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World Safety Journal

In This Edition

WSO's Certification Program
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ISO/IEC 17024:2012
ICAC
international certification accreditation council

World Safety Organization

Statement of Purpose and Objective

WSO's purpose is to internationalize all safety fields, including occupational and environmental safety and health, accident prevention movement, etc., and to disseminate throughout the world the practices skills, arts, and technologies of safety and accident prevention.

WSO's objective is to protect people, property, resources, and the environment on local, regional, national, and international levels. WSO membership is open to all individuals and entities involved in the safety and accident prevention field, regardless of race, color, creed, ideology, religion, social status, sex, or political beliefs.

WSO is in Consultative Category II Status (Non-Governmental Organization-NGO) to the Economic and Social Council of the United Nations.

The WSO is a Not-for-Profit Corporation (Missouri, USA), non-sectarian, non-political movement dedicated to

"Making Safety a Way of Life…Worldwide."

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Article Submission

Articles for inclusion in this journal will be accepted at any time; however, there can be no guarantee that the article will appear in the following journal issue.

All articles shall be written in concise English and typed with a minimum font size of 12 point. Articles should have an abstract of not more than 200 words. Articles shall be submitted as Times New Roman print and presented in the form the writer wants published. On a separate page, the author should supply the author's name, contact details, professional qualifications, current employment position, a brief bio, and a photo of the author. This should be submitted with the article.

Writers should include all references and acknowledgments. Authors are responsible for ensuring that their works do not infringe on any copyright. Failure to do so can result in the writer being accountable for breach of copyright. The accuracy of the references is the author's responsibility.

References

Articles should be referenced according to the Publication Manual of the American Psychological Association 2010.

Books are referenced as follows:
Author. (Year of publication). *Title of publication*. Place of publication: Publisher.

Articles are referenced as follows:
Author (Year). Title of article. *Name of Journal. Volume* (Issue), Page numbers of article.

Internet information is referenced as follows:
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Warrensburg, MO 64093, USA
or emailed to: editorialstaff@worldsafety.org

Articles, wherever possible, must be up-to-date and relevant to the Safety Industry. ***All articles are Blind Peer Reviewed by at least two referees before being accepted for publication.***

The World Safety Organization (WSO)

The WSO was founded in 1975 in Manila, The Republic of the Philippines, as a result of a gathering of over 1,000 representatives of safety professionals from all continents at the First World Safety and Accident Prevention Congress. The WSO World Management Center was established in the United States of America in 1985 to be responsible for all WSO activities, the liaison with the United Nations, the co-operation with numerous Safety Councils, professional safety/environmental (and allied areas) organizations, WSO International Chapters/Offices, Member Corporations, companies, groups, societies, etc. The WSO is a not-for-profit corporation, non-sectarian, non-political movement to ***"Make Safety a Way of Life…Worldwide."***

World Safety Organization Activities

The WSO publishes WSO Newsletters, World Safety Journal, and WSO Conference Proceedings.

The WSO provides a network program linking various areas of professional expertise needed in today's international community.

The WSO develops and accredits educational programs essential to national and international safety and establishes centers to support these programs.

The WSO presents annual awards: the James K. Williams Award, Glenn E. Hudson International Award, J. Peter Cunliffe Transportation Award, WSO Concerned Citizen, WSO Concerned Professional, WSO Concerned Company/Corporation, WSO Concerned Organization, Educational Award, WSO Chapter/National Office of the Year, and Award for Achievement in Scientific Research and Development.

The WSO provides recognition for safety publications, films, videos, and other training and media materials that meet the WSO required educational standards.

The WSO receives proposals from professional safety groups/societies for review and, if applicable, submits them to the United Nations for adoption.

The WSO establishes and supports divisions and committees to assist members in maintaining and updating their professional qualifications and expertise.

The WSO has Chapters and National/International Offices located throughout the world, providing contact with local communities, educational institutions, and industrial entities.

The WSO organizes and provides professional support for international and national groups of experts on all continents who are available to provide expertise and immediate help in times of emergencies.

Benefits of Membership

The WSO publishes the "WSO Consultants Directory" as a service to its Members and to the Professional Community. Only Certified Members may be listed.

The WSO collects data on the professional skills, expertise, and experience of its Members in the WSO Expertise Bank for a reference when a request is received for professional expertise, skill, or experience.

The WSO provides a network system to its Members whereby professional assistance may be requested by an individual, organization, state, or country or a personal basis. Members needing assistance may write to the WSO with a specific request, and the WSO, through its Membership and other professional resources, will try to link the requester with a person, organization, or other resource which may be of assistance.

The WSO provides all Members with a Membership Certificate for display on their office wall and with a WSO Membership Identification Card.

The WSO awards a Certificate of Honorary Membership to the corporations, companies, and other entities paying the WSO Membership and/or WSO Certification fees for their employees.

Members have access to WSO Newsletters and other membership publications of the WSO on the WSO website, and may request hard copies by contacting the WSO World Management Center. Subscription fees apply to certain publications.

Members are entitled to reduced fees at seminars, conferences, and classes given by the WSO. This includes local, regional, and international programs. When Continuing Education Units (CEUs) are applicable, an appropriate certificate is issued.

Members who attend conferences, seminars, and classes receive a Certificate of Attendance from the WSO. For individuals attending courses sponsored by the WSO, a Certificate of Completion is issued upon completion of each course.

Members receive special hotel rates when attending safety programs, conferences, etc., sponsored by the WSO.

Membership

The World Safety Organization has members who are full time professionals, executives, directors, etc., working in the safety and accident prevention fields, including university professors, private consultants, expert witnesses, researchers, safety managers, directors of training, etc. They are employees of multi-national corporations, local industries, private enterprises, governments, and educational institutions. Membership in the World Safety Organization is open to all individuals and entities involved in the safety and accident prevention field, regardless of race, color, creed, ideology, religion, social status, sex, or political beliefs.

Membership Categories

Associate Membership: Individuals connected with safety and accident prevention in their work or individuals interested in the safety field, including students, interested citizens, etc. **Affiliate Membership**: Safety, hazard, risk, loss, and accident prevention practitioners working as full time practitioners in the safety field. Only Affiliate Members are eligible for the WSO Certification and Registration Programs. **Institutional Membership**: Organizations, corporations, agencies, and other entities directly or indirectly involved in safety activities and other related fields. **Sustaining/Corporate Member**: Individuals, companies, corporations, organizations or other entities and selected groups, interested in the international effort to "***Make Safety A Way Of Life...Worldwide***."

The WSO Membership Application is included just inside the back cover and is also available on the WSO website:
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WSO National and International Offices and Directors

WSO National Office for Algeria
Mr. Ferhat Mohia, Director
c/o Institut des Sciences et de la Technologie (IST)
Contact: ferhatmohia@yahoo.fr

WSO National Office for Australia
Dr. Janis Jansz, Director
c/o Curtin University
Phone: (618)9266-3006 / Fax: (618)9266-2958
Contact: j.jansz@curtin.edu.au

WSO National Office for GCC
Mr. Garry A. Villamil, Director
c/o Arabian Gulf Falcon Contracting Establishment
Serving Bahrain, Kuwait, Oman, Saudi Arabia, and UAE
Contact: director@wsogcc.org

WSO National Office for India
Mr. C. Kannan, Director
c/o Indian Society of Safety Engineers (ISSE)
Contact: support@worldsafety.org.in

WSO National Office for Indonesia
Mr. Soehatman Ramli, Director
c/o Prosafe Institute
Contact: soehatman@prosafe.co.id
soehatmanramli@yahoo.com

WSO National Office for Lebanon
Dr. Elias M. Choueiri, Director
c/o Ministry of Transportation
Contact: elias.choueiri@gmail.com

WSO National Office for Macedonia
Mr. Milan Petkovski, Director
c/o Macedonian Occupational Safety and Health Association
www.mzzpr.org.mk
Contact: milan.p@mzzpr.org.mk | kontakt@mzzpr.org.mk

WSO National Office for Northern Mariana Islands
Mr. Marvin C. "Ike" Iseke, Director
c/o Networld CNME, Inc.
Middle Road, H.K. Pangelianna Bldg, Chalan Laulan
PO Box 7724 SVRB, Saipan MP 96950

WSO National Office for Myanmar
Mr. Win Bo, Director
c/o OSHE Services Company, Ltd.
Phone: (95)936091909
Contact: winbo@osheservices.com

WSO National Office for Nigeria
Mr. Olalokun Soji Solomon, Director
c/o Danarich Concepts
Phone: (234) 08121697235
Contact: info@worldsafety.org.ng

WSO National Office for Pakistan
Mr. Syed Tayyeb Hussain, Director
http://www.wsopak.com
Contact: info@wsopak.com

WSO International Office for Philippines
Eng. Alfredo A. De La Rosa, Jr., Director
Phone: (63) 2 709-1535, (63) 2 709-1738 / Fax: (63) 2 709-1737
Contact: info@wsophil.org

WSO National Office for Qatar
Mr. Allan N. Milagrosa, Director
c/o Bright Services
Contact: dolphin_ems@yahoo.com

WSO National Office for Taiwan, Republic of China
Dr. Shuh Woei Yu, Director
c/o Safety and Health Technology Center/SAHTECH
Contact: swyu@sahtech.org

WSO National Office for Vietnam
Mr. Binh Pham, Director
c/o Tuong Khoa Trading Service Company Ltd.
www.worldsafety.org.vn
Email: binh@worldsafety.org.vn

World Safety Organization Application for Membership

[✓]	Application Fee	$20.00 USD
[ ]	Associate Membership	$65.00 USD
[ ]	Affiliate Membership*)	$90.00 USD
[ ]	Institutional Membership**)	$195.00 USD
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*) For your country's fee rate, please contact our office.

**) In case of institution, agency, corporation, etc., please indicate name, title, and mailing address of the authorized representative.

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Please enclose your check, payable to the WSO, for your membership fee. Annual dues hereafter will be billed and payable on the anniversary date of your membership. **U.S. Funds only.** International postal money orders or bank drafts with a U.S. routing number on the bottom of the check are acceptable for outside U.S.A. members, or you may use Visa, MasterCard, American Express, or Discover.

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*) FOR AFFILIATE MEMBERS ONLY:

Only FULL TIME PRACTITIONERS in the safety environment/ accident prevention and allied fields are eligible for the WSO Affiliate Membership. Please briefly describe your present employment or enclose your current résumé.

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PLEASE specify your area of professional expertise. This information will be entered into the WSO "Bank of Professional Skills," which serves as a pool of information when a request for a consultant/information/expertise in a specific area of the profession is requested.

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By submitting this application, you are accepting that WSO will use the information provided to perform an independent verification of employer, credentials, etc.

Mail or email completed form, along with payment, to:

WSO World Management Center
PO Box 518 | Warrensburg, Missouri 64093 USA
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WSO Achieves International Accreditation for Certification Program!

The big news in 2017 is that World Safety Organization's Certification Program is now accredited by the International Certification Accreditation Council (ICAC). The WSO Certification Program has been evaluated, audited to, and deemed in compliance with the ISO/IEC 17024 Standard. Our membership has asked for this accreditation for a long time, and we are proud to announce that it is been obtained. This is a big, important step in making our certifications more meaningful and valuable in the workplace.*

Please spread the word of this important development. Also, if you have questions or would like a copy of the accreditation certificate, please let the staff at the WSO World Management Center know. Again, congratulations to everyone on this important addition to our Membership and Certification Programs!

About ICAC

[FROM THE ICAC WEBSITE] — The **International Certification Accreditation Council (ICAC)** is an alliance of organizations dedicated to assuring competency, professional management, and service to the public by encouraging and setting standards for licensing, certification, and credentialing programs.

In 1996, a group of association executives chartered the ICAC as a not-for-profit organization with the purpose of evaluating certification programs at a reasonable rate that smaller organizations can afford. Over the years the ICAC has developed a comprehensive process to evaluate certification programs against international standards. In this way, accredited organizations can both improve existing certification programs as well as demonstrate to the public that their programs comply with industry best practices.

By accrediting certification programs, the public and the industries represented have an additional level of assurance knowing that the program has been reviewed by a neutral third party and been found to meet or exceed reasonable levels of record keeping, security, objectivity, and professionalism.

The ICAC itself operates under the international guidelines established as a quality assurance regime for accreditation bodies *(ISO/IEC 17011 – Conformity Assessment: General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies),* and has established assessment tools and processes that assure certification bodies are in compliance with *ISO/IEC 17024 (2012): Conformity Assessment – General Requirements for Bodies Operating Certification of Persons.*

Members of the ICAC Board of Directors and its various committees are volunteers who draw from many years of experience in managing not-for-profit organizations.

2018 Membership Drive Underway

With our newly-accredited status, we are pushing to significantly increase both our general and certified membership base. In order to accomplish that, we are asking that each WSO member assist in the process by suggesting that colleagues and associates join WSO as a professional member and pursue WSO certification. If each current member were to add one new member over the next year it will help build our membership ranks and make the organization stronger!

Risk Management in the Western Australia Mining Industry

By Dr. Janis Jansz, Faculty of Health Science, Curtin University, and Lynette Gilbert, Tidehill Pty Ltd.

Abstract

The first miners in Western Australia were the Aboriginal people. This paper traces the history of mining in Western Australia from the original miners to today's miners. It reports the development of risk management in the Western Australian mining industry and how this has improved occupational safety and health for the Western Australian mining industry. One of the risk management methods used in the Western Australian off shore oil and gas mining industry is a safety case. Details of what a safety case is, how to develop a safety case and use it are included.

Key words. Western Australian mining industry. Occupational safety and health. Risk management. Safety Case.

Introduction

Risk management is a process in which hazards are identified, the risks are analysed and assessed, risks are controlled as much as is practical with the risk mitigation and control measures monitored, assessed and improved as opportunities for improvements are identified. Mining can be a very dangerous industry to work in because the workplace is constantly changing as minerals are removed from the earth, equipment is used to do this, the work environment can be polluted, the surroundings can be unstable with dangers such as rock falls or cyclones, and as the actions of people are not always safe and healthy. The people who work in the Western Australian mining industry would like to return from work to home with no injuries or ill health that is work related. This paper traces the history of mining from the beginning of recorded mining history in Australia to 2015, with a particular focus on Western Australia.

The first miners in Australia.

