WORLD SAFETY JOURNAL

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WORLD SAFETY ORGANIZATION (WSO)

Profile

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 1987 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"**.

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The World Safety Organization:

- Publishes WSO Newsletters, World Safety Journal - ESP, and WSO Conference Proceedings.
- Provides a network program linking various areas of professional expertise needed in today's international community.
- Develops and accredits educational programs essential to national and international safety and establishes centers to support these programs.
- Annual awards include the World Environmental/Occupational Safety Person Award, WSO James William Award, WSO Educational Award, WSO Concerned Citizen Award, WSO Concerned Safety Professional, WSO Concerned Company/Corporation Award, WSO Concerned Organization Award, Chapter/International Office of the Year Award, WSO Award For Achievement In Scientific Research and Development and International Award.
- Provides recognition for safety publications, films, videos and other training and media materials that meet the WSO required educational standards.
- Receives proposals from professional safety groups/societies for review and if applicable, submits them to the United Nations for adoption.
- Establishes and supports divisions and committees to assist members in maintaining and updating their professional qualifications and expertise.
- Chapters and International Offices located throughout the world provide contact with local communities, educational and industrial entities.
- 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.

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The World Safety Organization:

- Publishes the "WSO Consultants Directory" as a service to its Members and to the Professional Community. Only WSO Certified Members may be listed.
- 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, experience.
- Provides a network system to its Members whereby professional assistance may be requested by an individual, organization, state or country on 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 resource which may be of assistance.
- Provides all Members with a Membership Certificate for display on their office wall and with a WSO Membership Identification Card.
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- Members receive special hotel rates when attending safety programs, conferences etc., sponsored by the WSO.

Cover Photo: Dr. J. Peter Cunliffe, receiving his "WSO Concerned Professional Award" from Mr. Lon S. McDaniel. On September 18, 2002. At the WSO Awards Banquet, Las Vegas, Nevada.

Issue Dates

March
June
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Editorial

Dear Colleagues;

In case you didn't know this about the WSO, we have an outstanding Awards Program. I would like to take this opportunity to introduce it to you. We have selected our winners for this year. However, we are accepting nomination packages for next years awards.

In this Issue of the Journal you will find the WSO Awards Program & Nomination Procedures. Please, take the time and look through this material. If you know someone, know a company/corporation, training institute, etc., that is doing an outstanding job in their field of expertise, show them that you have noticed their hard work and dedication and nominate them for one of the WSO Awards.

The awards are given out at the WSO Awards Banquet towards the end of our Annual Conference.

If you have any questions about the Awards or about the WSO, please let us hear from you. For you convenience our email address is wsowmc@socket.net our address is at the bottom of page 4 in this Journal.

Sincerely,

Lon S. McDaniel
World Safety Organization
Chief Executive Officer

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Articles for inclusion in this journal will be accepted at anytime. 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 Time New Roman print and on a 3.5" diskette with the article typed in rtf (rich text format) 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 and current employment position. 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.

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

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March	31 January	June	30 April
September	31 July	December	31 October

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✓**Associate Member:** Individuals connected with safety and accident prevention in their work or interest in the safety field. This includes students, interested citizens, etc.

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✓**Institutional Member:** Organizations, corporations, agencies and other entities directly or indirectly involved in safety activities and other related fields.

Annual Membership fee in United States Dollars is as follows:

Student Membership	$ 35.00	Associate Membership	$ 55.00
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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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Improving Light Rail Safety and Security

by: Dr. J. Peter Cunliffe, P.E.

Reprinted by permission, it previously appeared in the August/September 2002 issue of TM+E

Two decades of light rail development provide a suitable milestone at which an assessment of safety and security can be objectively addressed. According to the U.S. DOT statistics, in 1998, light rail covered 659 directional route miles with 530 stations, in 23 systems, having a total of 1,205 vehicles, carrying 275 million unlinked passenger miles. Since that time, several more LRT systems have been constructed both in the U.S. and overseas.

Standards and rules, such as the *Manual of Uniform Traffic Control Devices,* state regulations and local building codes have been applied to engineering design, as has the Americans with Disabilities Act of 1990. System-related operational procedures have been adopted.

However, as LRT projects are isolated and independent, variations have occurred and will do so again as others are implemented.

Safety review

Now that the transportation industry has had real-time experience of LRT, it is appropriate to review some problems that have arisen in operating systems, which have lead to unsafe conditions, accidents, injuries and property damage, followed by consequential litigation.

Some of these may have resulted from faulty basic design of the system itself, which may or may not have been foreseen when the configuration was established.

Rather than being a form of criticism, this article is offered from real-world operational experience to improve the future security and safety of the traveling public, as well as to prevent litigation as the result of incidents. It is based on my experience of actual events that have taken place. The object is to prevent recurrence in the future wherever possible.

Incident report

Open Stations: This feature of LRT gives rise to people jumping the tracks in front of trains; stepping on the rough ballast; ignoring warnings, etc. In some instances, fences have been erected as a form of crowd control.

Island Platforms: These force the traveling public to cross at least one track to access the train. This procedure is an inherently dangerous condition. Even with gates and other deterrent devices, pedestrians are free to wander, even without thought to their own safety.

Highway Signals: Use of highway-type signs and signals for pedestrians lead to confusion, being not relative to foot or wheelchair traffic.

Grade Crossings: Associated pedestrian crosswalks, controlled by the highway warning devices, have been omitted, forcing pedestrians dangerously to divert their itinerary into road traffic lanes.

Coupler Jumping: Due to the extended space between coupled cars on some systems, and the lack of proper warnings or preventative devices, pedestrians have been known to pass between cars, jumping the couplers, thereby causing injuries - this is particularly dangerous when the train is moving. More than an estimated 6,000 such incidents occur annually on the San Diego system.

Stations on a Curved Track: Operators need to have maximum views of both sides of the train along the platforms. Only then can they ensure safety of passengers and anything else that is taking place between them. Specially designed mirrors provided a solution to this problem.

Wheelchair Accommodation: While transit systems are obligated to provide accommodations for the disabled, once a wheelchair is in the vehicle, and in the space provided for it, the occupant can still move and the wheelchair can shift. Tie-downs or anchors for wheelchairs in transit cars do not exist as they do in paratransit vehicles - a check with the Federal Transit Administration confirms that there are no such requirements.

Handholds: To prevent passengers from stumbling or falling within a vehicle, it is important that integral handholds be provided and easily accessible. They may be in the form of suspended straphangers, part of a seat or horizontal/vertical bars.

Trespass: Unfenced LRT systems are subject to trespass, as are railroads. System design should not ignore this hazard, especially in areas subject to high activity, which encourages vandalism as well as deliberate sabotage.

Signalization: Main-line signal systems as applied to light rail transit have not, as far as is known, caused any safety related incident. However, street movement of LRT vehicles requires special attention. Road traffic signals must be coordinated with LRT not only in regard to vehicular, but also pedestrian traffic. Preemption is an important element in the design of such systems so as to ensure the safe movements of all modes.

Preemption Control: In order to expedite light rail operations at road and/or pedestrian intersections, preemption is usually built into the control arrangements. Here again, timing is important, especially to provide clearance of crossing occupation prior to light rail vehicle movement over the crossing and to hold the rial vehicle until the crossing and to hold the rail vehicle until the crossing has been signaled to stop. The MUTCD and the CALTRANS *Traffic Manual* address the question. This is especially important in regard to pedestrians and their special characteristics at the location concerned. These include elderly and disabled persons, school children, rush hour traffic, etc., accustomed to use the particular location.

Pedestrians: Pedestrians generally are unpredictable, but they are the LRT system's payload and revenue. Their safety is a predominate feature of any light rail system, therefore, although their safety must be ensured, their access to the system must be encouraged and facilitated.

