dependent on "teaming" than ever before, where teaming is teamwork on the fly – coordination and collaborating, across borders, without the luxury of stable team structures. Teaming is especially needed when work is all the more relevant and important in today's world.

MIHA, registered on May 30, 2003, is an organization of professionals dedicated their passion to promote IH in Malaysia. With a vision to save workers' lives, achieve and maintain highest standards of IH, MIHA focuses its activities in raising awareness, capability development, standards/ guidelines development as well as collaboration with other advocators of IH. Hence, the national collaboration, such as via MyFOSH is all the more relevant and important today. Around 900 MIHA members can only do so much, but through collaboration, we can leverage on the strength of almost 8000 MyFOSH members.

At the international level, being part of the International Occupational Hygiene Association (IOHA) gives MIHA the opportunities to collaborate and exchange lessons learnt and best practices with other peers, connecting with 35 members countries, covering almost 18,000 members.

Worthy Rival

In Infinite Game, it is important for us to study our worthy rival, be it other OSH organizations or other professionals such as the medical, engineering and legal. Others may have something better than us —maybe marketing, leadership training, fit for purpose solutions, digital adaptations, customer focused etc. Viewing others who make us feel uncomfortable - makes us a worthy rival. The GAME is not to beat others, but the GAME is to stay as long as possible that outlasts. In Mainstreaming IH, study other organizations and culture will result in us exploring new possibilities and discover innovative ideas.

Research into OSH culture is an area that is worth to be explored. Compliance to rules and regulations correlates with the level of societal maturity and household income. In Asian culture, there has been a positive growth in the aspect of compliance, particularly with the stringent and transparent enforcement activities. While rules, systems and procedures are critical in setting standards practices, users or workers understanding of the purpose and meaning of those rules are crucial in shaping sustainable OSH culture. Culture of Compliance

must be supported with a robust feedback loop, effective risk assessment and audit program. Culture of Compliance built upon enforcement activities coupled with continuous education program proved to be more sustainable. Balanced rewards and intervention programs, adopting the principles of Just Culture is an important element in strengthening OSH compliance culture. In Infinite Game, OSH culture will reach and attain the maturity of Interdependent or Generative. This is when 'the teams feel ownership' for OSH, can only be achieved as a group and when everyone is doing the right thing right, even when no one is watching (PETRONAS, 2020).

Capability of Existential Flexibility

Existential flexibility calls on two human qualities without which Simon Sinek's (Sinek, 2019) fourth leadership practice is not possible:

- The first is humility – a preparedness to admit that you don't have all the answers and are not always right, a capacity to rise above your arrogance to consider another way.
- The second is courage – to fundamentally change not knowing whether it is in fact the right thing to do but absolutely knowing that to do so will not only be disruptive in the short term but may even result in failure.

In OSH management, the ability to make profound 180 degree, strategic shift because of the changing culture, technology and politics is crucial.

The challenge of OSH has existed for as long as people have worked or been employed in workplaces. However, growing awareness of the widespread occurrence of injuries, diseases and deaths at work dated from the industrial revolution that took place in Europe, the United States and some European colonies in the eighteenth and nineteenth century. The ILO was founded in the aftermath of the First World War as an agency of the League of Nations, both creations of the Treaty of Versailles in 1919, to give expression to growing international concern for social, labour and economic reform. The post-War agenda for international action included awareness of the need for the protection of workers from the risks to their safety and health at work (ILO, 2019).

While much progress has been made over the last 100 years, the challenge of creating safe and healthy work for all remains today. While many effective OSH instruments have been developed, too often they have not been ratified or effectively implemented in practice, in order to deal with persistent safety and health risks. Furthermore, new and emerging safety and health risks in an ever-changing world of work will create new challenges, as well as opportunities, for governments, employers, workers and other key stakeholders in ensuring safe and healthy working environments.

Considering all the changes and challenges, one cannot deny the important of capability development. Robust OSH competency development must begin from homes and schools, way before, individual starts his working life. Education reform to include OSH as a syllabus in schools in shaping the right OSH Culture in a country is must. Young children, who are taught good values such as respecting the law and care for others will develop good habits.

The growth of IH professional development and certification, on par with other professional accreditation such as engineers and medical officers, should be recognized as a noble profession, in the business of saving lives. This will further raise the profile and interest in the profession, promulgates research and development opportunities and explore new knowledge and best available technology to manage risks in a timely and cost effective manner. In 2015, the IOHA estimated that we needed 44 000 certified industrial hygienists, of which in reality we only have 7576 industrial hygienists (Tresider, 2015). Professional development of IH or other OSH disciplines should be integrated and supported by national OSH agenda.