The word '*Aborigines'* comes from the Latin words *ab origine* which mean '*from the beginning*'. In Australia it is thought that the original human inhabitants were a small statue (less than 1 ½ meters tall), dark skinned, curly haired, Negrito race that are called the Barrinean people. These Negrito people came from Asia (India, Burma, Thailand, Cambodia and Vietnam) in 2 waves of migration. The first group were known as the Kartan cultural group as they were first identified on the island of Karta (which is now called Kangaroo Island). The second group to migrate are called the Targangan cultural group as they were first identified on the island of Tartanga in the Murray River in South Australia. This Negrito race of people still lives in the Atherton tableland jungles of northern Queensland. They were common in Tasmania when the first European settlers came to Australia (Tindale & George, 1973).

The next wave of settlers to come to Australia was a race of fair skinned, medium build, people with straight hair who came from Asia. This race of people is called the Murrayian. They were given this name by the European settlers as this race of people was first found to be living along the banks of the Murray River. The Murrayian people mainly lived in the southern parts of Australia and took their land from the Negrito race of people. The Murryian race of people are thought to be related to the Ainu Aborigines of Japan. The next wave of people to settle in Australia was the Carpentarians. This race of people came from Asia. They are tall, thin, have dark brown skin, curly hair and settled in the land in the northern parts of Australia. The Carpentarians are thought to be related to the Veddas people of Sri Lanka (Tindale & George, 1973).

Collectively the Barrinean, Murrayian and Carpentarian people in Australia are called Aborigines. The three distinct races of people were conformed in 1938 through the research work of J. Birdsell of Harvard University in the United States of America and Norman Tindale from the South Australian Museum and the University of Adelaide in South Australia. Together these two researchers made a detailed analytical study of the racial characteristics of Aborigines in Australia at over 100 field stations. When Captain James Cook came to Australia in 1770 there were some 590 separate Aboriginal Tribes, each with their own language, customs, beliefs and home land. Family groups, of 15 to 40 people, (called a horde), joined together as a group to form a tribe of related people. Each tribe usually had at about 500 members (Tindale & George, 1973).

From when they first arrived in Australia the Aboriginal people were miners. Ownership of each mine rested with the horde of people on whose land the mine was located. Access to each mine was only allowed if the land owners gave permission. The main items mined were rocks and ochre. Ochre is iron oxide that is used for religious ceremonies and for art works. The rocks mined were used to make implements to gather, or kill, or to store food. Rocks mined included "amphibolite, andesite, basalt, blue metal, chal-

cedony, chert, diabase, granite, greenstone, greywacke, ironstone, limestone, mudstone, obsidian, porphyry, quartz, quartzite, sandstone, silcrete, silicified stone, siltstone and trachyte" (Mineral Resources, 2007, p.3). Certain members in each horde were provided with education on how to correctly and safely extract the resources from their mine. At this time worker safety and health in the mining industry was both an individual and a horde responsibility. Aboriginal people were the first professional miners in Australia (Mineral Resources, 2007).

In some parts of Australia mining was women's work. For example "Ochre from near Mount Rowlands in Tasmania was mined by Aboriginal women using stone hammers and wooden chisels. The ochre was then packed in kangaroo-skin bags for transport" (Mineral Resources, 2007, p. 2).

In other parts of Australia the miners were men. For example:

> The Wilgie Mai mine east of Geraldton in Western Australia was a major operation with a mining face of between 30 and 15 metres wide and up to 20 metres deep. The red and yellow ochre from the mine was excavated by men using heavy stone mauls and fire-hardened wooden wedges up to half a metre long. Pole scaffolding was erected for working at different heights. Several thousand tonnes of rock were removed from this mine. Wilgie Mai is considered 'a place of fabulous wealth' by Aborigines in the west and ochre from the mine was used in a huge area of Western Australia and may have been carried as far as Queensland (Mineral Resources, 2007, p. 2).

Aboriginal miners were important people in their horde and minerals trade was essential to the economy of the tribe. Most of the Aboriginal mines were open cut. There were a few underground mines, such as the flint mine at Koonalda in South Australia that extends 75 metres below the surface and up 300 metres from the entrance of a cave. In 2007 the New South Wales Department of Primary Industries had a record of 416 Aboriginal mines in Queensland, New South Wales and Victoria (Mineral Resources, 2007).

The Aboriginal population in 1770, when Captain Cook arrived in Australia, was about 300,000 people. The Australian Bureau of Statistics (2014) reported that Aboriginal people were 3% of the Australian population and numbered 713,589 people. Of this population of Aboriginal people 32% lived in major cities, 43% lived in country towns and 25% lived in remote areas. The Chamber of Minerals and Energy of Western Australia records that in Western Australia in 2012 Australian Aboriginal people made up 4.2% of the mining industry work force (i.e. there were 3,816 Aboriginal male and female mine workers). By 2014 5.8% of the Western Australian mining workforce were Aboriginal people with the percentage of Aboriginal miners expected to be 8.1% of the mining industry work force by 2020 (Chamber of Minerals and Energy of Western Australia, 2014).

Recent mining activities in Australia

The next wave of settlers to come to Australia were people from Britain. On 13 May, 1787, eleven ships, carrying about 1,530 people (736 convicts, 17 convicts' children, 211 marines, 27 marines' wives, 14 marines' children and about 300 officers and others) under the command of Captain Arthur Phillip, set sail for Botany Bay in New South Wales, Australia. A few days after landing at Botany Bay the new arrivals from Britain moved to Port Jackson where a settlement was established at Sydney Cove on 26 January 1788 (Frost, 2011). These people were not miners. A reason for this was that English law (which ruled these settlers) demanded that any gold or silver found became the property of the Crown (English Monarch). Unlike the Aboriginal people of the time these settlers could not profit from mining or mineral finds.

Unlike some other parts of Australian, South Australia had free settlers, not convicts, as European settlers. The first mining by people of European decent in Australia occurred in South Australia. In South Australia in 1841 lead was first mined in the Glen Osmond Hills. In 1842 copper was first mined at Kapunda and in 1945 at Burra Burra in South Australia (Australian mining history, 2012).

In 1840 many people of European decent left New South Wales to go to California in the United States of America to mine for gold. To reverse this trend of European decent settlers leaving Australia the New South Wales government offered a reward for the discovery of payable gold in Australia. The reward was claimed in 1851 by Edward Hargraves (5,000 pounds), John Lister (500 pounds) and William Tom (500 pounds). From this time onwards miners in Australia were allowed to keep the profits from their mining work and mining became an important industry in Australia (Australian mining history, 2012).

The first commercial mining in Western Australia began in 1898 with coal mining at Collie. This was followed in 1891 by gold mining in the Murchison district; in 1892 by gold mining at Coolgardie and in 1893 by gold mining in Kalgoorlie. In 1943 there was large scale mining of asbestos at the Wittenoom Gorge. In 1951 there was iron ore mining at both Koolan and Cockatoo Islands in the north of Western Australia. In 1953 oil mining began in the Exmouth Gulf of Western Australia. In 1963 bauxite mining

began in the Darling Ranges. In 1969 nickel mining began at Mount Windarra (Australian mining history, 2012; Department of Mines and Petroleum, 2012). In 2012 Western Australia had 90,856 people working in 513 commercial mineral projects, 893 operating mine sites, 64 operating oil and gas fields and has 140 exploration managers helping to identify new mining opportunities in Western Australia (Resources Industry Training Council, 2010; Department of Mines and Petroleum, 2012). In November 2014 there were 93,000 people working in the Western Australian mining industry (Chamber of Minerals and Energy, 2014). In the 2014 calendar year the Western Australian mining industry was worth over $120 billion in income generation (Chamber of Minerals and Energy, 2014). The following figure shows the breakdown of the mining income with iron ore being the major contributor to the profits.

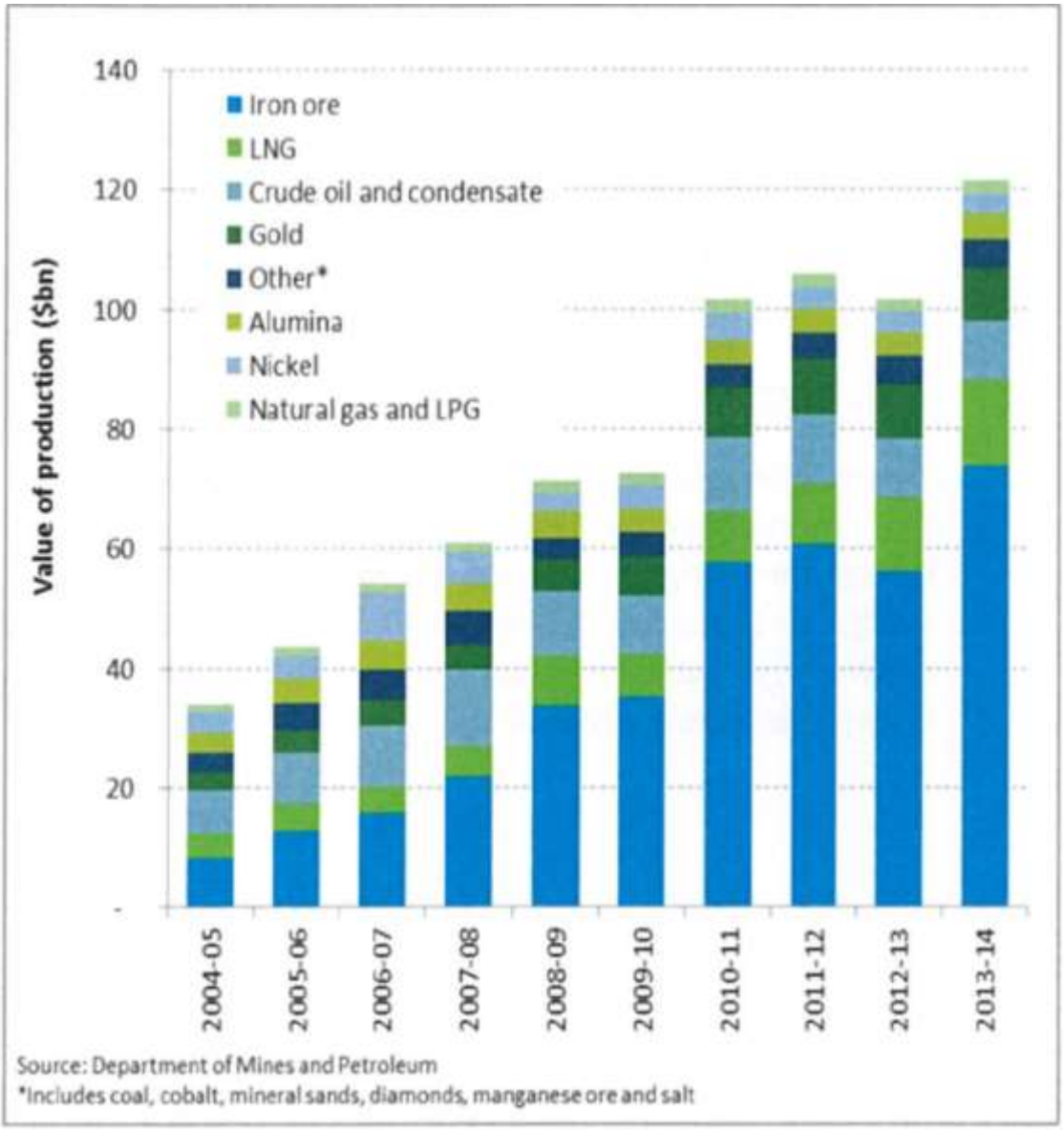

Figure 1. Value of production from Western Australian mining. (Chamber of Minerals and Energy, 2014, p.18.)

In 1902 the Western Australian School of Mines (WASM) was founded in Kalgoorlie as a tertiary education school to provide work related education for people who planned to work in the Mining industry. Until 1969 this mining educational facility was managed by the Western Australian Department of Mines. In 1969 management of this School was transferred to the Western Australian Institute of Technology which in 1987 became Curtin University. The current Director of the Western Australian School of Mines is Professor Steve Hall. The Executive Director of Resources Safety (the mine government regulation authority), is Simon Ridge, who is a graduate of the Western Australian School of Mines (Ridge, 2015). Both of these men, who are leaders in the Western Australian mining industry, have a strong focus on improving, and in maintaining improvements, in mining industry health and safety practices.

Health and safety in the Western Australian mining industry.

In the 1800s and 1900s in Western Australia miners were at first individual prospectors who were responsible for their own safety and health. Individual mining was gradually replaced with company mining as a more profitable way of mining. Below are the fatality statistics for the Western Australian mining industry for the early 1990s..

Table 1. Western Australian mining industry fatalities 1901 – 1918 (Gilroy, 2012).

Year	Fatalities	Workforce	Incident rate per 1,000 workers
1901	45	16,755	2.68
1902	39	17,525	2.22
1903	42	17,329	2.42
1918	23	17,790	1.29

Over the years workplace health and safety has improved in the Western Australian mining industry as is demonstrated in the following graph.

Figure 2. Western Australian mining industry fatalities per 1,000 employees from the 1950s to the 2000s (Gilroy, 2012, slide 4).

The incidence of fatalities (number per 1,000 employees) declined from 0.527 in 1988/89 to 0.047 in 2010/11 (Western Australian Department of Commerce, 2012). By 2012 there were no employees killed in the Western Australian mining industry as shown in figure 3.

Figure 3. Number of Western Australian Mining Fatalities. (Ho, 2013, p. 48).

The incidence of lost time and serious injuries was reduced similarly.