Personnel

Operator Competence: One single operator is responsible for perhaps hundreds of lives. Therefore, it is essential that all those responsible for ensuring operator competence have the necessary qualifications and experience to make the judgment and to reject, without qualms, an unsuitable applicant or existing employee. This includes safety personnel actually in charge of a train and supervision of their proper behavior in accordance with a clear set of rules and regulations as well as operating procedures, both of which must be updated as necessary.

Management: Notwithstanding all hardware and other safeguards provided in an LRT system, the safe operation ultimately depends on individuals, all of whom, from management to the lowest employee on the totem pole, should be competent and careful. This responsibility starts at the top, continues through the management structure through all concerned, especially safety personnel. This, of course, is an obvious statement and applies to most businesses, but it is all the more important where the lives of people is in their hands and should never be forgotten. Constant vigilance by management is essential for a safe system, and this applies to recruitment and employment of staff.

The Rule Book: This important document should be reviewed periodically by management - also requiring similar treatment are such instructions as standard operating procedures; drug policy; and maintenance instructions, including updates and changes.

Supervisory Staff: Delegation of responsibility for safety, among other things, is essential, but those concerned must be chosen for their reliability - slack or irresponsible attitude is unacceptable. Such staff should also be held responsible for any foreseeable mishaps or accidents relevant either to the system or the public. It is not sufficient to simply ride the trains, they must be trained to anticipate trouble, recommend solutions and, above all, follow up to ensure action is taken.

Medical: The medical condition of safety systems employees is a critical element in the safe operation of a transportation system, including light rail. Therefore the use, possession or sale of alcoholic beverages, intoxicants, narcotics or controlled substances must be prohibited, and checked to be so before taking up, and during duty.

Conclusion

Ever since transportation systems have been in operation, accidents have occurred. And although the results have, in some cases, been disastrous, the positive side is that they have led to remedial action and improved safety.

It is therefore logical that, although experience of so-called light rail in its present form is relatively short, the industry would be well advised to take stock periodically to review accidents and unsafe incidents to improve safety overall in this rapidly developing popular system of people transport.

A note from our Editor: I met Peter Cunliffe at the last World Safety Conference in Las Vegas, USA, and was impressed with his friendliness, his passion for safety and the paper that he presented. I asked Peter for a copy of his paper to publish in our Journal to share his knowledge with our safety professionals. The day after mailing the above article to be published in the World Safety Journal Peter died. Peter was always there to help people. His life made a difference and improved safety and health for people world wide. The following is a tribute to Peter Cunliffe by one of his friends, Dr. Peter Leggat.

Remembering: Dr. J. Peter Cunliffe, PE, WSO-CSSD (1927-2002)

"His passion was for the safety of railways for both passengers and workers".[1]

The safety profession was saddened to hear of the recent passing of Dr. J. Peter Cunliffe, PE, WSO-CSSD. The quotation above from the recent WSO News-Letter November/ December 2002 aptly sums up the late Dr. Cunliffe and no description of his life's work could possibly do justice to such a unique and outstanding individual, except perhaps to reflect on some of the highlights of an exceptional career.

J. Peter Cunliffe, P.E., held MS and PhD degrees in engineering, a BS in industrial management and was a Diplomat of the American College of Forensic Engineering and Technology. In addition to being a registered professional engineer in several states of the USA, he also held the WSO-CSSD designation. He was a member of AREMA, WSO and ASSE (Professional Member). He was also a Fellow of the Institution of Railway Signal Engineers, the Permanent Way Institution, of Logistics and Transport.

Peter Cunliffe had more than 40 years experience as a transportation safety professional, having been involved in transport systems worldwide. He was trained by British Railways and subsequently became a Chief Engineer of the Malayan Railway for 10 years. His most recent position was President of Movement Control Inc., California, a consulting engineering firm that specialized in transportation systems technology. Peter was also an expert witness and handled forensic cases involving transportation matters, as well as safety assignments and construction management.

A WSO member since 1988, Dr. Cunliffe attended many of the annual WSO conferences and those of who have attended these conferences will recall presentations by Peter on the subject of railway safety or related topic. Last year, at the 2002 Las Vegas WSO conference, Peter was again in excellent form, presenting two papers on the Channel Tunnel (update and Safety) and also a Review of Recent Railroad Accidents, [2,3] and he also participated in the WSO Global Safety Roundtable.[4] his professional contributions were not limited to the WSO and he contributed to a number of professional organizations, including the ASSE. He had a long list of publications, and one of his articles on railway safety in *Professional Safety* is still regarded as a feature article today by ASSE and is available on line,[5] and widely quoted.

Peter was widely recognized by professional awards and received two of WSO's highest awards, which were the WSO World Safety Person of the Year in 1996,[6] and also the WSO Concerned Professional Award in 2002 (a picture of Peter receiving this award is on the front cover of this Journal).[7] He also contributed to the formation of the WSO Rail Transport Safety Committee as the Chairperson.[8] One of his first profiles, as a WSO member, was published in 1990,[9] and helps gives some insight into the wide experience he had at senior level in railway and related aspects of transportation safety.

Those that had met Peter Cunliffe will remember him as a gentleman and a true safety professional. In the context of the WSO, we will remember his dedication to the WSO and its guiding principle, "Make Safety A Way Of Life".

Complied by:
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References:

. *WSO News-Letter,* November/ December, 2002: 10.
. Cunliffe JP. The Channel Tunnel: Update and Safety. Proceeding of the 16th International Environmental Health and Safety Conference and Expo. Las Vegas, USA. 16-18 September 2002: 4-6.
. Cunliffe JP. A Review of Recent Railroad Accidents. Proceedings of the 16th International Environmental Health and Safety Conference and Expo. Las Vegas, USA. 16-18 September 2002: 7-11.
. Leggat PA (Ed). Proceedings of the WSO Global Safety Roundtable. *WSO News-Letter.* November/December 2002: 1-3.
. Cunliffe JP. Rail/highway safety: the advent of high-speed rail systems. *Professional Safety.* 1999; 44(2): 24-26 available at http://www.asse.org/pfeb.htm (last accessed 21 January 2003).
. *WSO News-Letter.* November/ December 1996: 1.
. *WSO News-Letter.* September/ October 2002: 3.
. *WSO News Letter.* April 1990; 1.
. *WSO News-Letter.* April 1990: 3.

Literature Review On Company Motor Vehicle Safety Practices

by: Ms. Fiona Hanrahan

Ms. Fiona Hanrahan, is an Environmental Engineer who has completed a Masters in Occupational Health and Safety at Edith Cowan University in Western Australia. For the past eight years, Fiona has worked in Health, Safety and Environmental Departments of major oil & gas companies and is currently working in California, USA. This paper is the second in a series of three papers researched to assist her company in implementing a motor vehicle safety program throughout its worldwide operations.

ABSTRACT

Motor vehicle crashes (MVCs) are a major cause of death and serious injury within the workplace. Understandably, companies taking a proactive role to prevent MVCs, direct substantial resources through money, expertise and time to the success of such programs. Many companies have implemented programs in an attempt to prevent or minimize the severity of MVCs. Like the causes of MVCs, the preventative practices are many and varied. Such programs include:

- Policies and procedures
- Driver education and awareness
- Driver skill and defensive driving training
- Journey management
- Selection of vehicles and safety features
- Monitoring the success of the motor vehicle safety systems
- Behavioral modification techniques

There is little evidence to suggest that any single initiative used independently has universally sustained success in preventing MVCs. Rather, published literature on motor vehicle safety suggests that successful company programs are multi-faceted, and only one component of an integrated safety system and culture.

Introduction

Motor vehicle crashes (MVCs) are a major cause of death and serious injury within the workplace. Companies taking a proactive role to prevent MVCs, direct substantial resources to the success of such programs. This paper details components of Company motor vehicle safety programs identified in published literature.

Company Motor Vehicle Safety Programs

Many companies have implemented measures in an attempt to prevent and reduce MVC frequency and severity. Comprehensive programs more commonly target those who use company vehicles. A large number of companies also have more specific and narrow programs using skill based or defensive driving training for a larger workforce audience.