In Malaysia, the Certified Professional Industrial Hygienist, CPIH, is part of MIHA's initiatives towards achieving highest standard of Industrial Hygiene practice in the country (MIHA, 2020). Established since Oct 2014, the certification scheme was tailored for Malaysian requirement and the program is recognized and endorsed by the IOHA National Accreditation and Recognition (NAR) Committee as per the criteria shown in Figure 18.6. CPIH emphasized on ethical professional conduct with continued maintenance and further development of professional expertise through recognized channels.

Figure 18.6. **IOHA National Accreditation and Recognition (NAR) Committee Certification Scheme Criteria**

There are various pathways available for Industrial Hygienists to explore their journey in becoming certified Industrial Hygienists as shown in Figure 18.7 ((MIHA), 2020).

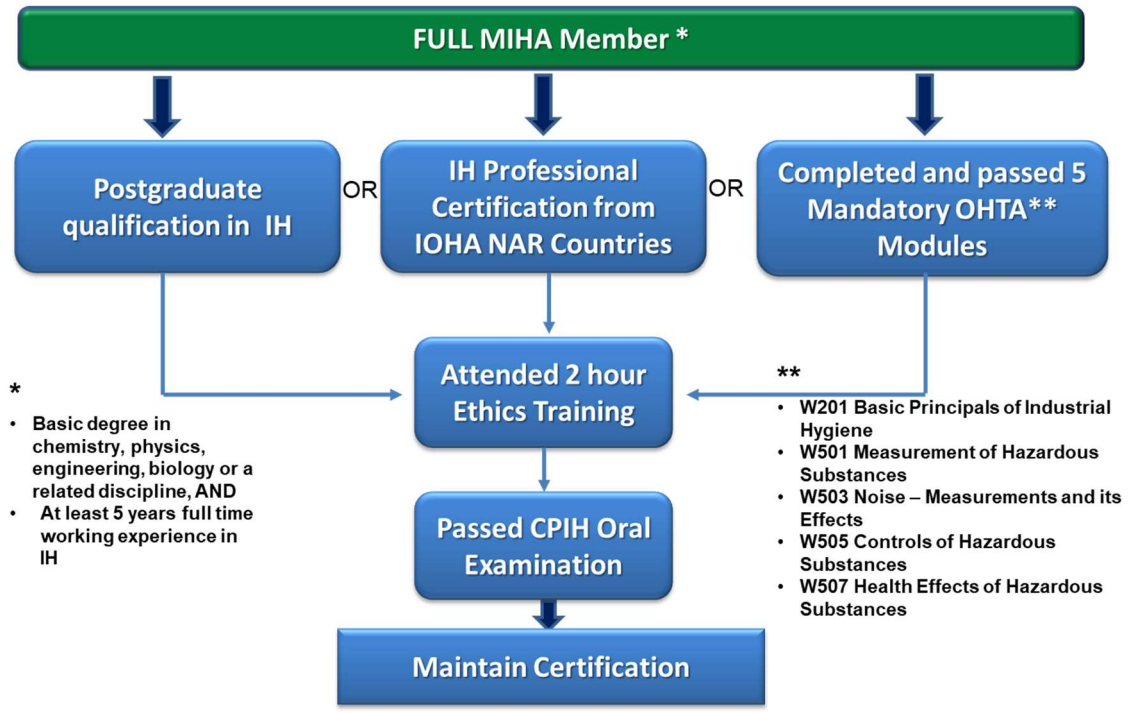

Figure 18.7. **Pathways of becoming a Certified Professional Industrial Hygienist (CPIH)**

With the limitation of our current OSH regulatory framework, the number of CPIH is still very low, merely 20 people. Our existing legal framework still emphasize on the various IH competency, and Figure 18.8 shows the standing of the competent persons related to IH as of July 2020 ((MIHA) M. I., 2020).