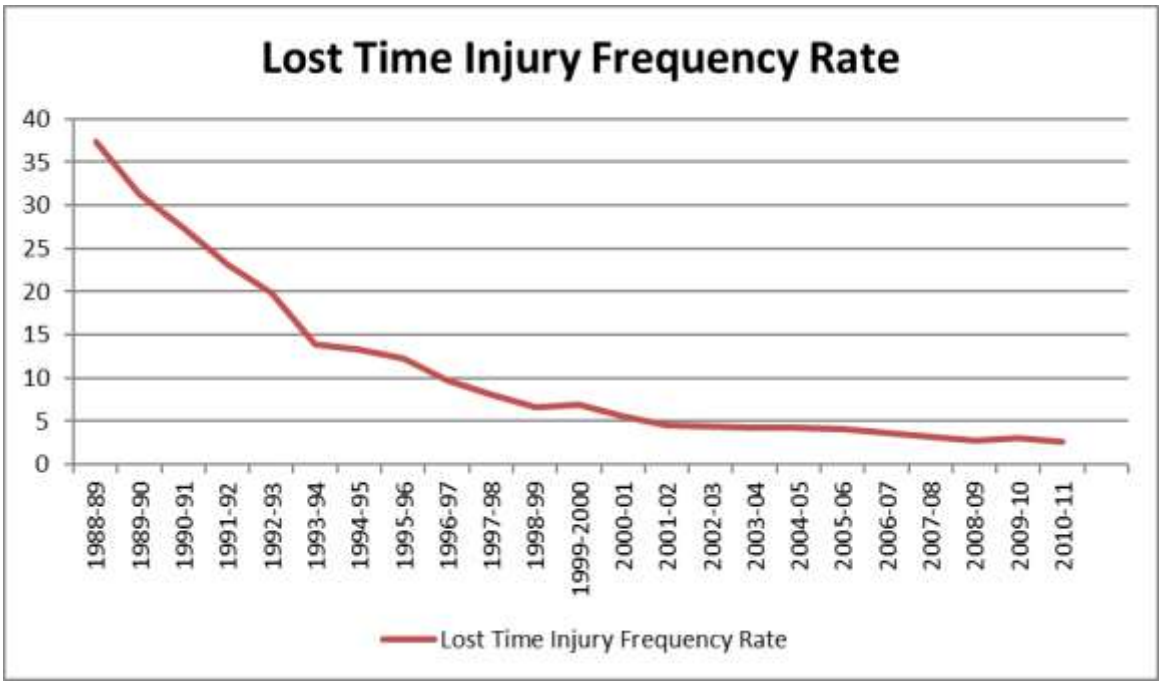

Figure 3. Lost time injury frequency rate per million hours worked in the Western Australian mining industry (Ho, 2012, p.29).

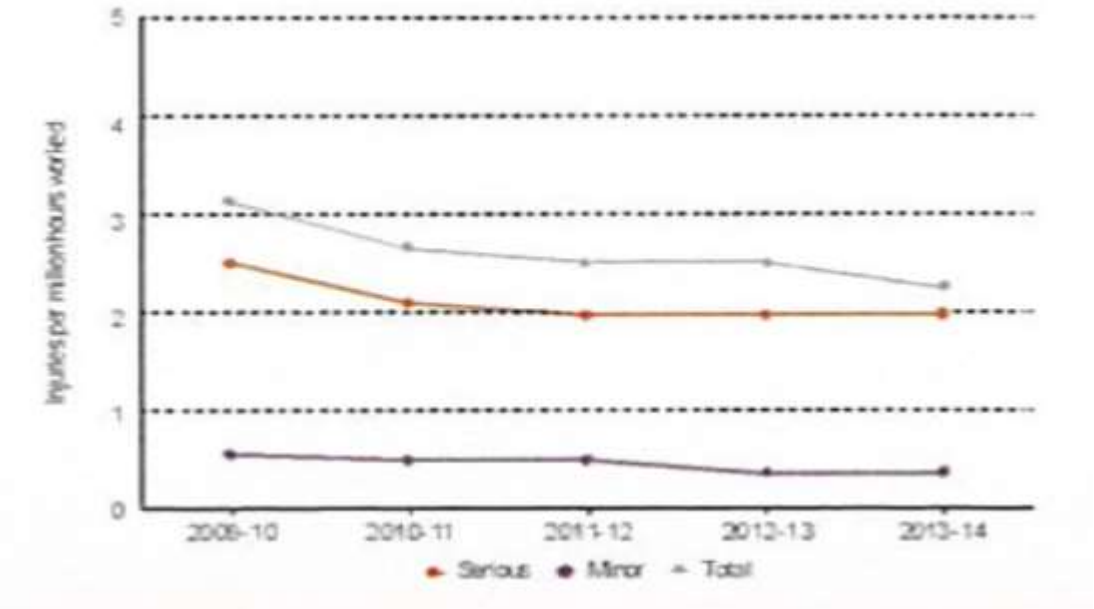

Figure 4. Serious, minor and total injuries per million hours worked in the Western Australian mining industry (Department of Mines and Petroleum, 2015, p.1).

The number of injuries in the Western Australian mining industry has stayed low, but unfortunately 2013-14 there were 5 fatal accidents (Government of Western Australia, 2015). In the Western Australian oil and gas off shore mining industry there were no fatalities in the 2013 -14 year and the following figure shows the lost time injury frequency rate per million hours worked in the Australian oil and gas mining industry, which is lower than the general industry average.

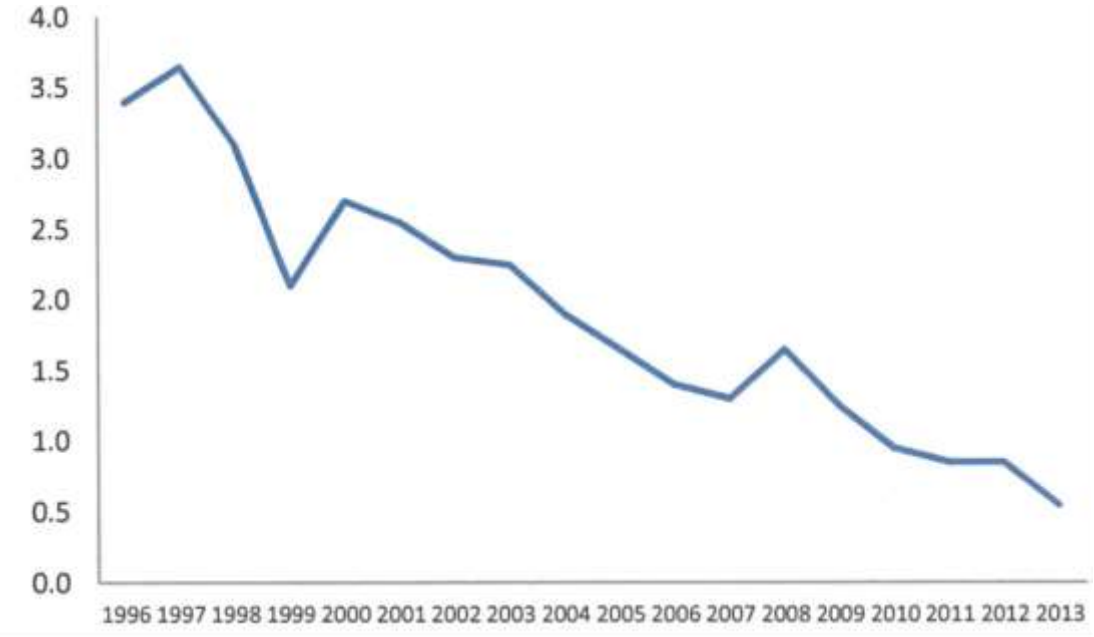

Figure 5. Lost time injury frequency rate per million hours worked in the Australian oil and gas mining industry (Economics and Industry Standing Committee, 2015, p. 62).

Safety Cases

One of the reasons that people who work in the Australian oil and gas mining industry place considerable effort on having a high standard of occupational health and safety is because in the Australia oil and gas mining industry since 1996, if the workplace did not have a safety case approved by the Regulator, it was not allowed to operate.

Risks of hazards causing harm cannot always be eliminated, but having made a safety case means that the company has demonstrated to the Regulator that they have met all occupational safety and health legal requirements, that the company has developed ways of managing risks effectively, have effective emergency management and have an effective safety management system. The Safety Case had its origins in the Nuclear Industry, with the foundations being laid as early as 1965. Since this time, a number of developments and industrial disasters have seen the Safety Case concept extend across industries and around the world.

In 1970 the British Committee of Inquiry in Safety and Health at Work was established to review the provisions made for occupational safety and health and to recommend any changes required. The Committee was chaired by Lord Robens and the resulting report, which was presented to Parliament in1972, became widely known as the 'Robens Report' (Browne, 1973). In response to the recommendations of the Robens Report the Health and Safety Commission (HSC) and its operating arm, the Health and Safety Executive (HSE) were formed in the United Kingdom (UK) (Wilkinson, 2002). Not long after the formation of the Health and Safety Executive, in 1974, the Flixborough disaster occurred. As the result of a poorly executed process modification 50 tons of hot cyclohexane was released into the air causing an explosion that killed 28 people, injured 36 people and completely destroyed the plant (Wilkinson 2002), This disaster prompted the Health and Safety Executive to establish the Advisory Committee on Major Hazards and in 1976 this Committee "proposed a three part strategy for managing major hazards: identification, prevention, control and mitigation, which was to have been backed up by regulations" (Wilkinson 2002, p. 4) when the Seveso disaster occurred in Italy, in 1976.

The release of dioxin in the Seveso disaster did not result in any human deaths, but it did result in the deaths of 3,000 pets and farm animals. 70,000 animals were subsequently slaughtered to reduce the harmful chemical from entering the food chain. This disaster led to the European directive, the Seveso Directive, in 1982. The Seveso Directive "was significantly influenced by the emerging ideas in the UK" (Wilkinson 2002, p. 4) and the course of events in the United Kingdom was influenced by the Seveso Directive. This led to the Control of Industrial Major Accident Hazards Regulations (CIMAH) in 1984. "CIMAH was amended in 1987 following the Bhopal disaster in India and again in 1998 following the Sandoz Warehouse fire in Switzerland" (Wilkinson 2002, p. 4). The Control of Industrial Major Accident Hazards Regulations were the precursor for the Control of Major Accident Hazard Regulations (COMAH) that were subsequently developed.

Throughout the development of the Safety Case concept, the Offshore Oil and Gas Industry had been insulated, to a

certain extent, until the Piper Alpha disaster in 1988. This disaster resulted in 167 deaths when an explosion caused a fireball that was in line with the galley which was the designated Emergency Muster Point. "Lord Cullen's inquiry into the Piper Alpha disaster carefully considered and endorsed the Safety Case concept" (Wilkinson 2002, p. 4), in what is known as the Cullen Report. "The prescriptive regime in place prior to the Piper Alpha incident had resulted in industry and the regulators failing to recognise, understand and control the high consequences, low likelihood hazards which can be unique to every different application" (Bonaparte, 2014, cited in Economics & Industry Standing Committee, 2015, p. 50). This was the basis of Lord Cullen recommending the implementation of oil and gas mining companies making a safety case to the Regulator that they had controlled all risk as low as reasonably practical and that they had an effective safety management system in place. The requirement for the United Kingdom offshore petroleum industry to make a safety case to the Regulator was then included in United Kingdom legislation.

Making a Safety Case is goal setting, rather than compliance legislation, which is what much of the off shore oil and gas industry occupational safety and health legislation was previously. In Australia in 1992 the *Petroleum (Submerged Lands) Act 1967 (Commonwealth Government)* legislation was amended to include the requirement for the off shore oil and gas operations to make a safety case to the Regulator to be able to operate and by 1996 this was enforced so that all operators had made a safety case that had been approved by the Regulator before they were allowed to operate. In 2003 the National Offshore Petroleum Safety Authority (NOPSA) was established with the passing of the *Petroleum (Submerged Lands) Amendment Bill 2003* to administer the Safety Case Regulatory Model and began as an authority in 2005. On 21st August 2009 the Montara wellhead platform drill rig had a blow out from the well head platform which resulted in a discharge of oil and gas pollution into the Timor Sea for 74 days before it was stopped (Borthwick, 2010). This caused massive sea pollution.

On the 20th of April 2010 the Macondo Deepwater Horizon semi-submersible Mobile Offshore Drilling Unit (MODU) also had a well head blowout that caused an explosion killing 11 people and resulting in an even larger oil spill that caused both sea and sea shore pollution (Bertolatti, Hannelly & Jansz, 2015). In response to this in 2011 legislation was further amended to turn NOPSA into the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and this organisation now Australia's National Regulator for not only safety, but also for well integrity and for environmental management for the offshore oil and gas industry with the ultimate responsibility for approving safety cases. NOPSEMA is fully funded by charging a fee for services that include approving and monitoring safety cases. For the 2013-2014 financial year NOPSEAMA generated a revenue of $29 million (National Offshore Petroleum and Environmental Management Authority, 2015).

According to NOPSEMA (2015, p1) a "safety case is a document produced by the operator of a facility which identifies the hazards and risks; describes how the risks are controlled; describes the safety management system in place to ensure the controls are effectively and consistently applied." The Economic and Industry Standing Committee (2015) records that a safety case has three required parts. The first is the facility description; the second is the formal safety assessment that identifies and describes all hazards, the risk of these hazards causing harm and risk control and mitigation strategies that will be used. The last part of the safety case is the description of the organisation's safety management system.

How to develop a Safety Case.

As well as the off shore oil and gas industry safety cases are required for all major hazard facilities in Australia. Safe Work Australia (2012a, b, c) has a series of nine publications that describe how to write a safety case and these can be obtained from the web address http://www.safeworkaustralia.gov.au NOPSEMA (2015) also provide comprehensive guidance materials for developing a safety case that can be obtained from the web address http://www.nopsema.gov.au/safety/safety-case/safety-case-approach This information includes a document on the Safety Case Approach; What is a Safety Case? Validation and a document titled Safety Case Guidance. Under Safety Case Guidance there are 2 Policy documents and 8 Guidance Notes. The Civil Aviation Authority (2005) also provides guidelines for airlines to prepare their safety case.

All of these publications recommend that the Safety Case is developed by to facility operator with input from, and participation by, experts, the work force and any other business stakeholders (such as local authorities and local communities). Safety cases are written for the three phases of business operations. A new safety case is written for each part of the life cycle of a facility; the commencement phase; for the operation phase; for the decommissioning phase. At the beginning of the safety case it needs to be documented which phase the safety case is written for. After this the context of the safety case is established with all relevant laws, standards, guidance notes and requirements for the facility being identified and considered.

This is followed by writing the purpose of the safety case and the safety case objectives. An example of a purpose is to demonstrate to the Regulator that all legal requirements are met and the facility is safe to operate. An example of objectives can be to demonstrate to all stakeholders that the safety case has:

- Identified the major hazards associated with the facilities and has provided appropriate controls to manage these hazards;
- A Management System that ensures that the design, construction and operation of the facility and its associated services result in tolerable levels of risk;
- Developed adequate provisions for responding in the event of emergencies at the facility;
- Ensured that the risk to individuals on the facility is tolerable, and;
- A process in place to reduce risk to as low as reasonably practicable (ALARP).

This can be followed by a description of how the safety case objectives are met.

The next part of the safety case is the facilities description. This provides a complete overview of the main systems, processes, equipment and any hazardous products present at the facility. The intent is to provide information to such an extent that the Regulator will be able to understand the purpose for each of these and the subsequent discussion on hazards later in the Safety Case. It also includes a description of the area surrounding the facility as this can be affected by the business operations.