To affect a reduction in MVCs, it is necessary to alter worker's vehicle use, their driving behaviors and their perception of the risk of motor vehicles. Unlike other hazardous workplace activities, people drive voluntarily and frequently in their own time. Motor vehicles are not only functional, but a source of pride in ownership and enjoyment in their driving experience. Consequently, Company motor vehicle safety initiatives may be received with resentment by some and viewed as impinging into their personal territory. There are those who consider their length of experience and being licensed to drive is evidence of competence and safe driving ability. Irrespective of such an emotive base, it is a Company's responsibility and duty of care to "provide and maintain workplaces, plant and systems or work that does not expose employees to hazards". It is challenging territory for companies to promote safer driving behaviors, especially when behaviors are formed by feedback and influenced by other drivers on the roads.

While most company initiatives only target workers driving during work time or to and from work, the writer supports the benefits of extending programs to the larger workforce and non work time. Evidence suggests that driving patterns formed at work act to condition workers in their own time. In addition, other potential measures may reinforce behavior in non work time, through the involvement of peers and/or families in a behavioral reinforcement and feedback intervention.

The intervention measures identified from published literature on existing motor vehicle safety programs are detailed below.

Management Involvement, Visibility & Commitment

One common element identified within the literature on company motor vehicle safety, was the importance of active involvement and visibility of the Company's Management in fostering a safety culture. Their leadership, commitment, focus and setting an example are seen as critical to achieving the goals of a motor vehicle safety initiative.

Safety culture: As stated in Haworth, Tingvall & Kowadlo (2000) the major characteristic that affects driver safety initiatives is the push of the general safety ideal of "no injuries at anytime". Creating a safety culture within an organization creates a positive attitude toward driver safety.

Commitment: Developing a safety

culture of which motor vehicle safety is an integral component requires the commitment of a large amount of time and resources. For example, managers from Halliburton spend an estimated 20% of time on safety, compared to 5%, five years ago (Halliburton interview, 2002).

Refocus: Often safety programs plateau unless reassessed and reoriented to renew enthusiasm and vigilance. Maintaining the interest of participants is critical and requires commitment from leadership and the implementation of a variety of programs or initiatives (Haworth *et al* 2000; Jutten Ndubisi, Regnault & Abifarin (2002); Segundo & Torifio, 2002).

Journey Management Program

Two oil service companies Schlumberger and Haliburton have actively implemented journey management programs as detailed by Segundo & Torifio (2002) and Jutten *et al* (2002) respectively. It is difficult to identify the independent role that journey management contributed in reducing MVCs, since both companies simultaneously introduced other MVC reduction strategies. However, both companies regard journey management as a key mechanism in motor vehicle safety.

The principle and practice of journey management is to perform a risk analysis and then establish suitable management practices and precautions for motor vehicle use. The objective of journey management when properly implemented, managed and enforced is to:

- Eliminate in some circumstances the use of motor vehicles through appropriate planning, scheduling and elimination of unnecessary trips
- Substitute to a safer transport alternative or safer vehicle type/s
- Limit the exposure to higher MVC driving risk conditions or routes (rural dual carriage way, windy, black spots etc)
- Limit the exposure to higher MVC risk times including night time due to alcohol and fatigue related MVCs, or for limited visibility
- Limit the ability to drive of individuals who are at higher risk such as the sleep deprived (shift workers, travelers) and those who are under the influence of alcohol or drugs
- Identify when drivers do not arrive at the destination, who may be involved in an accident and may require assistance or emergency medical care

Rigorous journey management also acts to reinforce the company's motor vehicle safety culture and perception of its importance to the organization.

Management of Schedules & Time Pressure

Research conducted by Salminen (1994) on occupational accidents, found that risk taking was involved in 54% of occupational accidents. The saving of time and trouble, and the necessity of keeping to timetables are the most important motives for risk taking and in influencing unsafe driving behavior (Lynn & Lockwood, 1998; Bonsall & Palmer, 1997; Hulst, Rothengatter & Meijman, 1998). Within a journey management program, companies can proactively manage time pressures and schedules to limit any time urgency factor, an example as detailed within Sarawak & Sany (2002). Another example of the impact of time pressure was a legal case in 1993 (Klara, 1998; cited in Haworth *et al* (2000) initiated against Domino's restaurant chain after one of its drivers caused a fatality when speeding in order to make the delivery within the 30 minute guarantee. Guarantees were subsequently withdrawn.

As detailed later in this paper, when vehicle speeds are effectively and persistently reduced, both MVC frequency and severity are reduced. Logically, time pressure influences that are an incentive to speed can also be managed within journey management scheduling.

Vehicle Standards

Vehicle design can prevent the occurrence of MVCs, and in the event of an accident, can isolate the occupants from impacts. Within a company context, standards for vehicle design and its features are often incorporated into procurement processes. Many companies are proactively selecting safer vehicles, fitted with equipment such as protection devices including antilock braking system (ABS) brakes, seat belts and air bags (Haworth *et al*, 2000).

The safety benefits (reduction of MVC frequency and severity) of vehicle designs and features can take several years at least to take affect with the gradual replacement of vehicles over time. The exception to this is the retro-fitting of additional features like seat belts on existing vehicles.

Vehicle safety standards and features that companies have adopted or specified within procurement procedures or refits include:

- Vehicle crash worthiness and weight
- MVC prevention features including ABS, power adjustable side mirrors, speed alert systems, vehicle color and day time running lights
- Occupant protection features to limit the degree of injuries like air bags, seat belts (and seat belt reminders) as well as cargo barriers (for station wagons)

Some companies have also adopted vehicle features that act to change driver behaviors including driver monitors (Jutten *et al*, 2002), speed limiters and alcohol interlocks.

Vehicle Crash worthiness

When purchasing or leasing a vehicle, obviously the choice of vehicle type is determined by its intended purpose. However, the choice of vehicle will influence its crash worthiness. While there will be price limitations, the vehicle with the best crash worthiness rating, will offer the greatest occupant protection in the event of an MVC. Vehicle crash worthiness and weight are considerations for their relative risk of causing and increasing accident severity or vice versa. The potential benefits of choosing the safest car appear substantial with the best and worst performing cars in crash tests within same weight class varying by ratios of 1 to 2.5 (Hell *et al* 1999; cited in Haworth *et al* 2000). One organization that acted to manage this aspect was Monash University who provided

guidance within their fleet safety policy (Kowadlo, 1999).

Vehicle Mass

Vehicle mass impacts the crash worthiness of a vehicle, influencing the potential for injury of vehicle occupants (Fildes, Lee & Lane, 1993). The difference in mass between vehicles plays an important role in collisions involving more than one vehicle. In a frontal collision a 100kg difference will increase the injury risk by 5-10% in the lighter vehicle and reduce injury risk by the same amount in the heavier vehicle with the same tendency in rear end impacts (Buzemann, 1997; Krafft, 1998; cited in Kowadlo, 1999).

In terms of company motor vehicle safety practices, these factors may also be managed through journey management, by avoiding routes where heavier vehicles travel frequently. In addition, procurement procedures can focus the choice of vehicle within its class to be as consistent as possible in weight and size as other vehicles in the traveling region. Of the literature reviewed, only Monash University provided guidance within their fleet safety policy on vehicle weight limits (Kowadlo, 1999).

Accident Prevention Features

Companies cited in Haworth *et al* (2000) have specified vehicle safety features within procurement guidance. Such features include antilock brakes, vehicle conspicuity and day time running lights. The benefits of these features are detailed below.