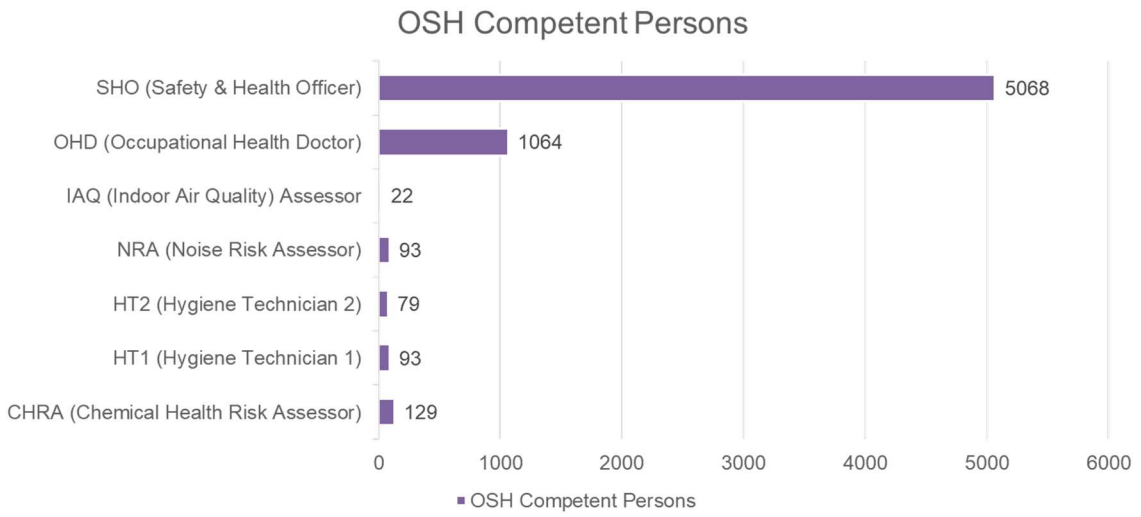

Figure 18.8. **Number of Industrial Hygiene Related Competent Persons in Malaysia as of July 2020**

The number of registered Safety & Health Officer (SHO) is far more superior compared to the specific IH related competency, which indicated that in order to mainstream IH, greater co-operation and collaborations with other OSH associations are the way to go. Competency of general workers on the basic risks and controls required to protect their health and safety must be intensified. Easy access to OSH information on the internet makes learning faster and exciting, compared to the primitive ways of learning. In addition, numerous reliable information is readily available on websites hosted by governmental or OSH organizations and e-learning providers.

One of the catalyst that drives competency is access to Safety & Health Coaches, individuals that are trusted to guide and mentor workers. Considering the 4.436 billion Asian population, it has the most number of employed persons, where continuous coaching and mentoring are necessary. Voluntary organizations, education partners and multinationals, in collaboration with government agencies should focus to develop more volunteers accessible to workers and small medium enterprises.

In June 2020, MIHA kicked off i-GROW, MIHA Mentoring Program, targeted to nurture future IH leaders among MIHA members by guiding them in personal development through a structured process. Experienced MIHA member (Mentor) will share skills, knowledge and experience while MIHA new members (Mentee) acquire the skills they need to succeed at their current job, as well as those in need for career advancement.

Courage to Lead

Most of the time when we go to work, we are pressured to play finite game. Here, leaders must have tremendous courage to play the Infinite Game.

We cannot deny the significant influence a leader has in shaping the right OSH Culture, and hence produces the desired OSH results. Strong leadership commitment must begin with the highest authority in a country, where the government values workers' lives, whenever they made strategic decisions. Here, it is not the just the role of the Department of Occupational Safety and Health (DOSH) or Ministry of Human Resources, but it is from the country leadership, supported by all ministries. Government commitment and accountability to safeguard its people (including foreign workers) whilst promoting economic growth is crucial to support the United Nation (UN) Sustainable Development Goals (SDGs), where access to safe workplaces is a basic human rights.

Leadership commitment to drive IH must be instilled in the hearts and minds of business leaders, so that sufficient OSH costs is allocated in business planning. Leaders actively develop their skills and must become a role model in hazards and risk management. Commitment and perseverance of leaders from the voluntary IH/ OSH organizations and research institute is paramount in creating this drive. Clearly defined and joint accountability or teaming of these leaders, as seen in many developed countries, is a mandatory expectation in Asia, including Malaysia. The MyFOSH formation in bringing all OSH associations together is seen as the steppingstone for this purpose.

As companies navigate through the operational disruptions and OSH challenges posed by the COVID-19 pandemic and bring employees back to work in this rapidly evolving OSH landscape, utilizing digital and mobile solutions has taken on an entirely new importance. OSH must be an integral part of Technology & Digital Transformation for organizations to survive today's challenge.