The Formal Safety Assessment that follows this description identifies all potential hazards at the facility that could cause a major accident event. It "is a detailed and systematic assessment of the risk associated with each of those hazards, including the likelihood and consequences of each potential major accident event; and identifies the technical and other control measures that are necessary to reduce that risk to a level as low as reasonably practical" (Economic and Industry Standing Committee, 2015, p. 72). The following diagram illustrates this process.

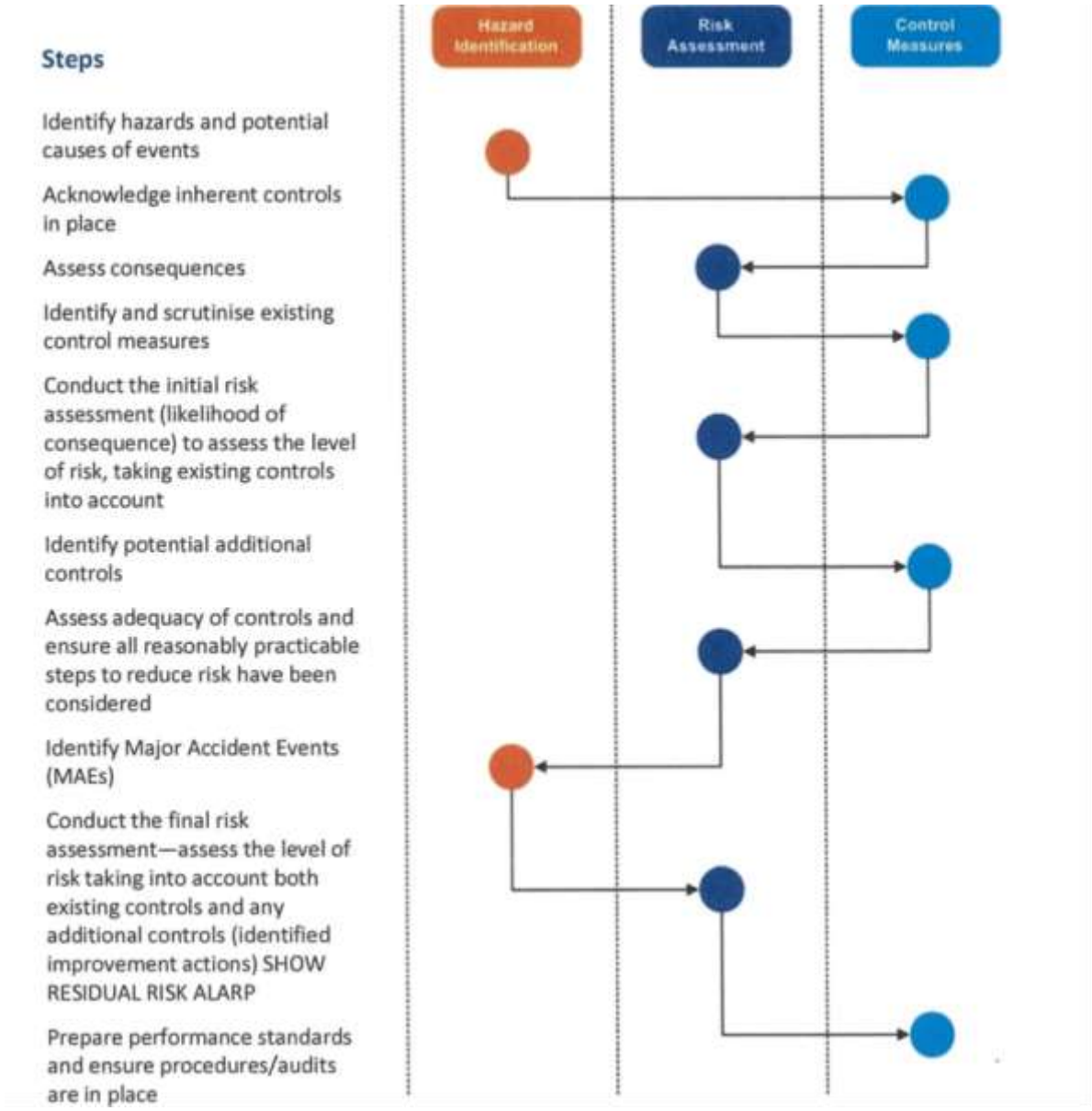

Figure 5. Formal Safety Assessment Process (Economic and Industry Standing Committee, 2015, p. 73).

The formal safety assessment phase includes a description of emergency management plans and recovery strategies that will be used at the facility if a major accident does occur. These plans must include strategies that minimise risks of harm that may occur during evacuation, escape, rescue and any risks of harm to the surrounding area. This section ends with a description of the planned methods for evaluating the effectiveness of the risk management, mitigation and risk control strategies.

The final section of the safety case is the safety management system description which integrates the hazard management system into all parts of the organisation's activities. Parts of the safety management system may include the following.

1. Management system, policy, objectives and planning.
2. Organisation and responsibility. Performance requirements.
3. Education and training provided.
4. Document control.
5. Resource purchasing and management procedures.
6. Control of service provision.
7. Risk assessment and risk management.
8. Communication and consultation.
9. Resource management.
10. Contractor and support services.
11. Design, construction and commissioning.
12. Control of operations.
13. Maintenance, inspection and testing.
14. Change management.
15. Emergency response.
16. Positive performance indicators.
17. Incident, hazard and non-conformance reporting and investigation.
18. Medical checks and health monitoring.
19. Workers compensation & rehabilitation management.
20. Decommissioning and abandonment.
21. Audits and management review.
22. Improvement procedures.

What is included in the safety management system for the safety case will depend on the stage of the organisation business, the type of organisation, the work processes performed, the work force employed at the organisation and who may be affected by the activities of the organisation. Safety must be included in the design stage for everything. The safety management system must provide for a safe, healthy operation that meets all legal requirements and include a description of each strategy in enough detail to inform the Regulator about how the system operates. When the safety case management system is implemented in the workplace it is important to check that everyone is educated on how to use this system effectively, that it is complied with, effectiveness is monitored and that improvements are made where opportunities for improvements are identified.

An advantage of the safety case for the off shore oil and gas mining industry, and for other industries, is that it is goal setting legislation that allows the business operator to research and implement best practice in safety management, for this to be checked by experts and then submitted to the Regulator to check before approving. These many layers of checking are what help to provide a high standard of workplace safety. This checking does not stop once the safety case is approved as there is further and ongoing checking by the Regulator that the safety case is operating as intended and is continuing to use best practices in safety management.

Conclusions

Health and safety practices in the Western Australian mining industry have changed over time. Today there is a high standard of occupational health and safety that is resulting in a constantly improving standard of safety and employee health as is evidenced by the statistical information included in this paper. One of the reasons for the high standard of workplace health and safety in the Western Australian off shore oil and gas mining industry is that safety cases are used to ensure that there is good risk management and business owners and employees are assisted in ensuring this by their Regulator.

This goal setting method of risk management in which the operator is responsible for reducing all risks as low as reasonably practical, developing and maintaining a positive safety culture throughout their organisation to ensure that safe work procedures are followed and improved when opportunities for improvements are identified; injury and fatality statistics are showing has been more successful than having only prescriptive legislation as a guideline for workplace health and safety management and that making a safety case can be considered as a risk management method for all industries in which workplace hazards exist.

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Accidents, Injuries, and Deaths: Measuring Perceptions of Personal Safety in Saudi Arabia's Workplaces

By Majed Moosa, Lecturer, Department of Industrial Education, Jazan University, Saudi Arabia

Abstract

Background: Research indicates that workplace accidents are a worldwide concern, and the numbers are increasing. In rapidly developing countries like Saudi Arabia, safety issues are largely ignored and little are known about the causes. The aim of this study was to measure workers' personal safety perceptions, discovering contributing factors to these events and providing a basis for future research and for workplace accident prevention.

Methods: To shed light on factors causing Saudi Arabian accidents, a detailed survey of safety training, safety knowledge, safety motivation, safety compliance and safety participation was sent out to employees in different sectors in Saudi Arabia, with a response of 172 participants.

Results: An analysis of the data showed that Saudi employees do not receive proper or adequate safety training. However, they are motivated to maintain and encourage safety. Thus, the study showed that a lack of safety training causes workplace accidents in Saudi Arabia. Placing a higher value on workplace safety and improving training may prevent the deaths and injuries of Saudi workers.

Keywords: Safety, Perception, Level, Awareness, Workplace, Accident

Introduction

Workplace accidents are a worldwide concern, and in some areas the number of these accidents is increasing. According to the International Labor Organization (ILO), every 15 seconds one worker dies and 153 work-related accidents occur across the globe. 6,300 people die every day as a result of work-related accidents or diseases. There are 2.3 million fatalities and 317 million occupational accidents around the world every year. These accidents affect many laborers, causing them to be absent from jobs for extended periods of time[1]. Workers in developing countries such as Saudi Arabia are especially impacted. Saudi Arabia's workplace accidents are an ongoing problem that affect tens of thousands of people each year, and the country's occupational accidents have begun to increase. For example, in 2010 75,000 Saudi Arabians experienced worksite injuries. 507 of those workers died[2].

Several factors affect safety perceptions, such as safety climate and safety knowledge. For this paper, it was hypothesized that in Saudi Arabia a lack of knowledge and education about safety training leads to human errors. Moreover, a lack of enforced safety laws and regulations leads to accidents. Thus, workers may not perceive when their safety is in danger. A survey was conducted for the purpose of measuring the personal safety perceptions of laborers in Saudi Arabian workplaces, providing insight into the factors that contribute to the country's worker fatalities and injuries. The results of this research thus contribute to a basis for future steps to be taken to improve safety training and to prevent workplace accidents in Saudi Arabia.

A workforce must understand the importance of applying safety rules to workplaces, and workers must act accordingly. To enforce safety rules, staff must use their perceptions and knowledge of safety to ensure an accident-free workplace. This fosters a strong safety climate and greatly impacts any organization. "Safety climate" was first used by Zohar in 1980. The term describes a workforce's shared safety management attitudes and perceptions at specific moments when operating their workplace [3]. Neal et al. have noted that significant elements of safety climate include management value, management and organizational practices, communication, and employee involvement in workplace health and safety[4]. The concept focuses on organizational behaviour rather than on the behaviour of individuals.[3] [4] Organizational behaviour (i.e., organizational climate) encompasses an organization's general behaviour, such as communication and leadership, and its specific behaviour, such as safety climate. In 2000, Neal et al. found that general organizational behaviour directly impacts workplace safety climate[4]. In turn, the effects of safety climate are driven by safety regulations and procedural compliance, as well as safety activity participation within organizations[4]. In 2010, Vinodkumar and Bhasi noted that no studies had researched a worker's perception of his or her ability to manage safety practices. There was a research gap in this area[5].

Cooper and Phillips noted that organizations should concentrate on changing and improving unsafe conditions and workers' safety behavior, rather than on improving workers' safety perceptions[6]. However, Vinodkumar and Bhasi noted that a worker's occupational perceptions is one of the most fundamental aspects of safety climate[5]. An organization's safety climate is established by its safety management practices. Safety climate reflects the relationship between "safety management practices, behavioural and attitudinal factors of managers and workmen, work and discipline in the organization, and risk perception at work" [5]. Safety perceptions of workers can thus inform and impact their climate, including conditions, behaviours, and practices.

A variety of factors influence the occupational perceptions of workers. Gyekye found that laborers satisfied with their jobs are

committed to managing safety in their workplaces and have positive safety climate attitudes[7]. Another occupational safety aspect that is likely to impact a workforce's safety climate perception is safety knowledge.

Safety education and knowledge are essential for preventing occupational accidents and injuries. According to Vinodkumar and Bhasi (2010), safety training is the most significant safety management practice in regards to improving safety knowledge and motivation, which are key links between safety compliance and participation (Vinodkumar & Bhasi, favourable worker behaviours[5]. Griffin and Neal's work safety perception findings correlate with this[8]. They found that perceptions of safety knowledge and motivation mediate safety climate and performance. According to Neal et al., safety behaviour is affected by safety climate, which directly impacts safety knowledge and motivation[4].

Vinodkumar and Bhasi also examined the role of safety knowledge in regards to the relationship between safety management practices (management commitment, safety training, worker's involvement, safety communication, safety rules and procedures, and safety promotion policies) and safety performance[5]. Safety practices that transfer information, such as training, communication, and rules and procedures, promote knowledge; thus, they expand workers' safety knowledge[5]

Materials and Methods

To measure workers' perceptions of personal safety in Saudi Arabian workplaces, this study used an online questionnaire that asked participants about their own perspectives concerning workplace safety and their management teams. The survey was based on a questionnaire previously used in Vinodkumar and Bhasi's 2010 study[5]. Their survey was altered to meet this study's research objective; thus, some parts of the original survey were been removed. Moreover, many different types of questions were used in the questionnaire and differed from the original copy. Changes to the survey were based on primary academic sources from journals, global websites, and governmental websites.

The questionnaire had had five sections: safety training, safety knowledge, safety motivation, safety compliance, and safety participation. The safety training section asked questions concerning whether or not participants received safety training, and if they did, how adequate the training was. The safety knowledge section examined what aspects of the workers' jobs and safety procedures they were aware of. The section titled Safety Motivation measured workers' feelings towards safety in regards to its importance and use, while the safety compliance section questioned what procedures and regulations participants followed, and whether or not the participants felt they were necessary. Finally, the safety participation section asked respondents what initiatives they took in the workplace to maintain safety.

The survey was presented to the subjects in two languages: its original English wording and an Arabic translation. It was distributed through email and social networking websites such as Facebook. The distribution methods made it difficult to calculate the response rate. Nevertheless, the primary objective of using such methods was to gain a large number of participants. The questionnaire was built using Google Documents. It was open to participant responses for a month, starting on July 1st, 2013 and closing on July 31st, 2013. When the survey closed, the results were compiled by Google and analyzed.

Participants

All participants were willing volunteers. Each respondent was required to have current or previous work experience in Saudi Arabia. Each volunteer's participation has been kept confidential. The participants learned about the survey through email and social media.

Results

Seventy-two workers voluntarily participated in the study. All respondents were from varied and broad work environments in Saudi Arabia from both the public and private sectors. The sectors include governmental offices, ministries, and public and private organizations and companies.