Anti-lock Brake System (ABS)

Anti-lock brake system (ABS) is designed to improve vehicle maneuverability when braking. They have the potential to assist in accident avoidance and reduced accident severity. Cars with ABS have been found to be less likely to be involved in rear impact collisions (Kullgren, Lie & Tingvall 1994, cited in Kowadlo, 1999). In particular, ABS are most beneficial in wet conditions, where research has found that ABS reduces the risk of crashing into a lead vehicle in wet roads by 32±8%. Unfortunately if other vehicles do not have ABS it increases the risk of being hit from behind by 30±14% (Evans & Gerrish, 1996).

Vehicle Color & Day Time Running Lights

Specification of light vehicle colors and day time running lights are both low cost measures to reduce multiple vehicle crashes during daylight hours by increasing vehicle conspicuity and detect ability. Koornstra, Bijkeveld & Hagenzieker (1997) identified that 50% of daytime accidents are the result of one driver failing to see another vehicle. Contrasting vehicle color against the natural background and cars with day time lights, have been found to assist the identification of cars and their separation distance. The use of lights has the greatest affect in lower visibility conditions, common at higher altitudes.

Occupant Protection Features

Occupant protection features including seat belts, air bags and other features including driver monitors were detailed in Haworth *et al* (2000), Kowadlo (1999), Sarawak & Sany (2002) and Jutten *et al* (2002). The benefits of these features are detailed below.

Seat Belts

The benefits of seat belt use are overwhelming. Seat belts are reported to reduce the risk of fatal injury to front seat passenger car occupations by 45% and the risk of moderate to critical injury by 50% (NHTSA, 2000a). For light truck occupants, seat belts reduce the risk of fatal injury by 60% and moderate to critical injury by 65%. This statistic is supported by the fact that in the US, 60% of vehicle occupants killed in MVCs in 2000 were unrestrained (NHTSA, 2000b).

Seat belt reminders have also been found to be very effective in compelling front seat occupants to use seat belts (Nygren 1984 cited in Haworth *et al* 2000. This is supported by German research indicating that 31% of those not wearing a seat belt forgot to put it on (Mulder, 1998).

Air Bags

In the US, analysis indicates that air bags reduce fatalities by 12% (NHTSA 2000a). Further research by Evans (1991) suggests that use of American (full sized) airbags reduce severe injury by the following extent:

- 41% for those not wearing a seat belt
- 8% for those wearing a seat belt

The above statistics indicate that airbags assist in reducing injury severity, particularly in locations where seat belt use is low. It should be noted however, that airbag designs and their protection vary internationally.

Other Features

Some companies have adopted vehicle features that assist in changing driving behavior largely through the use of monitoring tools. Such features include:

- Intelligent Speed Adaptation Systems including personal in vehicle information systems, fleet management systems and radio data system traffic message channels and on board global positioning systems.
- Driver Monitors (as documented by Jutten *et al,* 2002) which have resulted in significant improvements in driving behavior over time. Driving behaviors are monitored and feedback given.
- Alcohol interlocks which inhibit the starting of the vehicle after detection of excess BAC (Haworth *et al,* 2000).
- In car speed limiters have positive safety effects particularly in free driving conditions, and even suppressed speeds momentary high speeds in congested traffic (Várhelyi & Mäkinen, 2001).

The above features enable active monitoring or control of behaviors, and consequently are often resented by drivers. To combat the increase in driver frustration, when these features are adopted, negative aspects should be recognized, explained and their use and purpose in preventing MVCs continually reinforced.

Potentially undesirable features for Motor Vehicle Safety

Adaptive cruise control systems while positively perceived by drivers are shown to increase unsafe driving behaviors. While appropriate use of cruise control can assist in setting and maintaining speed at safer levels and preventing speed creep, they have drawbacks. The undesirable behavioral adaptation observed include cruise control settings at higher speeds, smaller minimum time headways (tailgating) and use of larger

break force (Hoedemaeker & Brookhuis, 1998). The larger brake force is assumed to be due to the fact that drivers hesitate from overriding the cruise setting.

Traveling routing is most safely conducted prior to the start of a journey. However, Advanced Traveler Information Systems can aid drivers in identifying alternative routes following crashes, foul weather or traffic jams. These navigational systems particularly visual displays increase the demands on the driver's attention away from the road and have led to unsafe driving (Liu, 2001). If required they should be selected with auditory functions, adequate training and familiarization conducted before the initiation of journeys.

Policy & Procedures

A common element of company's motor vehicle safety systems is a policy stating the expectations for the program and the priority of motor vehicle safety (Haworth *et al*, 2000; Jutten *et al*, 2002; Downs, Keigan, Mayock, & Grayson, 1999; Schlumberger 1999; and Halliburton, 2002). Such policies clearly outline the expectations for motor vehicle usage and corresponding driving behaviors as well as illustrating management's focus on the issue.

Examples of companies vehicle safety policy requirements detailed in Haworth *et al* (2000) include both supporting practices and motivating factors (rewards and discipline). Examples of policy details or practices enforced include:

- Mandatory seat belt usage
- Speed restrictions and enforcement
- Restricted use of mobile/cell phones
- Prohibit driving under the influence of alcohol and drugs
- Random alcohol testing
- Management and or detection of drivers at risk of fatigue
- Practices to prevent high risk or high frequency accidents (e.g back in first practices)
- Immediate repair of vehicles after MVC or damage

The mechanisms of which these can be applied are discussed in following paragraphs. These are not confined within the context of companies due to the lack of relevant literature but are expanded to wider community application.

Seat Belts

Through education and enforcement the use of seat belts in the US has increased in the period of 1985-1995 from 41.5% to 74.1% (Shinar, Schechtman & Compton, 1999). Enforcement has been deemed the most effective means to increase usage. Research in Ferguson *et al,* 1999 (cited by Haworth *et al,* 2000), detailed the use of seat belts of taxi drivers in Maryland, Virginia and the District of Columbia (DC). This study was conducted six months after DC implemented a fine and license point penalty for those not wearing seat belts. Both the States of Maryland and Virginia did not require taxi drivers to wear seat belts. For taxi drivers in their own jurisdictions, belt use rates were much higher in DC at 74% compared to 38% in Virginia and 20% for Maryland. DC taxi drivers were also found to wear seat belts in adjoining states even where they were not required at rates of 76% in Maryland and 64% in Virginia. Thus study indicates that negative consequences and enforcement does increase seat belt use, with compliance extending conditioning to non-enforced times.

This type of research indicates the effectiveness of enforcement mechanisms for seat belts. The added benefit of enforcement to increase seat belt usage during work time is that it acts to condition and increase restraint use for workers in non work time. Within a workplace, policy requirements that have been used include mandating the wearing of seat belts as a condition of employment implemented respectively by Haliburton and Schlumberger (Segundo & Torifio, 2002; Jutten *et al,* 2002). These companies have also set and adhered to severe penalties for contravention.

Speed

There is overwhelming evidence that lower speeds result in fewer collisions of reduced severity.

Research undertaken in the US after interstate speed limits were raised (Finch, Kompfner, Lockwood & Maycock, 1994) illustrated an increase in mean speed of 2-4 miles/hr resulted in a 19-24% increase of the number of fatalities. Similarly, a 10% increase in mean speed results is a 26% increase in the frequency of all injury accidents and a 30% increase in serious and fatal accidents (Taylor, Baruya, & Kennedy, 2002). Conversely, a 1km/hr speed reduction has been shown to result in a 3% drop in accidents on residential and town roads, with a lower accident reduction on higher quality suburban and rural roads (Taylor *et al,* 2002).

The challenge for companies is how to actually ensure workers reduce their speed, keep within safe speed limits for the conditions, and to also sustain such a reduction over time. One effective method identified to control speed is the use of enforcement, which is further enhanced by use of feedback.

Research reported in Harrison, Fitzgerald, Pronk and Fildes (1998) details a clear relationship between drivers' attitudes towards speed, their observed speeds and their perceived risk of detection. The perception of being caught speeding acting as a deterrent is verified by a post evaluation study of enforcement techniques with high level of publicity. One study documented by Diamantopoulou & Cameron (2001) evaluated covert and overt speed enforcement through mobile radar in rural areas of Victoria, Australia. Results indicated a 71.3% reduction in casualty crashes on the same day or up to four days after the enforcement was present, when enforcement was accompanied by high levels of publicity awareness.