It has been suggested that the world of work is going through a 'fourth industrial revolution'. If the three previous revolutions stemmed from the advent of steam power, electricity, and personal computers then the fourth is being driven by the digitalization of information. Digitalization and ICT (Information and Communications Technology), alongside related developments such as AI (Artificial Intelligence), advanced analytics, robotics, automation, autonomous vehicles, drones, smart devices, 3-D printers, novel human-machine interfaces, the Internet of Things (IoT), Big Data, cyber-physical systems, advanced sensor technologies, cloud computing, quantum computing, communications networks, e-retail, e-waste and so on, are all becoming increasingly commonplace ((ILO), 2019). While technology and digital advancement positively impacted the OSH management, there are few challenges need to be better addressed as shown in Figure 18.9.

Figure 18.9. **Digitalization and ICT: Opportunities and Challenges**

Specific to IH, the growth of OSH software solutions aimed at empowering employees at all levels, to make workplaces healthier, more productive environments. By cutting through the time and complexity of the most important IH tasks, software makes it possible to maintain a world-class program and have real-time visibility and reporting of important activities. Figure 18.10 provides overview on areas where IH management can be further improved by leveraging on OSH software (Today, 2019).

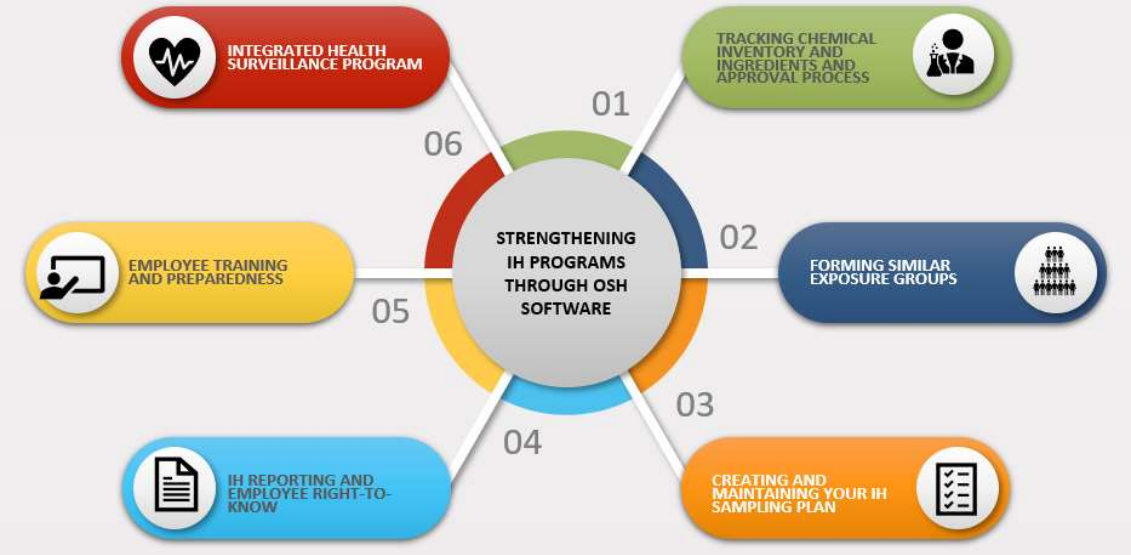

***Figure 18.10*. Enhanced Industrial Hygiene Focused Areas Leveraging on OSH Software**

Conclusion

Over the last two decades, there have been rapid growth of OSH governance driven by regulators and supported by multinationals and voluntary OSH organizations in Malaysia and Asia at large. Though the focus has been primarily on safety, for the obvious reasons of immediate or acute effects, the importance of IH is becoming more critical. The stringent regulatory requirements, coupled with greater understanding on the health impacts, and the growth of the professional Industrial Hygienists facilitated the positive changes. The question is, how can we accelerate the future growth and mainstreaming of IH? Let's hop on this Infinite Game! Our world is becoming smaller with better connectivity driven by Technology and Digitalization. The future success will be at rapid growth in comparisons to the improvement achieved in the last 100 years.

Heraclitus, a Greek philosopher said "change is the only constant in life." Mindset change and resources which includes human capital and funding are the main challenges to steer the growth of IH to greater heights. Nevertheless, the opportunities outweighs the challenges, and that drives Industrial Hygienists to persevere, consistently carry the message that we care for each other and our planet, simply because it is the right thing to do.