Safety Training

The analysis shows that 65% of participants did not receive adequate training in safety rules and procedures, as shown in Figure 1. Likewise, 64% of respondents reported that their companies did not provide them with comprehensive training in workplace health and safety issues. In addition, 69% stated that the safety training given to them was not adequate to enable them to assess hazards in their workplace. When the survey asked participants if safety issues are given high priority in training programs, about 38% reported that they agreed, while approximately the same percentage reported that they disagreed. In addition, 57% indicated that they were not adequately trained to respond to emergency situations in their workplaces. Only 32% or workers stated that management encouraged them to attend safety training programs.

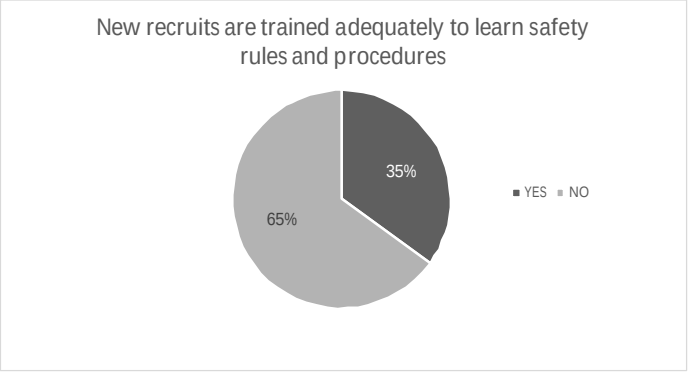

Fig. 1: Basic safety training

Safety Knowledge

The survey showed that 78%, a majority of the respondents, knew how to perform their job in a safe manner, as shown in Figure 2. Slightly more than half of the respondents said that

they knew how to use safety equipment and followed their standard work procedures. In addition, 60% of participants stated that they knew how to maintain or improve workplace health and safety; the remaining 40% said they were not aware of how to do so. A total of 58% of the participants explained that they knew how to reduce the risks of accidents and incidents in the workplace, while 35% reported that they did not know what to do or whom to report to if they noticed a potential hazard in the workplace.

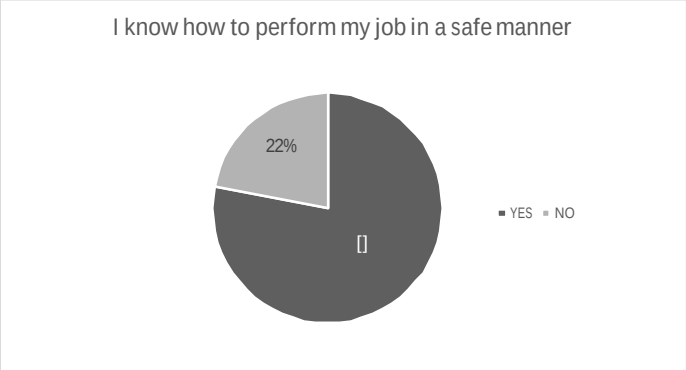

Fig. 2: Safety knowledge

Safety Motivation

The survey showed that almost all of the participants were motivated about their safety. 97% of respondents said that they felt it was important to maintain safety at all times. Similarly, 99% of participants reported that they believed safety in the workplace was a very important issue. However, more than 92% of those who responded said that safety could be compromised for the sake of increasing production.

Safety Compliance

The safety compliance garnered varied responses. 78% of respondents stated that they carried out their work in a safe manner, and 68% said that they followed correct safety rules and procedures while carrying out their job. However, while 51% of participants reported that they used all necessary safety equipment to do their job, almost a quarter of all workers – 24% – said that they did not use this equipment.

Safety Participation

The results from the questionnaire showed that Saudi employees were strong contributors to safety in their workplaces. As shown in Figure 3, 21% said "always", 31% said "almost every time", and 26% said "sometimes" when asked if they helped their colleagues who were working under risky or hazardous conditions. Approximately 60% reported that they had always informed management if they observed any questionable safety-related matters in their company; however, a quarter, 25%, confessed that they had never informed management. Furthermore, 39% of participants reported that they put in extra effort to improve safety in their workplace, while 33% of the respondents said that they did not do so.

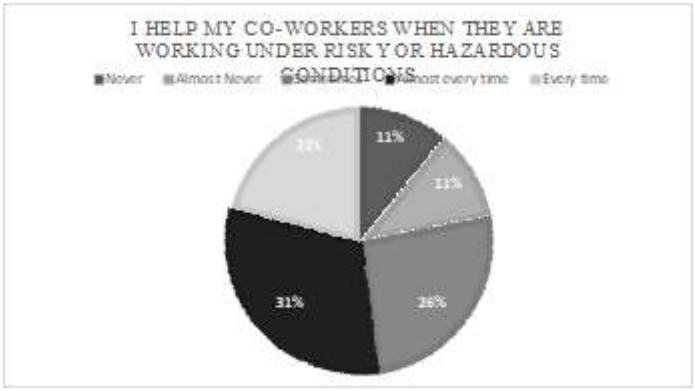

Fig. 3: Safety Participation

Discussion

The main purpose of this study was to measure the perception of personal safety in Saudi Arabian workplaces by testing five different safety roles: safety training, safety knowledge, safety motivation, safety compliance, and safety participation. These five patterns were found to be helpful in doing so, as they demonstrated the participants' range of perceptions in regard to these roles. Moreover, the questionnaire's results indicated that Saudi employees were not well trained. Nonetheless, the study did show that these employees had some knowledge about safety and were safety motivators in the workplace.

Safety Training

Each person at a work site should be adequately trained to ensure that at the end of the work day they go home safely. Different work sites and activities need their respective official training to be comprehensive and detailed. However, the questionnaire's results showed that Saudi workers were not trained properly. Unfortunately, inadequate training may lead to workplace injuries and deaths. Thus, this finding supports the hypothesis that a lack of training may be a contributing factor to Saudi's increased number of occupational accidents. The results also show that safety training was perceived as the responsibility of employers. However, respondents indicated that employers did not actually pay adequate intention to this important issue. Furthermore, although employers are required to provide proper training for their employees, they did not encourage the workers to attend the safety training programs; for example, 65% of the respondents indicated that they were not trained or taught about safety when they were hired. Moreover, 69% said that they could not assess hazards in their workplace due to a lack of safety training.

These results support the study's second hypothesis that a lack of enforcement of safety rules and regulations may also be a cause of workplace accidents in Saudi Arabia. Safety laws and regulations require people, whether employers or employees, to have proper safety knowledge before engaging in any work. However, it is clear from the findings that these laws and regulations are not enforced. If safety legislations were enforced, the number of occupational accidents would likely be lower.

Safety Knowledge

Safety knowledge is considered the most important factor in

workplace risk prevention and safety. The survey's results do show that Saudi employees are knowledgeable about safety practices. For example, 78% of the respondents said that they knew how to perform their jobs in a safe manner. This finding was unexpected, considering the high number of occupational accidents in Saudi Arabia. This indicates that workers may *believe* they know how to work in a safe manner, but may actually lack the required knowledge to do so. As the results of the safety training questions show, Saudi workers do not receive proper safety training. Moreover, about half of the respondents also said that they did not know how to use safety equipment and standard work procedures. Accordingly, these results yield questions. From where did they receive this safety knowledge, if not from their employers? To what extent are workers knowledgeable about the concept of safety in the workplace? How can workers respond as safety-knowledgeable people, but be unable to use important preventative methods such as safety equipment? Comparing the participants' safety training responses to their safety knowledge responses, it is likely that the participants were thinking of simple, commonly known safety procedures such as emergency exits and calling 911.

Safety Motivation

All employers need their employees actively motivated and mindful of their own safety to maintain a safe worksite. This can be done by offering incentives such as bonuses, rewards, or gifts to employees who follow and use adequate safety tools and procedures, and is crucial to motivate workers to stay safe. The study's results show that Saudi employees are indeed motivated about their safety. For example, approximately 97% of participants said they felt it was important to maintain safety at all times. Most the responses in this section indicated that the participants strongly valued workplace safety. For this reason, it seems likely that Saudi people will readily involve themselves in any safety training programs they may receive. Saudi employers need to take advantage of this widespread safety motivation and work to foster and provide safe workplaces for their employees. Given the increase in workplace accidents in Saudi Arabia, it does not seem that employers are currently doing so, but such an action can prevent deaths, injuries, and work absences.

Safety Compliance

Similar to the previous sections, Safety Motivation and Safety Knowledge, the study's results show that Saudi employees are compliant with safety. For example, 68% of participants said that they followed correct safety rules and procedures when carrying out their work. However, once again this raises a question. How can they be complaint if they do not understand or recognize risks and hazards? One must remember that 69% of participants said that they cannot assess hazards in their workplace due to a lack of safety training. Risks one is unaware of cannot be responded to. However, these answers reflect the employees' own safety perceptions; they show that those of Saudi workers are high. Furthermore, the answers indicate that Saudi employees are be likely to enforce safety laws and regulations. This finding may oppose the second hypothesis that a failure to enforce safety laws may be a significant cause of frequent workplace accidents.

Safety Participation

The result shows that employees in Saudi Arabia are participating in safety. As a whole, the participants indicated that they responded to and participated in varied safety matters, acting according to their different workplace environments and managements. For example, 61% of respondents stated that they voluntarily carried out tasks or activities that helped improve workplace safety. Their answers ranged from "sometimes" to "always." However, variations in safety participation may be a contributing factor in the country's workplace accidents. One must recall that in 2010, 507 Saudi workers died while 75,000 were injured. It can be concluded that when workers are unenthusiastic about their safety, they lose their concern for and participation in safety.

Conclusions

This study was conducted to measure workers' levels of awareness of workplace personal safety in Saudi Arabia. The research was divided into five sections: safety training, safety knowledge, safety motivation, safety compliance, and safety participation. It showed that Saudi employees do not receive adequate training. However, the study also showed that employees feel that they are knowledgeable and compliant with safety. Consequently, the perception of personal safety among Saudi employees is high. The study proved the first hypothesis – that a lack of safety training causes workplace accidents in Saudi Arabia. However, the second hypothesis, that a lack of safety law and regulation enforcement causes workplace injuries and deaths, has not been proven.

The results lead to the questions, "Why don't employers provide workers with adequate training, and take advantage of their workers' safety motivation?" It seems likely that management is unaware of the benefits of doing so beyond saving lives and preventing injuries. As Jannadi & Assaf (1998, p.16.)[9] found when studying Saudi Arabia's construction industry, while some companies understand the necessity of safety measures to save both lives and money, many do not. This is supported by additional studies seeking the cause or causes of poor safety performance, which often show that inadequate supervision, education, or training result in a poor safety climate (Ghasemi et al. 2015[10]; Kim, Park, & Park 2016[11]; Horie 2010[12]). Further research could specifically examine Saudi Arabian management's perceptions of workplace safety.

It is likely that the organizational climate in Saudi workplaces is negatively impacting worker perceptions due to lack of proper training and education of workers. Saudi management needs to be motivated to take advantage of workers' willingness to comply with safety by taking more initiative in providing adequate training and safety knowledge for employees. The questionnaire's results certainly indicate an opportunity for improvement. It is also recommended that safety training for Saudi Arabian workers be bolstered. New recruits need to be adequately trained in safety rules and procedures; safety training needs to be more comprehensive; workers need to be adequately taught to asses hazards; and workplace safety needs to be given a high priority when training. These measures may significantly reduce Saudi Arabian workplace injuries and deaths.

This research was originally intended to measure perceptions of workplace safety between Saudi Arabian and Canadian employees. However, a lack of Canadian responses to the online survey (9 Canadian responses compared to 72 Saudi responses) necessitated that a focus only be placed on the Saudi Arabian workforce. Further research could target the Canadian workforce to measure their safety perceptions with the same number of Saudi responses: 72. Canadian responses should then be compared to those of Saudi Arabians.

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Appendix A: Personal Workplace Safety in Saudi Arabia Questionnaire Items

Safety Training

1. My company gives comprehensive training to employees in workplace health and safety issues.
2. New recruits are trained adequately to learn safety rules and procedures.
3. Safety issues are given high priority in training programs.
4. I am not adequately trained to respond to emergency situations in my workplace.
5. Management encourages the workers to attend safety training programs.
6. Safety training given to me is adequate to enable to me to assess hazards in workplace.

Safety Knowledge

1. I know how to perform my job in a safe manner.
2. I know how to use safety equipment and standard work procedures.
3. I know how to maintain or improve workplace health and safety.
4. I know how to reduce the risk of accidents and incidents in the workplace.
5. I know what the hazards associated with my jobs are and the necessary precautions to be taken while doing my job.
6. I don't know what to do and to whom to report if a potential hazard is noticed in my workplace.

Safety Motivation

1. I feel that it is important to maintain safety at all times.
2. I believe that safety at workplace is a very important issue.
3. I feel that it is necessary to work to reduce accidents and incidents at workplace.
4. I believe that safety can be compromised for the sake of increasing production.
5. I feel that it is important to encourage others to use safe practices.
6. I feel that it is important to promote safety programs.

Safety Compliance

1. I use all necessary safety equipment to do my job.
2. I carry out my work in a safe manner.
3. I follow correct safety rules and procedures while carrying out my job.
4. I ensure the highest levels of safety when I carry out my job.
5. Occasionally due to lack of time, I deviate from correct and safe work procedures.
6. Occasionally due to over familiarity with the job, I deviate from correct and safe work procedures.
7. It is not always practical to follow all safety rules and procedures while doing a job.

Safety Participation

1. I help my co-workers when they are working under risky or hazardous conditions.
2. I always point out to the management if any safety related matters are noticed in my company.
3. I put extra effort to improve the safety of the workplace.
4. I voluntarily carry out tasks or activities that help to improve workplace safety.
5. I encourage my co-workers to work safely.

About the Author

Majed Moosa is a full-time lecturer in the Department of Industrial Engineering at Jazan University, Saudi Arabia. Mr. Moosa is a Ph.D. candidate in Industrial Manufacturing Systems Engineering at the University of Windsor in Canada. He holds a Master's degree in Engineering Project Management from the University of Melbourne in Australia and a Bachelor of Science degree in Mechanical Engineering from King Abdul-Aziz University in Saudi Arabia. His research interests include occupational health and safety, human factors, and project management. He can be contacted at moosam@uwindsor.ca.

Barriers and Interventions into Providing a Safe Working Environment for Employees within Small and Medium Enterprises

*By **Wendy Mirza**, currently studying an undergraduate degree in Health, Safety and Environment at Curtin University, Western Australia. Email: wendy.mirza@student.curtin.edu.au*

Abstract

Small Medium Enterprises (SME's) employ an estimated 99% of the population. Previous research findings have detailed the lack of Occupational Health and Safety (OSH) infrastructure within this area. The literature review has consolidated published research findings into the factors which attribute to this. A further examination is completed into some of the interventions which have been suggested, trialed and published to assist with breaking the barriers of having successful occupational safety and health practices within small and medium sized business enterprises.