Within a company perspective, the reliance of police enforcement may be a relatively weak enforcement mechanism, since the perception of being caught is low in many locations. Alternatively, the installation of speed limiters and monitors has very strong and persistent behavioral changes when actively monitored. As detailed by Jutten *et al* (2002), Schlumberger in Nigeria have recorded significant improvements in driving behavior including compliance with speed limits. Grayson & Rothengatter (1996) conducted a comprehensive study of the effectiveness of nine various speed controlling approaches and concluded that the more

effective methods involved a feedback system.

Driving under the influence of Alcohol

In the US, in the period of 1982 to 2000 the percentage of alcohol related fatalities has declined from 57% to 40% (National Center for Statistics and Analysis, 2002). These advances have been achieved through education and enforcement of drinking under the influence restrictions. The risk to workers from alcohol related MVCs is two fold, one from workers themselves and the other from other drivers under the influence. Companies can implement measures to prevent or minimize both of these exposures.

To restrict the hazard of employees drinking and driving, some companies have a clear and strong policy against the intake of alcohol before driving (Haliburton, 2002 and Schlumberger, 1999). In the writer's opinion, companies should also consider actions to support compliance including:

- provision of alternative transport after social occasions
- education and the promotion or a nominated non drinking driver
- Promote compliance of employees and contractors through random (and frequent) breath testing. Again like speed enforcement the probability of being detected is the deterrent.
- Fit alcohol interlocks on vehicles within high risk or non compliant locations

Journey management practices can also act to minimize the exposure to other drivers who may be driving under the influence. Driving at high risk times and locations can be actively avoided by use of journey management as detailed by Jutten, *et al* (2002).

Fatigue Management

Prevention of fatigue related MVCs, requires the recognition of fatigue causes, those at risk and then the implementation of appropriate fatigue prevention measures or restriction of driving exposures.

The major causes include (Åkerstedt, 2000):

- The time of day (especially night and early morning)
- A long duration of wakefulness
- Inadequate sleep
- Pathological sleepiness (sleep apnea)
- Prolonged work hours

Those at particular risk should be identified (e.g shift workers) and measures adopted to manage fatigue and restrict their exposure, for example through:

- Education
- Fatigue countermeasures
- Journey management and appropriate scheduling of driving
- Identify medical conditions causing sleepiness during driver selection or hiring of drivers
- Ensure remuneration does not encourage unsafe work practices such as to work until fatigued

Education

One of the measures recommended for management of fatigue is to promote education on fatigue and countermeasures (Åkerstedt, 2000). Drivers should be educated to recognize conditions that will increase there risk of a drowsy/fatigued crash such as shift work, short term or chronic sleep loss and extended wakefulness. They should be made aware that driving under these conditions is as dangerous as drunk driving. However education alone will not be sufficient for not all drivers feel drowsy or recognize fatigue symptoms before they crash. Prevention measures should go beyond education and recognition of symptoms, as research indicates that 44% of sleep crash driver and 51% of fatigued crash drivers did not feel drowsy before their MVCs (Stutts, Wilkens & Vaughn, 1999).

Fatigue Countermeasures

Nguyen, Jauregui & Dinges (1998) state there is little scientifically validated behavioral countermeasures to stay awake and remain alert, with the only safe countermeasure to cease driving as soon as possible. Some studies do however support the use of the following countermeasures (Åkerstedt, 1995; cited in Stutts, Reinfurt, Staplin, & Rodgman, 2001):

- careful scheduling of duties with reference to sleep adequacy
- behavioral sleep management such as napping particularly for high risk groups (shift workers)
- Use of drugs to enhance alertness should only be used in unusual circumstances. The effects of caffeine may dissipate fast with effects lasting an hour (Horne & Reyner, 1995; cited in Nguyen, Jauregui, & Dinges, 1998)

Journey management may also assist to monitor and prevent driving exposure for at risk fatigued workers. As 16 hours of wakefulness has shown to have an equivalent drink driving with BAC of 0.05%, scheduling may extend to promote the use of alternative transport than after an interstate or international trip.

High frequency accidents - Back in First Practices

Some companies have implemented specific policies to prevent high risk or frequency MVCs, for example promoting the "back in first practice". One company that has adopted this practice as a guideline is the Oil Company-Amoco as discussed by Loafmann (1999).

Distractions-Cell/Mobile Phone

While cell/mobile phone use is only one of the distractions identified (Stutts *et al*, 2001) that are an attributed cause of MVCs, it was the only distraction identified in the literature whereby companies are taking an active role in preventing or restricting the use of phones and educating employees.

Companies with management measures in place are typically enforcing these restrictions via policies. The intent and management of risks was observed to vary as follows:

- Provide guidelines on use including for example when to receive calls, recommending against note taking, and restricting the length of calls (Smith, 2002)
- Specify that only hands free phones are to be used (Smith, 2002)
- Prohibit the receipt or initiation of calls while driving on either hand held or hands free phone (Haliburton, 2002; and Schlumberger, 1999).

The Cellular Telecommunications and Internet Association have published a guide to responsible phone use while driving (CTIA, 2002). Based on the extent of the current concern and

research into the association of phone use and increased risk of MVC involvement, the writer believes it is likely that more companies will implement policies restricting phone use while driving. Similarly, it is also expected that more Governments will ban the use of phones while driving.

Driver Training & Competency Evaluation

Employees are increasingly required to undertake defensive and competency driving training as detailed in Haworth *et al* (2000), Downs *et al* (1999) and Jutten *et al* (2002). The premise of driver training to develop appropriate driving skills for certain conditions (cornering, ice, rain) and defensive driving has long been supported to improve driving behavior. Results do support the use of training to reduce accident rates; however there are limits and exemptions-including skill training for young drivers and the isolated effectiveness of education. Training is effective when well targeted and supported by competency testing and other safe behavior reinforcement or enforcement measures.

Training

A comprehensive study by Swedish Road and Traffic Research Institute (Gregersen, Brehmer & Morén (1996) studied 4,500 professional drivers to evaluate the relative effectiveness of driver training, group discussions, campaigns and bonuses. There were no real changes for the campaign (exposed to various educational or promotional materials), bonus or the control groups. The driver training and group discussion were identified as the most effective.

Kedjidjian (1995) cited in Haworth *et al* (2000) indicated that Hertz Corporation in the US, after completing a four hour defensive driving course found a 35% reduction of crashes between trained and untrained personnel. The National Safety Council claims that reductions of MVCs of 50-65% have been achieved after training (National Safety Council, 1999 cited in Haworth *et al* 2000). The writer does question the individual significance of training to MVC reduction in the absence of other motor vehicle safety initiatives.

Skill Based Training

Driver skill training has been promoted to assist drivers in developing skills suitable for particular driving conditions. Studies have identified that skill based training for young drivers have failed and in some cases has led to an increase in accidents. A study conducted by Katila, Kestinen and Hatakka (1996) found that training of novice drivers for maneuvering in slippery conditions in Finland increased their self confidence, leading to an underestimation of risks and consequent driving at higher speeds. Skill based training should be well targeted for the specific risk driving and orientated to increase the perception of risk, rather than reduce it.

Wilde (1994) states that "better driving skill does not necessarily mean fewer accidents", for example race car drivers have greater skills than the average motorist and have an increased proportion of accidents. Wilde (1994) theorizes that this is due to their overall greater average acceptance of risk and consequent adoption of unsafe driving behaviors.

In summary, training is one of the most frequently utilized company motor vehicle safety methods. Christie (2002) references extensive evidence from countries across the world and age groups which conclude that driver training contributes little to reduced crash risk involvement. Instead he suggests that driver training and education be used and sustained more by an assumption of effectiveness rather than proven evidence. As an independent MVC prevention mechanism, the writer again questions the long term sustainable influence of education and training to enable a reduction of MVCs without other supporting practices.