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Examination
Experience
Explain

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Factories and Machinery Act
Fall Protection Equipment Testing Laboratory
Feedback
Forensic Engineering Laboratory

G
Gas chromatography
Gas Detector Calibration Laboratory

H
Hazard
Hearing Conservation Program
High performance liquid chromatography
higher education
Human Ergonomics Assessment Laboratory
Hydrostatic Testing Laboratory

I
Implement
Improvement
Indoor Air Quality
Induction
Industrial Hygiene
Industrial Hygiene Analytical Laboratory
Industrial Hygiene Division
Industrial Hygiene Laboratory Accreditation Program
Industrial Hygiene Technician
Industry Code of Practice
information
Interaction
Ion chromatography

J
Japan International Cooperation Agency
Job

K
Knowledge
Korean Occupational Safety and Health Agency

L
Learning
Local Exhaust Ventilation
location
Lumbar Motion Meter
Lung Function Testing Analysis

M
Malaysian Institute of Chemistry
Measure
Medical Surveillance
Method
Monitoring
Motivate

N
National Institute of Occupational Safety and Health
National Institute of Occupational Safety and Health, Japan
NIOSH Augmented Reality Simulation of Safety and Health Training
Noise Risk Assessment

O
Objective
Occupational Health
Occupational Health Division
Occupational Health Doctor
Occupational Health Laboratory
Occupational Hygiene Courses by Occupational Health Training Association
Occupational Medicine Center
Occupational Noise Related Hearing Disorder
Occupational Safety and Health
Occupational Safety and Health Act
organizational structures
OSH Hazard Evaluation and Control Technology Centre
OSH Institute
OSHECT

P
Participant
Performance
Permissible Exposure Limit
Personal Hearing Protector
Personal Protective Equipment
Phase contrast microscope
PPE Simulation Laboratory
Practical
Productivity
Programme
Psychomotor

R
Regulatory Compliance
Resources
Risk

S
Safety Passport
Scientific Equipment Calibration Laboratory
Simulation
Skills
Skim Akreditasi Makmal Malaysia
Standard
Standard and Industrial Research Institute of Malaysia
Sustainable Development Goals

T
technical expert
Total Wellness and Health Promotion
Trainee
Trainer
training
Training Delivery
Training Environment
Training Facilities
Training Package

U
Use and Standard of Exposure of Chemicals Hazardous To Health
workplace

X
X-ray diffractometer

PART II: OCCUPATIONAL SAFETY

A
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Ammonia
Analysis of exhibits
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B
Behaviour
Behaviour based safety

C
Certification
Chemicals
Communication
Competency
Competent person
Competent person
Consultancy service
Constructions
Customised training
Cultures

D
Dangerous occurrence

E
Effectiveness
Enforcement
Environment
Environmental
Evacuation
Equipment

F
Factors
Fatality
Flammable
Forensic engineering investigation
Forensic analysis

G
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Guidance

H
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Hazard identification

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I
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Industrial revolution
Initial review
Innovation
Inspection
Instrument
Intervention

L
Laboratory service
Legal
Legislations
Legal compliance
Lighting

M
Management
Mandatory
Maintenance

N
Noise

O
Obligations
Occupational
Occupational accident
Occupational health and safety
Occupational safety
Occupational safety and health
Occupational Safety and Health Act
Occupational safety and health management system
Oil and gas
OSH solution
Organisational

P
Personal protective equipment
Permit to work
Policy
Practice
Preventive
Physiological

Q
Quality

R
Refrigeration
Reportable
Research and development
Respiratory
Responsibility
Risk assessment
Risk control

P
Performance
Pressure

S
Safety
Standard conformance
Supervision

T
Technical
Technology
Temperature

V
Vapours
Ventilation

W
Welfare
Workplace assessment

PART III: OCCUPATIONAL HEALTH

C
Chemical Health Risk Assessment
Chemical Exposure Monitoring

D
Department of Occupational Safety and Health

F
Factories and Machinery Act

H
Hearing Conservation Program

I
Industrial Hygiene
Industrial Hygiene Division
Indoor Air Quality

J
Japan International Cooperation Agency

L
Local Exhaust Ventilation
Lung Function Testing Analysis.

M
Medical Surveillance

N
National Institute of Occupational Safety and Health
Noise Risk Assessment

O
Occupational Health
Occupational Health Division
Occupational Hygiene Courses by Occupational Health Training Association
Occupational Medicine Center
Occupational Noise Related Hearing Disorder
Occupational Safety and Health Act

P
Personal Hearing Protector

R
Regulatory Compliance

U
Use and Standard of Exposure of Chemical Hazardous To health

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National Institute of Occupational Safety and Health

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