Keywords: Small Business Enterprise. Occupational Health and Safety. Intervention

Introduction

Small Medium Enterprise's [SME's] represent approximately 99% of the workforce within Europe (Eurostat, 2015), in the United States, SME's provided employment for 48.4% of the population in 2012 (Caruso, 2015). The Australian Bureau of Statistics [ABS] (2016) figures show that less than 1% of the workforce is employed by companies employing over 200 people.

SME's are defined by the number of people they employ. The ABS classifies a micro business as one who employs 0-4 people, small as employing up to 19 people and medium as a maximum of 199 employees (Department of Industry, Innovation, Science, Research and Tertiary Education, 2012). The European Commission (2003) classifies micro business's as having fewer than 10 employees and medium with less than 50 employees. Classification within the U.S. differs from that of Australia and Europe with figures of less than 20 employees for very small enterprises, 20 to 99 for small enterprises and 100 to 499 for medium (Caruso, 2015).

Despite the large levels of contribution SME's make to the financial and employment stakes within countries, it is acknowledged that they have a higher risk of injury and death to their workers than that of large enterprises (Bonafede et al., 2016; Cunningham & Sinclair, 2015; Farina, Bena, & Dotti, 2015; Holizki, McDonald, & Gagnon, 2015; Holte, Kjestveit, & Lipscomb, 2015; Kvorning, Hasle, & Christensen, 2015; Masi & Cagno, 2015; Micheli & Cagno, 2010).

Comparative studies have been made between SME's and larger companies, looking at any constraints that may impact Occupational Health and Safety (OHS). Intervention programmes have also been suggested and tested, to see if there is a way to decrease the instants of injuries and fatalities within SME's.

Method

To gather relevant information needed to conduct the literature review on OHS within SME's, an initial literature review was conducted via ScienceDirect, SpringerLink, ProQuest and OSH Update. An initial search using the key words "OHS SME", with no date restrictions, produced results of 6400, 18, 1828 and 173 respectively. Results produced in the OSH Update produced 4 suitable articles, 2 of which were Government Papers. The search was further refined using the ScienceDirect database using "OHS SME" "and" "safety" which produced 577 results. On close review of these, 20 articles were found to be suitable for closer observation. A further 13 articles were gathered through citations and included for consideration to assist in exploring the topic further. Searching under "OSH SME" "and" "safety" on ScienceDirect produced 48 results.

It was decided that articles which described comparative studies as well as intervention programmes were of interest to ascertain an accurate view of OSH within SME's.

Government websites were also searched to gain data on SME classifications and numerical values.

Discussion

Comparative studies

SME's are acknowledged to have an important role within every country in both a financial and social aspect (Cunningham & Sinclair, 2015; Hadjimanolis, Boustras, Economides, Yiannaki, & Nicolaides, 2015; Jingdong & Han, 2012). Despite this they have poorer OHS conditions within the workplace than those of larger companies. Studies into the reasons for this have received minimal scrutiny within North America, though there is more extensive research being completed in Europe (Champoux & Brun, 2003).

Higher risk within SME's is attributed to the fact that these enterprises are predominantly owner-managed and as a result OHS is seen as being of less import than other matters such as the financial success and security of the company, and sustaining other requirements to ensure a successful company (Kvorning et al., 2015; Ozmec, Karlsen, Kines, Andersen, & Nielsen, 2015). Research was conducted by Masi and Cagno (2015) into the perceived barriers within SME's towards implementation of OHS policies. These were listed as regulation (legal requirements and bureaucracy), resources (time constraints and financial burden) and information (poor communication, inadequate information, limited knowledge, poor technical support from authorities and a scarcity of guidelines).

There is also the expectation within governmental bodies and regulators that what works in regards to OHS guidelines and regulations for large companies will also work for SME's (Kvorning et al., 2015). Also raised is the lack of agreement on whether micro enterprises should be examined separately to small enterprises due to smaller employment and financial levels, which in turn creates different requirements (Masi & Cagno, 2015; Micheli & Cagno, 2010).

Several authors conducted comparative research by sending questionnaires to SME's, asking for feedback on their current OHS standards. Each study found that the response rate to the questionnaire was low, and those who did respond had a higher level of OHS than expected. The authors assumed those who didn't respond had low standards of OHS within the workplace and feared government regulatory visits and subsequent fines based on the responses to the questionnaires (Kongtip, Yoosook, & Chantanakul, 2008; Lamm, 1997; Sørensen, Hasle, & Bach, 2007). Low standards of OHS can be linked to the perceived view that SME's have a lower risk of accidents occurring, so the short term investment in OHS resources is not seen as a priority (Farina et al., 2015). Unfortunately this is seen as a warped view of the true situation as many accidents go unreported in SME's (Sørensen et al., 2007). Fatalities within SME's are of higher prevalence than in larger organisations. Holizki et al. (2015) highlighted this in British Columbia, where nearly 9% of work related deaths within SME's occurred during the first week of employment and a further 4% of fatalities occurred within one month. This is in comparison of approximately 4.5% and 1% respectively in larger companies. It was also found by Holte et al. (2015) that apprentices in electrical and building trades had a higher prevalence to injury when employed by companies of 10-19 employees, as against those of higher employment numbers.

Workers in smaller enterprises also see Health and Safety as being an individual's responsibility due to the informal nature of the company being Owner/Operator. Employees have the opinion that as long as they use common sense everything will be fine (Holte et al., 2015; Ozmec et al., 2015). One positive outcome mentioned by several authors is that both the informal nature and small company size enabled more direct communication between employers and employees (Bonafede et al., 2016; Holte et al., 2015). Ozmec et al. (2015) conducted research into this subject by assessing construction companies within Denmark. It was found that though the owner/employer provided equipment, it was the employees who took care of themselves, as no formal OHS policy was seen to exist. Employees also preferred it if the owners maintained minimal contact with them during the working day and just let them get on with it. Ozmec et al. (2015, p.281) go further to state "safety practice was a negotiated practice established in both internal and external struggles for legitimacy, identity , positions and craftsmanship".

SME's that did conform to some level of OHS, were either those whose parent companies assisted in the financial and implementation aspects of OHS, or unless a certain level of OHS was in place, then the SME would not be awarded contracts by larger companies (Kongtip et al., 2008; Vassie, Tomàs, & Oliver, 2000). Jingdong and Han (2012) found that within China, those companies who were foreign owned or funded had a higher understanding and management of OHS requirements than those of local SME's. Further highlighted is the disparity between individual countries OHS policies, regulatory bodies and support systems. For example the European Union [EU] has guidelines set in place but it's down to the individual country to ensure these are implemented as identified by Reinhold, Järvis, and Tint (2015), Vassie et al. (2000) and Ozmec et al. (2015). It is not a case of one plan fits all.

Also raised was some SME's unwillingness to employ or consider using Health and Safety consultants or other intermediaries. They were seen to be expensive and provided documentation and advice which was too complicated and time consuming for practical use (Walker & Tait, 2004).

Intervention studies

Despite the acknowledgement that OHS requirements within SME's is lacking, there has yet to be a definitive plan on how to improve this. Researchers have, over the years, looked at different ways to assist SME's, however there doesn't seem to be one answer. Various research methods have included the following;

Kvorning et al. (2015) discuss a Danish government program called 'Prevention Packages' which provided financial and professional assistance to SME's to help rectify ergonomic aspects of the businesses.

Farina et al. (2015) assessed the concept of encouraging SME's to improve OHS conditions and machine safety in Turin, Italy. Assistance was given through site visit and appraisals, followed up by free training sessions being given.

Cunningham and Sinclair (2015) reviewed the National Institute for Occupational Safety and Health (NIOSH) led initiator-intermediary-small business approach, through four case studies in different sectors within the US

Walker and Tait (2004) examined the impact of SME's initially having training at a free Information Centre followed up by an onsite assessment by a retired HSE inspector with experience in UK SME's.

Kines, Andersen, Andersen, Nielsen, and Pedersen (2013) oversaw a study financed by the Danish Working Environment Research Fund where randomly chosen small metal companies either received intervention or not on assisting to prevent workplace injuries. This was achieved using DeJoy (1996) behavior based "problem solving" and "culture change" model. Both management and worker involvement is required in this model.

Olsen and Hasle (2015) looked at the relationship between intermediaries and agricultural small companies in New Zealand. It highlighted that the intermediaries own personal/business interest, impacted on the success of helping to introduce OHS into the agricultural businesses.

Intermediary usage was examined by Lamm (1997) in New Zealand. This was between small accounting firms, OHS regulators and SME's.

Cagno, Micheli, Jacinto, and Masi (2014) reviewed safety focus models using a focus group comprising of five OSH and SME professionals. It proposed a model comprising of three predominant features: systemic, intervention orientated and SME specific.

Using smart phones and tablets, Bragatto, Ansaldi, and Agnello (2015) looked to create a safety management system for small businesses which was simple and practical. This is used in conjunction with the Bowtie system for assisting with risk and safety audits. The effective use of this system was judged by undertaking 2 case studies.

Intermediaries were used in several of the methods to mixed results. Kvorning et al. (2015) acknowledge that motivating the owner/operator to implement OHS within their companies is difficult as it is seen to be an issue to be resolved when it eventuates. They go further to say that this lack of motivation inhibits owners to accept assistance. Lamm (1997) discussed the importance of a coefficient relationship between the intermediary and SME for any degree of success to be gained. This was further built on by employing intermediaries who have some connection and understanding of the SME's individual business type i.e. farming, construction, general industry, metal working etc. Recommendations were accountancy firms (Lamm, 1997), financial advisors (Olsen & Hasle, 2015) and workers compensation insurance (Cunningham & Sinclair, 2015). Having this type of company as intermediaries also enables them to inform the SME of any financial benefits they would gain from government and regulatory bodies by having OHS in place. One concern highlighted by using this type of intermediary was the level of OHS experience they would have (Lamm, 1997). Cunningham and Sinclair (2015) also note that in their case studies, NIOSH, as the initiator of the program, didn't relinquish enough control over to the intermediary, which in turn hampered the establishment of a relationship between the intermediary and SME.

A survey undertaken by the Sensis Business Index (2004) for the National Occupation Health and Safety Commission Australia found that whilst the most preferred way for OHS information to be conveyed to SME's was via personal meetings, each sector differed slightly in the way they received and then actioned information. It is therefore important to realise that all SME's should not be clumped together and each sectors needs should be identified.

Kines et al. (2013) took a different approach to intermediary intervention by using Dejoy's safety culture model. The authors used their backgrounds in clinical psychology and coaching to help the owner/operator identify and compile their aims for OHS within their companies. They were then guided by the authors to create a feasible and workable plan. Meetings were also arranged between the authors, owners and workers. Kines et al. found that those companies which took part in the intervention through to completion of the project had a better attitude to OHS changes.

It is also important to note that due to the lack of OHS expertise by owner/operators, HSE's may not be aware of the companies OHS needs. Farina et al. (2015) highlighted this as well as the fact that the initial baseline site visit completed at the beginning of their study was seen to be more beneficial than the free training sessions. On the final site visit for each company, they also found that low cost improvements were predominantly completed in comparison to the higher cost ones like machinery repairs. This collaborates previous findings that many SME's do not have the financial resources to put into establishing good OHS levels within their companies (Farina et al., 2015; Kvorning et al., 2015; Masi & Cagno, 2015; Vassie et al., 2000)

The use of technology to assist with the implementation of OHS was investigated by several authors. Bragatto et al. (2015) found success in a limited test capacity of their AGILE program. Both workers and managers became more aware of OHS procedures and implementation due to the ease of using the program, though as Bragatto et al. state, a true test will be after it's been released to the general public and seen long term use. They will also be able to ascertain whether it is a short term fad with the user or one that has longevity.

Though not a work place based intervention, Cagno et al. (2014) developed a SME specific safety performance model. Other models produced have been mainly geared towards large enterprises and Cagno et al. hoped to provide a better option. The authors state that more refined studies need to be made of the SME model to ascertain transferability and ease of use.

To help SME's with implementation of OHS projects, the European Agency for Safety and Health at Work (2005) provided partial funding to chosen SME's. They received 647 proposals with 40 being chosen to receive funding. This is a way for individual projects to go ahead which otherwise may not have done. Unfortunately, it doesn't deal directly with problems within SME's. Those that applied for funding are already aware of OSH issues that need to be rectified.

Conclusions

It is a globally acknowledged fact that whilst SME's provide substantially to individual countries income and employment levels, they suffer through low or non-existent adherence to OHS. There are a multitude of recognized factors that inhibit the implementation of OHS, which include low priority given by owner/managers, general complacency due to no major accident occurring and limited financial resources.

Whilst interventions have been considered and investigated, no one specific plan has to been found to solve this problem. The interventions investigated in the journal articles reviewed, all need further long term investigation. It is also important to recognise the diversity of requirements between sectors and these needs should be considered when structuring a cross-sector intervention plan.

Additionally, due to the vast number of SME's and the individuality of each, further thought needs to be done by governing bodies to enable a better implementation of OHS. Maybe each owner has to compulsorily attend a OHS course prior to registering/setting up a SME?

It is important to note that a higher number of intervention studies were found from recent years, which shows that it is an issue which is being given considerable thought and research. A recommendation for a further search and study of intervention research to amalgamate knowledge, enabling further clarification of findings, is suggested.

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About the Author

Wendy Mirza *is currently pursuing an undergraduate degree in Health, Safety and Environment at Curtin University, Western Australia. You may email Wendy at: wendy.mirza@student.curtin.edu.au*

The Pyramid Effect: Key to a Positive Safety Culture

*By **Monica P. Cervantes** WSO-CST/CSI(SL), ASP, CIH; Owner, Twin Horse Environmental, Hobbs, New Mexico, USA*

ABSTRACT

The "Pyramid Effect" utilizes Abraham Maslow's theory to help management construct a positive safety culture which will reduce cost, provide efficiency, and overall employee satisfaction. The "Pyramid Effect" will give direction and ease to the miscommunication of ideas and enhance the overall employee well being. The idea is simple to understand and can be implemented easily once a decision has been made to adopt the "Pyramid Effect" into your workplace. Abraham Maslow's pyramid has proven through the test of time to be effective in building stronger, healthier individuals. By incorporating these techniques into our workplace a more productive, positive work environment can be accomplished. "Pyramid Effect" theories will help define your next safety meeting, policy, and standards of procedure to sharpen and structure your existing safety program or help you design a new program to redefine your company's safety culture.