Monitoring & Accident Investigations

The validation of performance within a company's motor vehicle safety initiative, and compliance with polices is critical to check progress and identify gaps. As noted by Vincoli (1994) full reporting of accidents "is one of the most essential elements in a successful accident investigation and loss control program." In themselves, accident data do not improve safety performance. Rather, it requires solid and continual application of a safety management system.

Tracking performance specifically for MVCs is conducted by most companies with motor vehicle safety practices. The various mechanisms employed include:

- Lag indicators including number of incidents and measurement of actual injuries, property damage and whether the MVC was preventable.
- Spot checks or audits to validate practices are in place and being followed for example journey management by Haliburton (Segundo & Torifio, 2002) and Schlumberger (Jutten *et al*, 2002)
- Observations to validate behaviors by Amoco (Loafmann, 1999) and Duluth Transit Authority (US Transport Research Board, 2001).
- Positive performance indicators (for example % compliance of seat belt use, % workers who have participated in training, the % of root cause analysis conducted on MVCs...etc)

An additional metric for safe driving behaviors is fuel consumption which is promoted for use by Sweden and the Netherlands road safety councils (Haworth *et al*, 2000). This metric was not being actively utilized by any companies reviewed in the literature survey.

An understanding of the root causes of accidents is critical to formulate appropriate strategies to prevent future accidents. Companies tracking MVCs as preventable and unpreventable were detailed in Haworth *et al* (2000) and Sarawak & Sany (2002). The writer however questions the merit of classifying as preventable and unpreventable, for all crashes are preventable. Tracking and tagging unpreventable crashes classified to be the fault of another driver can inhibit progress in implementing effective management and prevention measures.

Road Conditions

The following practices have greatest application in locations where companies are responsible for building and maintaining roads to enable access to their facilities. In such instances the

additional safety features should be considered to lower the risk and impact of potential MVCs. Such features may include:

- Roadside barriers
- Dividing barriers between opposing traffic
- Rumble strips on road edge to assist fatigued drivers to wake
- Maintain roads to prevent potholes or other obstacles that cause erratic and dangerous driving avoidance behaviors

The effects of road features can be significant. For example, Monash University Accident Research Centre Annual report (2000) state that for vehicles that leave the road, 90% of fatal and serious injuries can be prevented by roadside barrier systems erected to prevent vehicles striking trees, poles, embankments or from crossing into the path of opposing traffic.

This research was not able to identify any companies that noted specific measures to improve road conditions within their motor vehicle safety policies. The writer acknowledged that all companies rely on to some degree on infrastructure provided by Governments. However, in some remote locations where companies researched within this paper including Shell, Schlumberger and Haliburton, may exert a degree of influence over road construction and conditions.

Leveraging from Government Sponsored Programs & Sharing of Best Practices

There may be opportunities and advantages for companies to leverage from existing government and internationally sponsored motor vehicle safety programs, for example those sponsored by the World Bank or United Nations.

Again none of the literature reviewed specifically acknowledged knowledge networks for MVCs. However, the use of networks and leveraging from existing systems and practices can assist companies to implement effective and proven safety programs.

Many government, road authorities, education institutions, non profit organization, industry and community groups are active in public awareness campaigns. Some road authorities have published their own fleet safety guidelines. Companies can effective leverage from learning's and initiatives of others from these publications, some examples include:

- VIC Roads in Australia titled "Safe Driving Policy-VIC Roads Corporate Policy for the safe and responsible Use of Fleet Vehicles" (cited in Haworth *et al*, 2000).
- The Network of Employers for traffic Safety (NETS) a collection off public and private employers and government organizations in the US promoting highway safety (Kedidjian, 1995 cited by Haworth *et al*, 2000).
- Exploration & Production Forum (E&P 1996) have produced a set of guidelines to assist companies to implement motor vehicle safety initiatives.

Conclusion

Many companies have implemented forms of policy and practices in an attempt to prevent MVCs. Like the causes of motor vehicle crashes, the preventative practices are many and varied. There is little evidence to suggest that any single initiative used independently has universally sustained success in preventing MVCs. Rather, a multi-faceted approach is required. Company motor vehicle safety systems largely require employees' adoption and compliance with programs through changing their own behaviours. All of these components do not arrive from a simple initiative or quick fix, but arrive from sustained effort over a broad front.

The success of a company's motor vehicle safety system is therefore reasoned to be contingent on the strength of the company's safety culture and its leadership. It is suggested that it is the culture and leadership that enable people's receptivity to a motor vehicle safety program and also sustain their motivation. The writer also acknowledges that companies adopting motor vehicle safety initiatives operate in a multitude of countries and safety cultures, which may have variant motor vehicle risks than those detailed from this report. Consequently any motor vehicle safety initiative, should involve an analysis of the exposures and local variances to evaluate if alternative risk factors than the common causes discussed in this report.

References

Åkerstedt, T., (2000). Consensus Statement: Fatigue and accidents in transport operations. *Journal of Sleep Research, 9*(4), 395.

Bonsall, P.W. and Palmer, I.A., (1997) *Do time-based road user charges induce risk taking?-results from a driving simulator. Traffic Engineering and Control, 38*(4), 200-208.

Christie, R (2002). *Effectiveness of Driver Training/Education as a Road Safety Measure: Popular views, assumptions and scientific evaluation.* Keynote Address of The Australian College of Road Safety Conference on Developing Safer Drivers and Riders, Brisbane, 21-23 July 2002.

CTIA (2002). *A guide to safe and responsible wireless phone use*. Cellular Telecommunications and Internet Association. http://www.wow-com.com/consumer/issues/driving/articles.cfm?ID=85 [November 26, 2002]

Diamantopoulou, K., & Cameron, M., (2001). *An evaluation of the effectiveness of Overt and Covert Speed Enforcement Achieved through Mobile Radar Operations*. Monash University Accident Research Centre, Report No.187. www.general.monash.edu.au/muarc/rptsum/es187.htm *[AUG, 1,2002]*

Downs, C.G., Keigan, M., Mayock, G. & Grayson, G.B., (1999). *The safety of fleet car drivers: a Review* (TRL Report 390). UK Transport Research Laboratory, Crowthorne.

E & P Forum (1996). *Land Transport Safety Guidelines*. Report No. 6.50-238. The Oil Industry International Exploration and Production Forum.

Evans, L. (1991). *Traffic Safety and the Driver*. Van Nostrand Reinhold, New York.

Evans, L., & Gerrish, H., (1996) Antilock brakes and risk of front and rear impact in two vehicle crashes. Accident

Analysis and Prevention, *28*(3), 315-323.

Fildes, B.N., Lee, S.J., & Lane, J.C., (1993). *Vehicle mass, size and safety.* Australian Federal Office of Road Safety, Report No. CR133.

Finch, D.J., Kompfner, P., Lockwoord, C.R., & Maycock, G., (1994). *Speed, speed limits and accidents.* (TRL Project Report 58) UK Transport Research Laboratory, Crowthorne.

Grayson, B. & Rothengatter, J.A., (1996) *Controlling speed choice. Behavioral research in road safety* vi. (TRL Report 3138/96). UK Transport Research Laboratory, Crowthorne.

Gregersen. N.P., Brehmer, B., & Morén., (1996). Road Safety Improvement in Large companies. An experimental comparison of different measures. *Accident Analysis and Prevention*, 28(3), 297-306.

Halliburton Corporate Policy (2002) "*Driving Safety-Operation of Motor Vehicles*". Reference No. 3-1005. Date May 24, 2002.

Haworth. N., Tingvall. C., & Kowadlo. N., (2000). *Review of Best Practice Road Safety Initiatives in the Corporate and/or Business Environment.* Monash University Accident Research Centre. Report No. 166. www.general.monash.edu.au/muarc/rptsum/es140.htm *[AUG, 1,2002]*

Harrison. W., Fitzgerald, E.S., Pronk, N.J. & Fildes, B., (1998). *An investigation of characteristics associated with driving speed.* Monash University Accident Research Centre. Report No. 140.

Hoedemaeker, M., & Brookhuis, K.A., (1998). Behavioral adaption to driving with an adaptive cruise control (ACC). *Transportation Research Part F: Traffic Psychology and Behavior, 1*(2), 95-106.

Hulst, M., Rothengatter, T., & Meijman, T., (1998). Strategic adaptions to lack of preview in driving. *Transportation Research Part F: Traffic Psychology and Behavior, 1*(1), 59-75.

Jutten. J.J., Ndubisi. J.J., Regnault. P., & Abifarin. O., (2002). *Working towards Zero Automative Accidents in the Niger Delta.* Paper presented at the Society of Petroleum Engineers Conference on Health, Safety & Environment in Oil & Gas Exploration held in Kuala Lumpur, Malaysia, March 2002. SPE Paper 74048.

Katila, A., Keskinen. E., & Hatakka., M., (1996). Conflicting goals of skid training. *Accident Analysis and Prevention, 28* (6), 785-789.

Koornstra, M.J., Bijkeveld, F., & Hagenzieker, M.P., (1997). *The Safety Effects of Daytime Running Lights.* SWOV Institute for Road Safety Research, The Netherlands (Report R-97-36).

Kowadlo, N., (1999*). Background information for the Monash University Accident Research Centre (MUARC) Fleet safety Policy.* www.general.monash.edu/muarc/carpolcy.htm [July 30,2002]

Liu, Y.C., (2001). Comparative study of the effects of auditory, visual and multimodality displays on drivers' performance in advanced traveler information systems. *Ergonomics, 44* (4), *425-442.*

Loafmann, B., (1999). Accelerating Safe Driving Behavior. *Occupational Health & Safety*, 68, 3, 66.

Lynn. P., & Lockwood, C.R. (1998). *The accident liability of company car* drivers (TRL Project Report 317) UK Transport Research Laboratory, Crowthorne.

Monash University Accident Research Centre (2000). *2000 annual report*, Victoria Australia.

Mulder, J.A.G., (1998). *Gebruik van beveiligingsmiddelen in 1998.* SWOV Institute for Road Safety Research, The Netherlands (Report R-987-44).

National Center for Statistics and Analysis (2002) *Fatality Analysis Reporting System (FARS).* http://www-fars.nhtsa.dot.gov/finalreport.cfm?title=Crashes&stateid=0&year=2000&title2=Location [July 30,2002]

NHTSA (2000a). *Traffic Safety Facts 2000 Occupation Protection,* US Department of Transportation-National Highway Traffic Safety Administration, DOT HS 809 327.

NHTSA (2000b). *Traffic Safety Facts 2000 Overview,* US Department of Transportation-National Highway Traffic Safety Administration, DOT HS 809 329.

Nguyen. L.T., Jauregui. B, & Dinges. D.F., (1998). *Changing Behaviors to Prevent Drowsy Driving and Promote Traffic Safety: Review of Proven, Promising and unproven Techniques.* Supported by the American Automobile Association Foundation for Traffic Safety. www.chp.ca.gov [July 30,2002]

Salminen, S., (1994). Risk Taking and serious occupational accidents. *Journal of Occupational Health and Safety-Australia and New Zealand, 10*(3), 267-274.

Sarawak, G.T., & Sany. M.N., (2002). *Road Transport Safety Management-A Successful Transformation Journey.* Paper presented at the Society of Petroleum Engineers Conference on Health, Safety & Environment in Oil & Gas Exploration held in Kuala Lumpur, Malaysia, March 2002. SPE Paper 74044.

Schlumberger. (1999, October). *Oilfield Services Driving Policy.*

Segundo J., & Torifio. S., (2002). *Journey Management in Colombia.* Paper presented at the Society of Petroleum Engineers Conference on Health, Safety & Environment in Oil & Gas Exploration held in Kuala Lumpur, Malaysia, March 2002. SPE Paper 74047.

Shinar, D., Schechtman, E., & Compton, R (1999). Trends in safe driving behaviors in relation to trends in health maintenance behaviors in the USA: 1985-1999. *In Accident Analysis and Prevention; 31*(5), 497-503.

Smith (2002). *A guide to business use of cell phones while behind the wheel.* Smith System Driver Improvement, Inc. www.smith-system.com

Stutts, J.C., Wilkens, J.W., & Vaughn. B.V., (1999). *Why do people have drowsy driving crashes? Input from drivers who just did.* Prepared for the AAA Foundation for Traffic Safety. http://www.aaafoundation.org/pdf/sleep.pdf [Aug 1, 2002]

Stutts, J.C., Reinfurt. D.W., Staplin. L., & Rodgman, E.A., (2001). *The role of Driver Distraction in Traffic Crashes.* Prepared for AAA Foundation for Traffic Safety. www.aaafoundation.org/projects/index.cfm?buttons=distraction [Feb 19, 2002]

Taylor, M.C., Baruya, M. A., & Kennedy, J.V., (2002). *The relationship between speed and accidents on rural single-carriageway roads.* (TRL report 511). Crowthorne; Transport Research Laboratory.

US Transport Research Board (2001b). *Effective Practices to Reduce Bus Accidents*: www.trb.org/trb/publications/tcrp/tcrp_rpt_66.pdf *[AUG,1,2002]*

Várhelyi, A., & Mäkinen, T. (2001). The effects of in-car speed limiters field studies. *Transportation Research Part C: Emerging Technologies, 9*(3), 191-211.

Vincoli, J.W. (1994). *Responsibilities in the investigation process.* In basic guide to accident investigation and loss control. (p. 35-41). New York: Van Nostrand Reinhold.

Wilde, G.J.S. (1994) *Target Risk.* PDE Publications, Canada. ISBN 0-9699124-0-4. www.Pavlov.psyc.queensu.ca/target/ [9 August 2002]

DIARY OF EVENTS

World Safety Organization
Title: 17th International Environmental Safety & Health Conference & Expo
Venue: Holiday Inn Denver International Airport Conference Center, Denver, USA
Dates: 3 - 5, November, 2003
Cost: $600.00 (US) WSO Members. $675.00 (US) Non-members
Contact: Debbie Burgess. Ph. (660) 747 3132. Fax. (660) 747 2647. Email: wsowmc@socket.net

Title: Bullying & Harassment at work
Venue: Hotel Eckero, Aland, Finland
Date: 11-15 August, 2003
Contact: Gunilla Rasi,. Email: gunilla.rasi@ttl.fi Ph: +358 9 4747 2398

Title: First International Seminar on Good Management Practice – Interaction of Environment, Safety & Quality
Venue: Hotel Levitunturi, Sirkka (Lapland) Finland
Date: 15-17 September, 2003
Contact: Gunilla Rasi,. Email: gunilla.rasi@ttl.fi Ph: +358 9 4747 2398

Title: Occupational Safety & Health in the Construction: Impact of new demands & global management:
27th International Symposium ISSA Construction Section Lisbon, Portugal
Venue: Portugal
Date: 22-24 October, 2003
Contact: Ph: +351 21 792 7059 Email: aiss2003@idict.gov.pt

Health And Safety Issues Arising From The Initial Urban Search And Rescue Response To The World Trade Center Attacks: Some Observations For Disaster Planning

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ABSTRACT

The terrorist attacks on the World Trade Center (WTC) initiated a citywide emergency response in New York to remove as many survivors as possible from the remainder of the WTC twin towers. The initial response to the terrorist attacks at the WTC provided some pointers to the need for disaster preparedness globally. Some of the issues arising included credentialing of potential first responders, preparation for potential exposure to environmental contaminants, management and documentation of the injured, and management of injuries to first responders.