As the number of work related injuries and accidents increases each year, employers as well as employees must incorporate more efficient and effective safety cultures in order to decrease incidents within the constraints of their company policies, procedures, and code of ethics. A balance between personnel and authority must be met with an understanding, respect, and obedience in order to reduce injuries and fatalities in the workplace.

Current safety culture flaws give rise to incidences involving people, environment, and materials. Employers may find incorporating safety training, techniques, procedures, and policies difficult to maintain. The lack of motivation and cooperation on behalf of employees, supervisors, as well as management can encourage a poor safety attitude and culture within the workplace.

Understanding the employees' needs can help management design a more positive safety culture. The "Pyramid Effect" utilizes Abraham Maslow's theory to help management construct a positive safety culture which will reduce cost, increase efficiency, and improve overall employee satisfaction. The "Pyramid Effect" will give direction and ease to the miscommunication of ideas and enhance the over all employee well being. The idea is simple to understand and can be implemented easily once a decision has been made to adopt the "Pyramid Effect" into the workplace.

With all decisions comes uncertainty and change, as Abraham Maslow wrote:

> "An authoritarian person or organization does not ask, listen, or solicit honest feedback. Rather, it tells, orders, or makes pronouncements, without obtaining feedback, evaluation, or assessing customer satisfaction or gaining any real knowledge of how the system is actually working. In contrast the democratic attitude which arises from a person's character structure and from societal arrangements, involves a profound respect for other people I might even describe this attitude as one of compassion, agapean love, or openness to others, a willingness - even an eagerness- to listen." (Future visions, Maslow 157)

The art of listening to people is one difficult to master. A complex combination of verbal and nonverbal cues which must be understood with limited time frame. Being open to and actively looking for a person's needs will help us to better understand the level of motivation and well being of the speaker.

Active listening in the workplace can help us determine and tune into each individual's personalities. Personality is simply defined as a set of emotional qualities and ways of behaving which makes a person different from other people.

The current workplace environment has a vast variety of personalities which must work together throughout the work day to yield an outcome. Understanding personalities is complex and has been theorized in trait-theory of personality, self-efficacy and personality, Freud's theory of personality, and Maslow's hierarchy of needs . Of all the fore mentioned theories, Maslow's hierarchy of needs is one designed to deal with the individual need. Abraham Maslow wrote:

> "This theory is, I think, in the functionalist tradition of James and Dewey, and is fused with the holism of Wertheimer, Goldstein, and Gestalt Psychology, and with the dynamiscism of Freud and Adler. This fusion, or synthesis, may arbitrarily be called a 'general-dynamic' theory." (Maslow Business Reader, Maslow 252)

Abraham Maslow's Theory is general and dynamic simply because all human beings have needs which can be filled and completed. A need is defined as something that must be accomplished in order to live or succeed or be happy.

Maslow's Hierarchy of needs consist of physiological needs, safety and security, Love/Belonging, Esteem, and Self Actualization. Maslow's pyramid can help to evaluate your workplaces safety culture as a whole and individual basis . The ability of this Macro and Micro evaluation comes in the understanding of success of the corporation through the building of the individual. Reaching for success through helping others reach their God-given potential can be a win-win situation for companies and employees.

"If we want a motivated workforce, we must build and continually modify an environment in which people can fulfill their needs while pursuing the goals of the organization. The obvious key to

the successful implementation of this theory is alignment-of personal needs and organizational goal." (Maslow's Business Reader, Maslow 250)

Evaluation of the workplace organization utilizing the Hierarchy of Needs will give direction to the whole. This alignment for success can encourage employees to fulfill their needs and go about achieving their goals. The employee's actions will be coincide with the best interest of the organization. This "Pyramid Effect" can be the key to creating a positive safety culture within your business.

Heirarchy of Needs

The "Pyramid Effect" begins with the physiological needs of the employee and business. The homeostasis of an individual and the heartbeat of the community must be understood by management in order to successfully implement the "Pyramid Effect." The success can be measured in individual and company growth in harmony, out reach, and unification of each to form a positive whole. The physiological needs are food, water, sleep, etc. A company can offer adequate pay scale to and for the employee according to cost of living for the area. This will and can help provide for some of the major physiological needs. As for the company, a well managed budget will provide the needed revenue to provide the basic monthly and yearly cost.

Companies can develop programs to review employee's health quarterly. In order to improve health and attendance, employers may add health and wellness programs. These programs deal with the human body which is a finely tuned combustion engine. Each individual will need adequate time to refuel, replenish, and rest for best results. In addition employers can also incorporate "Fit to Work" programs which can help to ensure an employee has been given ample time to rest and nourish his/her body.

Stress Effects on Pyramid

Stress can and will cause havoc on an individual's well being. This stress may lead to drug and alcohol consumption. This consumption can lead to abuse if underlying issues are not addressed. In order to deter drug and alcohol abuse, an employer must establish a clear and concise drug and alcohol policy. This policy should include an employee assistance program (EAP) which can improve love/belonging within the pyramid.

Stress management techniques can also be encouraged among staff members to reduce stress related illnesses and workplace violence issues which may arise from an event.

The beauty of the "Pyramid Effect"

The workplace can be an environment which can promote healthy attitudes which can carry over into the home and community.

Abraham Maslow wrote:

> "For instance, I would expect that if the management policy were truly growth fostering and truly better-personality producing, that these individuals would, for instance, become more philanthropic in their communities, more ready to help, more unselfish and altruistic, more indignant at injustice, more ready to fight for what they thought to be true and good, and so forth. This can easily enough be measured, at least in principle. (Maslow's business, p.139)

Maslow's paper continues with the concept of the changed man would become a better father, husband and an all together better citizen.

The "General Duty" of Safety and Security

The levels of the pyramid needs begins with physiological needs once these needs are met. An individual will move on to the next level of Safety and Security. Safety and Security within the workplace is a very dynamic, yet ever changing topic which is a by-product of environmental, personal, and community relationships.

The "General Duty" of Safety and Security in the workplace is presented in the OSHA general duty clause.

The Occupational Safety and Health Act (OSHA) of 1970 General Duty Clause, Section 5(a)(1) states employers are required to provide their employees with a place of employment that "is free from recognizable hazards that are causing or likely to cause death or serious harm to employees."

The need for safety has been long understood by our nation's lawmakers. The real battle begins when employers or employees fail to take on a safety oriented approach to job processes and work place design.

Employers training of employees in safety standards and developing workable Standard of Procedures can help to fill the employees need for safety and security. Training expands the knowledge base of the employees and can be the key to success. By educating employees on the workplace safety measures and standards in place to protect him/or her, employers will build trust and understanding among their employees. This bond will fill the safety and security need on the pyramid.

Once safety has been defined and established it will depend on the worker to use and assist others to encourage a safety oriented workplace. Management will need to over see this through BBS programs, field evaluation, etc. Management must also be unwavering and committed to the idea of all employees will abide by the standards. Employees will look to management to serve as role models to encourage others to incorporate safety techniques and ideas.

Love/Belonging

Individuals build bonds through time and events. Nurturing relationships with employees must be selective and beneficial to the company as a whole. The time spent must yield positive outcomes for company, employee, family, and community in order to be well spent.

If an individual or organization is not filling the subject's needs there will be a rupture in the relationship. Workers, co-workers,

and employers all form a different pattern of relationships; each fills the need for love and belonging for each. Employers can encourage employees to attend company picnics, weight loss contest, golf tournaments, etc. to build a sense of belonging for the employee towards the company.

Continuous Relationships Builds Esteem

Esteem is simply defined as respect and affection. Employer's high regard for themselves, one another and employees is one built through positive connections through time and positive worth-while interaction which is truly valued by employee, co-workers, employer, and community. The building blocks of esteem gives rise to the respect and affection an employee has for his/or her job or occupation.

Employees will encourage others to join him/her to accompany them throughout his/her workday. Father and sons /mother and daughters will be seen throughout the workplace. This is a clear sign both father or mother are proud of their work environment and want their children to participate in much the same quality of work.

Clear investment are seen on behalf of the employee in regards to time, effort, and efficiency when esteem has been built for the company. Safety Awards, Safety points, Bonuses, etc.. all help to encourage a financially beneficial environment and good competition among employees.

The Dream Man

The top level of the Hierarchy of needs pyramid is self actualization. Self actualization is reached when a man or woman becomes who they were destined to be. A self actualized person uses there natural or learned ability to make a positive impact for themselves, others, and community without interest of time or money just simply to make a difference in this world. Some characteristics of a self actualized person are as follows:

- Embrace the unknown and the ambiguous
- Accept themselves, together with all their flaws
- Prioritize and enjoy the journey, not just the destination
- Are inherently unconventional, but do not seek to shock or disturb
- Motivated by growth, not by the satisfaction of needs
- Have purpose
- Are not troubled by the small things
- Are grateful
- Share deep relationships with a few, but also feel identification and affection towards the entire human race
- Are humble
- Resist enculturation
- Are not perfect

In a letter written to Mr. John D. D. Rockefeller III, Abraham Maslow commends Rockefeller on his Manila talk on "The Quality of Life". Maslow ,goes on in the paper to state, he found Rockefeller's talk fascinating. Maslow's letter continues with:

> "...Another general scientific finding that I think would be helpful to you in your thinking about the quality of life is the finding that these basic needs are organized into what I have called a "hierarchy of prepotency." That is, although these are all universal human needs that demand gratification on pain of developing illness, some of them are more urgent, more prepotent, more demanding than others. The hierarchy of prepotency is an order of urgency or demandingness. The findings are so far that most urgent are the material needs; then come the safety-security needs; then comes belongingness; then come loving and caring, friendship, and affection; then come respect and self-respect and dignity; and then, finally, comes fulfilling one's own individual potentials, what I have called self-actualization. As you point out, self-actualization or dignity and so on are quite expendable when the person is hungry." (Hoffman, p.201)

Conclusion

The Hierarchy of Needs can help develop a more positive work environment which is safety focused and employees contribute and develop ideas to support and enhance the day to day production. The Hierarchy of Needs apply at various level in human development can identify needs and help to problem solve. The need can be addressed promptly without a rupture in employer and employee relationship. Without a doubt, the "Pyramid Effect" is the key to a safety culture which can build positive communities one individual, one company, at a time.

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About the Author

Monica Cervantes *is an Associate Safety Professional, Certified Industrial Hygienist, OSHA Certified Trainer, WSO-CST/CSI0SL), American Red Cross Instructor Trainer for the Professional Rescuer, FEMA Emergency Manager, Incident Commander Level III, and Advance ICS. She currently holds a Texas Fire Extinguisher license, PEC Safeland Instructor, PEC H2S All Clear Instructor, PEC Core Instructor, PEC Safe Construction Instructor, and PEC Pipeline Instructor. Monica is also a Medic First Aid instructor trainer, proud member of the WSO, and chartering President of the WSO New Mexico Chapter.*

The Risk Management of Community-Acquired Pneumonia Caused by Clinically Diagnosed Legionnaires Disease

*By **Moriah Moylan**, currently pursuing a Bachelor of Science in Health, Safety and Environment at Curtin University, Western Australia.*

Abstract

Legionella is a major concern causing infection in humans leading to community-acquired *Legionella* pneumonia. The causative bacterium is found readily in artificial water-cooling systems and human exposure is usually by fine particulate aerosols meaning it can be inhaled. This article analyses published peer-reviewed literature associated with Legionnaires disease and the risk management in place to minimise the likelihood of exposure. The article considers current diagnosis and treatment as well as existing control measures and regulatory aspects. The aim of this article was to summarise risk management and its use in Legionellosis prevention and management improvement.

Keywords: Legionella, Legionellosis, Legionnaires Disease, Legionellae, Pneumonia, Community-Acquired Pneumonia

Introduction

The genus Legionella bacteria consists of 58 species, all of which are isolated to natural and artificial aquatic environments (Cunha, Burillo, & Bouza, 2016a). Around 30 of these causative microorganisms are identified to cause infection in humans (Cunha, Burillo, & Bouza, 2016b, p. 2), affecting the lower respiratory tract in the form of Pontiac fever to the potentially lethal form of pneumonia- Legionnaires disease (Azuma, Uchiyama, & Okumara, 2013). The bacterium was first discovered in 1976 at a convention for the American Legion in Philadelphia, where a major outbreak of community-acquired pneumonia affected 182 individuals, 29 of whom died due to being infected by the L. pneumophila species (Sakamoto, 2015). The spread of the disease indicated it was airborne, yet it was not identified until the following year as the Legionellosis bacterium (Cunha, Burillo, & Bouza, 2016a).

The causative bacterium's ideal conditions for rapid growth are in water temperatures between 25–42D C (Sakamoto, 2015), which explains why outbreaks of Legionnaires disease have been linked to contaminated artificial water systems, such as air conditioners used for water cooling (Falkinham, Hilborn, Arduino, Pruden, & Edwards, 2015). Furthermore findings show the growth of the causative bacterium in creeks and ponds, hot water taps, water cooling towers, evaporative condensers and spa-baths (Azuma, Uchiyama, & Okumara, 2013). The main route of passage is known to be inhalation of aerosols/ fine particulates that contain bacteria from the genus Legionella (Newsom, 2009). The incidence of Legionnaires disease worldwide is unknown due to people in some countries lack of awareness levels, poor diagnostic methods and non-reporting of the illness. Legionnaires disease is accountable for 2-9% of community-acquired pneumonia (Stout, & Yu, 1997).

Methodology

To determine the risk management of community-acquired pneumonia caused by clinically diagnosed Legionnaires disease a literature review was conducted. The literature search was limited to full text peer-reviewed articles, health organisation reports and Australian Codes of Practice. Books in regards to Legionella were investigated, with all references published between 1982 and 2016. Collection methods consisted of using public health databases such as Pubmed, Science Direct and Curtin Universities Library catalogue together with webpages and reports on clinical diagnosis of Legionnaires' disease as well as Legionella and the Prevention of Legionellosis from the World Health Organisation.

Using Curtin Universities Library catalogue and searching using the key-words 'Legionnaire's disease', 24,154 results were displayed. A refined search was then conducted limiting the results to peer-reviewed articles (9,082 results) and thirdly refined to a resource type of 'Articles', limiting the results and number of articles to 8,835 results. Using Pubmed and Science Direct the relevant indexes and searching the key-words 'Legionnaires disease' the following number of articles was found in each database; 4898 and 4086. Another search to find information on community-acquired pneumonia caused by Legionella was completed using the key-words 'community-acquired Legionella pneumonia', with 3,585 results found on Science Direct. Further information was collected from sources found through peer-reviewed articles as well as the World Health Organisation. Only the most relevant publications to the topic are included in this article.

Of the publications reviewed, twenty-six peer-reviewed articles are included in this literature review. Two PDF documents and books are cited as well as four webpages, one law, two Codes of Practice and two Australian Standard.

Risk Factors for Legionnaires Disease

High fevers and gastrointestinal symptoms occur more frequently in legionnaires' disease than any other causes of community-acquired pneumonia (Mulazimoglu, & Yu, 2001). Known risk factors include chronic lung disease, smoking, persons 50+ years of age, travellers, diabetics and individuals with immunosuppressive conditions (Nguyen, Picard-Bernard, & Perriot, 2010). Men are predominantly affected by Legionnaires disease,

with five males to every three females contracting the disease. (Den Boer, Nijhof, & Friesema, 2006; World Health Organisation, 2016).

The Centre for Disease Control and Prevention conducted a study on New York residents with results depicting higher risks of developing Legionella. The incidence of this disease has increased by 230% since 2009 in the New York area (American Medical Association, 2014). Those living in poverty and of older age were more likely to get the disease. The risk of exposure to legionella has been found to be especially prevalent when working in outdoor occupations such as machinery, protective or cleaning services, transportation and construction as these jobs have increased likeliness due to exposure to airborne water vapours via plumbing systems or from being outdoors (American Medical Association, 2014).

Diagnosis of Legionnaires Disease

The American Journal of Medicine diagnoses Legionnaires disease through six characteristic clinical and laboratory parameters to foretell or rule-out the disease before biological clinical testing. Findings such as highly elevated ferritin levels, C-reactive proteins erythrosedimentation rate, presence of microscopic haematuria, highly elevated creatine phosphokinase tests and hypophosphatemia all associate with positive Legionellosis results (Cunha, Strollo, & Schoch, 2010; Cunha, 2008). Diagnostic eliminators consist of a negative chest x-ray showing no infiltrates, a sore throat and muscular pain (Cunha, Wu, & Rasa, 2015). If over three of these findings are established it is very likely that the community-acquired pneumonia suffered from is linked with Legionnaires disease, where-as if fewer than three of these symptoms as well as diagnostic eliminators are present it strongly suggests against the Legionellosis diagnosis (Cunha, Wu, & Rasa, 2015).

Overtime, the prevalence of clinically diagnosed Legionnaires disease has increased. This may be because of developing recognition and reporting with greater use of the legionella urinary antigen testing or because of an actual increase in the illness. This information is not readily answered (Yu, 2014), yet the bacterium caused disease results in the most severe pneumonias, consequently resulting in a higher mortality rate (Ruiz et al., 1999).

Due to its non-specific symptoms, Legionnaires disease is not always suspected so testing is often delayed (Cunha, Burillo, & Bouza, 2016a). The World Health Organisation (2016) recommends that diagnostic testing should be performed on all patients with community-acquired pneumonia, including those who are seriously ill, whether or not they have symptoms that suggest Legionellosis. It is suggested that community-acquired pneumonia patients displaying symptoms that do not match their diagnosis- particularly patients that are ill or above 50 years of age, are immunosuppressed or unresponsive to β-lactam antibiotics, undergo testing for the bacterium disease (Euser et al., 2013).

Legionnaires disease is usually determined through a serology or urinary antigen test, yet this diagnostic method is not the most desired testing due to lack of sensitivity (Cunha, Burillo, & Bouza, 2016). Culture-based testing of sputum or bronchoalveolar lavage (washing the bronchial tubes and alveoli with repeated injections of water) is the most accurate clinical testing for Legionella yet the most invasive (Bartram, Chartier, Lee, Pond, & Surman-Lee 2016). This method also presents growth time-delays which can be unsuitable for the treatment of Legionellosis (Haubitz et al., 2014).

Treatment of Legionnaires Disease

The community-acquired pneumonia caused by Legionella is unresponsive to β-lactam antibiotics but the epidemiology and pathogenesis of the disease has since been clarified with non-culture based diagnostic testing available (Cunha, Burillo, & Bouza, 2016a). Doxycycline, quinolones and macrolides have shown to be effective treatment for the incidence of community-acquired pneumonia caused by Legionnaires disease (Stallworth, Steed, Fisher, & Nolte, 2012). The delay of antibiotic treatment can lead to higher mortality rates of those with acute symptoms (Viasus, et al 2013).

Approaches to Risk Management

Identifying Risk Control Measures

Risk control measures are actions and processes that are applied to a system to prevent hazards from causing harm. These measures are applied at a control points as a preventive measure or elimination stage to reduce Legionella as a health hazard.

The peer reviewed article by Eggins and Oxley (1982), states risk control measures for Legionella bacterium include:

- Eliminating the microorganism;
- Influencing the environment to reduce colonisation and limit growth of the microorganism (through controlling nutrient levels, temperatures and preventing low water flow and water stagnation);
- Using disinfectant

Risk control measures using physical techniques such as coagulation, sedimentation, filtration plus disinfection reduce the amount of legionellae in water supplies (Kuchta, States, Mcnamara, Wadowsky, & Yee, 1983). The efficiency of control measures for Legionella depends on numerous variables. Physical systems of removal such as UV and filtration may have positive effects if fitted near the waters point of use, yet if biofilm harbouring Legionella bacteria is downstream from removal system it will not have satisfaction in removing the bacteria (Bartram, et al., 2016). The supplier of the water should ensure appropriate drinking water guidelines of jurisdiction with the water source not containing high levels of nutrients; there is no defined criterion for effective removal of Legionella in water (Bartram, et al., 2016). In high-facilitated areas such as hospitals, diffusers to reduce water should not be installed as more aerosols are produced when in place. Mixing valves should be as close to the water exit route as possible and shower fittings should be detachable to ensure easy access for routine cleaning and disinfection (Bartram, et al., 2016). The use of the chemical

compound Monochloramine, can be used as a disinfectant, competent in the removal of Legionella in biofilms (Kool, Carpenter, & Fields, 1999).

After elimination and substitution, engineering is the best control measure. Control measures for Legionella should begin at the design stage of a water system. In intricate systems regulation valves must be used to control water flow and furthermore dead ends should be avoided (Bartram, et al., 2016). Construction materials used to construct piped water systems should be of high quality to ensure they're compatible with the chemical composition of water therefore minimising the likeliness of Legionella growth (Bartram, et al., 2016).

Temperature is critical in Legionella control; therefore water temperatures should be well controlled, measured and registered. To ensure minimal bacteria water should be above 60ºC in a re-circulating hot-water system with as short as possible piping connecting taps with hot-water systems. Cold-water systems should not exceed 25 ºC and where possible should be below 20 ºC to decrease the growth of legionellae (Bartram, et al., 2016). Increases of temperature in cold-water pipes, reservoirs and treatment devices should be prevented through proper insulation and adequate distance between cold and hot water pipes and heating equipment (Bartram, et al., 2016). These control measures should be applied in all organisations using water systems and respirators and protective equipment should be worn for individuals working in high-risk occupations to prevent disease transmission (American Medical Association, 2014).

Management and Communication

Preventative measures have been widely adopted by public and private bodies, using cleaning efforts more regularly (at least 3 monthly) to prevent build-up of the bacteria and by implementing well-developed supporting programs, established documentation and risk communication procedures (Bartram, et al., 2016). Through these processes, risk management procedures can be prepared and used.

Monitoring

Organisations should apply risk management through monitoring control measures and by supervising water flow rates and prevention water stagnation (Bartram, et al., 2016). This is fundamental and vital as a preventative measure. All approaches of microbial control depend on water chemistry, temperature and the use of water systems so the monitoring would involve observing these factors.

Environments with temperatures for optimal growth of Legionella are to be avoided, and when water systems are at risk of stagnation, disinfection and flushing should be periodic (at least weekly) (Bartram, et al., 2016). This "flushing" process should be monitored with control measures in place to minimise exposure to aerosols that may contain legionellae (Bartram, et al., 2016).

Surveillance

The ongoing systematic collection, analysis and interpretation of health data is essential to the planning, prevention and evaluation of Legionnaires disease (Bartram, et al., 2016). The vital link with surveillance is that data collected is applied to counter-prevent and control disease outbreak and implement a risk management system (Bartram, et al., 2016).

Regulatory Aspects

Legionnaires' disease was first identified in 1976 and this being a recent discovery, ongoing investigation and documentation is needed (Sakamoto, 2015). In 2001 a meeting was held in Adelaide, to deliberate methodologies to regulate microbial drinking -water quality and develop risk assessment and risk management approaches. This was incorporated into the 3rd edition of the World Health Organisation "Guidelines for Drinking Water" (Bartram, et al., 2016), being a health standard internationally. This meeting also suggested a guideline document to be produced on Legionella, with the research article "Legionella and the Prevention of Legionellosis' made to inform the public and citizens interested on the disease.

Existing Guidelines

The Standards Association of Australia/Standards Association of New Zealand (2002) consists of documents that provide recommendations for control of Legionella including preventative risk management. This is based on the principle that prevention is best to manage hazardous situations. In regards to guidance to minimise illness and ensure safe levels of bacteria in water, relevant Australian Standards exist and include the following:

- AS/NZS 3666.3 Sections 3/ AS4032
  Maintenance of cooling/warming water system
- AS/NZS 3666.2 Clause 2.6.2
  Maintenance logbooks
- AS/NZS 3896 (for microbiological testing)
  Annual inspections and microbiological testing

Other guidance in Australia is provided through the following two Codes of Practice and one law.

South Australia Public Health (Legionella) Regulations, 2013.

Code of Practice. Prevention and Control of Legionnaires' Disease (Government of Western Australia, 2010)

Code of Practice for the Control of Legionnaires' Disease (2nd edition) New South Wales (2004)

Responses to detection of Legionella

Upon specifying Legionella presence, the owners of a manufactured water system must immediately shutdown or decontaminate the system and report test results to relevant authorities within 24 hours.

Outbreak Investigation

Epidemiologists, microbiologists and environmental health specialists within the country of concern should manage Legionella outbreaks with a control team that should that have awareness of Legionellosis risks (Bartram, et al., 2016). The outbreak control team should consist of a public health specialist, consultant epidemiologist and microbiologist with expertise in Legionella, consultant from a local microbiology laboratory as well as a hygienist, data manager, infection control nurse, health and safety enforcement officer and media spokesperson (Bartram, et al.,

2016). The media spokesperson must be prepared and have a good knowledge concerning the epidemic, as was seen in 1976 at the legion conference (Sakamoto, 2015).

Analysing Legionnaires Disease Management

Although Legionella urine antigen testing is the primary diagnostic testing for Legionellosis, the importance of culture-based testing is evident as urine testing only detects L. pneumophila. The sensitivity of urine antigen tests also varies with disease severity (Kanatani et al, 2013).

Discussion: Improving Legionnaires Disease Management

Legionnaires' disease is not frequently suspected and is often misdiagnosed as the symptoms can be non-specific and the diagnostic tests routinely available are not at a desired sensitivity (Azuma, Uchiyama, & Okumara, 2013). Research and risk assessments on Legionella are currently inadequate, with an improved understanding of Legionellosis epidemiology needed to identify causing environmental factors and improve risk evaluation as well as investigate case control and outbreaks (Azuma, Uchiyama, & Okumara, 2013). This is necessary in Legionella ecology to help with further understanding into the diseases severity and risks (World Health Organisation, 2016).

Quantitative Microbial Risk Assessments (QMRA) applies estimations of pathogen density and infectivity information to assess pathogen risks, such as risks from inhalation of Legionella (Buse, Schoen, & Ashbolt, 2012). Using guinea pig testing, inhalation data of L pneumophila was established to find a dose -response relationship (Sakamoto, Ohno, Nakahara, Satomura, Iwanaga, & Kouyama, 2009). The dose-response was applied with the QRMA, predicting disease risk and mortality, presenting a strong method of risk assessment to further diagnose and evaluate Legionella exposure.

For future prevention of Legionellosis the Water Safe Plan published by the World Health Organisation is an implemented preventive risk management system and is a foundation to form guidelines and regulations on Legionellosis (Bartam, et al., 2016). The regulatory authority for toxicology and pharmacology (Health Victoria, 2016) believes testing should potentially be standardised and routinely undertaken in all patients with community-acquired pneumonia.

The Australian Government, Department of Health (2016) requests that bacterial infections, including Legionellosis are reported and notified to the Department of Health in all states and territories of Australia. This is compulsory for both confirmed and probable cases of Legionellosis (Comcare, 2014). The Legionellosis bacterium within the state of Victoria has a statutory requirement to immediately notify via telephone or fax, followed by written notification within 5 days of discovery (Health Vic, 2016).

Study Limitations

Legionnaires disease is mostly diagnosed using urine antigen tests, meaning sensitivity causes limitations and less-severe cases may not have been traced (Newsom, 2009). Legionellosis is a worldwide disease, yet in many countries relevant laboratory testing is unavailable so the incidence of Legionella is unknown (Sakamoto, 2015). This means studies and statistics assessing Legionella occurrence can be inaccurate or are limited to relatively small numbers as a dataset (Haubitz et al., 2014).

Conclusion

The reporting on bacterial diseases is important to lower the risk of growth and exposure to workers in close proximity to carriers, with compulsory reporting and investigation of Legionella this should reduce the exposure time to the disease, limiting the recurrence of Legionellosis (Bartram, et al., 2016). Optimum treatment remains uncertain, as macrolide and quinolone antibiotic treatment has shown the potential to become resistant (although this is rare) and with this, theoretically there would be no cure to Legionella. New alternative treatments should be found as well as clinical and environmental strains of antibiotics systematically investigated (Cunha, Burillo, & Bouza, 2016).

With increasing global warming, climate change might increase the incidence of legionellosis through increased reliance on air conditioning systems, as well as through more subtle effects on bacterial ecology or airborne exposure pathways (Sakamoto, 2015). By identifying control measures via management, the necessary communication, monitoring and surveillance, Legionnaires disease diagnosis and treatment is essential to be sought. By means of regulatory aspects through expanding Australian guidelines and standards as well as outbreak investigations, the analysis and improvement into risk management of community-acquired pneumonia caused by clinically diagnosed Legionnaires disease can increase the probability of Legionellosis control in the future.

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info@worldsafety.org
editorialstaff@worldsafety.org