Introduction

The terrorist attacks on the World Trade Center (WTC) initiated a citywide emergency response in New York to remove as many survivors as possible from the remainder of the WTC twin towers. The building towers collapsed soon after the terrorist attacks. Unfortunately, the emergency response workers were understandably not prepared for the scale of the unfolding immediate developments in this disaster.

The major issues, which have been discussed in the subsequent published literature, included difficulties in:

- Roll out of the emergency response plan and Communications (Anonymous, 2001a), including the Emergency Medical Services responding to the disaster (Asaeda, 2002), and Managing and verifying the credentials of volunteers (Anonymous, 2001a)
- The exposure of responders to environmental contaminants (EPA, 2001; Anonymous, 2001b)
- Managing the flow of injured survivors at hospitals, which peaked about 2-3 hours into the disaster, and documentation of these casualties (Anonymous, 2001b;2002)
- Rescue worker injuries (Anonymous, 2002)
- Other areas, such as the possible limitation in primary response capabilities once the search and rescue was successful.

Disaster Planning

The initial response to the terrorist attacks at the WTC provided some pointers to the need for disaster preparedness globally. It was vital that disaster plans across the city of New York were consistent and part of an integrated working document, which could be rolled out at short notice in response to a disaster. Major issues, which arose as a result of difficulties in rolling out such a disaster plan, were (After Anonymous, 2001a):

- Difficulties in communications
- Difficulties in credentialing of volunteers
- Forwarding of casualties inappropriately to hospitals and forwarding to inappropriate hospitals.

There was a need for a better triage system to ascertain who needed first aid treatment compared to more intensive and critical care treatment. The forwarding of all casualties to various hospitals had the potential to inhibit effective management of the more serious patients at the receiving hospitals. Although a system of credentialing of emergency responders does exist from place to place in the USA, the system is not consistent, and needs to be examined worldwide in disaster management planning. An identification card with consistent information for volunteer emergency responders may need to be developed. A significant number of volunteer medical personnel had to be turned away because of inability to adequately verify the credentials of these individuals. As in any disaster, effective communications systems are needed, which may need to bypass the traditional means of communication (eg. radio communication devices). The presence of a thick cloud of smoke and dust also made it very difficult for responders and survivors to see their way clear of the building.

Exposure of Initial and Subsequent Responders to Environmental Contaminants

Unfortunately, although some emergency responders were prepared with appropriate personal protective equipment, many initial responders were exposed to a range of environmental contaminants, including (after Anonymous, 2001b):

- asbestos,
- smoke,
- dust, and
- chemicals,

through inhalation and some contaminants through skin, eye and mucous membrane contact, as the contaminants in dust and smoke was exceptionally thick in the early part of the disaster, especially during the aftermath of the building collapses.

The EPA (2001) observed that this type of scenario required:

- procurement and distribution of respiratory and eye protection equipment
- health and safety training of site staff
- design and implementation of a site monitoring plan
- technical assistance for site control and decontamination
- asbestos respirators, self-contained breathing apparatus, and protective clothing suits in large quantities.

Many of the initial responders may not have been aware of the potential hazards and/or may not have been prepared to deal with the hazards. Despite this, the EPA (2001) felt that the hazards were more likely to be a concern if there was longer-term exposure, however they felt that engineering controls be used to minimise the environmental hazards, eg. Water sprays and rinsing to prevent or

minimise potential exposure and to limit releases of potential contaminants beyond the debris site. The WTC disaster illustrates the need for a city emergency response plan to have a catalogue of buildings and a virtual materials safety data sheet (MSDS) for each, so that potential environmental contaminants can be predicted and appropriate protective measures taken.

Managing the Flow of Injured Survivors at Hospitals

The flow of injured survivors peaked about 2-3 hours into the disaster (Anonymous, 2001b) and an analysis of hospital data following the September 11 2001 terrorist attacks was undertaken and reported upon in MMWR at the beginning of this year (Anonymous, 2002). One of the difficulties with the documentation of the casualties, which may be useful for developing plans for future disasters, was that documentation of these casualties was not carried out consistently or at all (Anonymous, 2001b; 2002). The triage system for the disaster was overwhelmed (Asaeda, 2002) and casualties were being sent to the hospital inappropriately and to inappropriate hospitals (Anonymous, 2001a). Many first aid treated casualties were not recorded and many of the survivors that went to the hospital were requiring only first aid treatment (perhaps as many as two thirds) in the first few hours, which has the potential to overwhelm an emergency department. There was also a delay in extrication of some casualties.

This disaster reinforced the need for

- disaster management plans to factor in the use of appropriate first aid resources, where appropriate, and for
- the training of members of volunteer organisations, which have members with first aid training, such as the State Emergency Service, St. John Ambulance etc, in disaster management, and integration of the command and control functions of these services into disaster management plans.

There was a need to include in disaster planning for search and rescue some plan concerning which survivors were directed to the hospital and then which hospital. The special treatment facilities of some hospitals needed to be catalogued. In addition, emergency personnel overlooked some hospital facilities in the casualty clearance process.

Rescue Worker Injuries

A number of rescue workers and survivors of the initial plane crashes were killed or injured in the subsequent fire and collapse of the twin tower buildings (Anonymous, 2001b). More than 300 rescue workers were treated by hospitals immediately following the disaster (Anonymous, 2002), where the hospitals collected data. These rescue workers had a significantly higher incidence of ocular injuries compared with other survivors (Anonymous, 2002). "The initial wave of rescue worker injuries occurred while responding to the collapse of the upper floors of the towers" (Anonymous, 2002:4). Rescue workers who sought care at emergency departments (EDs) did so as a result of various injuries resulting from exposure to fire and smoke, sharp objects and unstable building rubble (Anonymous, 2002). It is important that there is appropriate medical support of rescue workers as well as other survivors.

Conclusion

The initial response to the terrorist attacks at the WTC provided some pointers to the need for disaster preparedness globally. Some of the issues arising included credentialing of potential first responders, preparation for potential exposure to environmental contaminants, management and documentation of the injured, and management of injuries to first responders. Despite the many lessons, which have come from the many ongoing reviews of this disaster, the dedication, bravery and resourcefulness of the first responders was outstanding and will not be forgotten. The Association of Military Surgeons of the United States (AMSUS) have produced a CD examining various aspects of disaster management from the health perspective, published as a supplement to *Military Medicine* (AMSUS, 2001).

Acknowledgments

The assistance of Dr. Bill Griggs in perusing the initial report is greatly appreciated.

References

Anaeda G. (2002) The day that the START triage system came to a STOP: observations from the World Trade Center Disaster. *Acad Emerg Med* 9: 255-256.

Anonymous. (2001a) Prepared for the unthinkable: EDs respond to the terrorist attacks. *ED Manag* 13: 121-123.

Anonymous. (2001b) New York department of Health Response to Terrorist Attack, September 11, 2001. *MMWR* 50(38): 821-822. Available at http://www.cdc.gov/mmwr/PDF/wk/mm5038.pdf (Last accessed 28 January 2003)

Anonymous. (2002) Rapid assessment of injuries amongst survivors of the terrorist attack on the World Trade Center-New York City, September 2001. *MMWR* 51(1):1-5. Available at http://www.cdc.gov/mmwr/PDF/wk/mm5101.pdf (Last accessed 28 January 2003)

Association of Military Surgeons of the United States (2001) Effective Medical Response to Disasters. CD. Contact AMSUS at http://www.amsus.org (last accessed 28 January 2003)

Environmental Protection Agency. (2001) Press Release: Terrorist Attacks-EPA conducts environmental monitoring. Available at http://www.epa.gov/wtc/stories/headline_091301.htm (Last accessed 28 January 2003)

A Retrospective Cohort Study Of Workers' Compensation Indicators (Part 2)

by: **Dr. Alan Verdonk,** of Curtin University of Technology; **Dr. Milos Nedved**, Associate Professor, Faculty of Computing, Health & Science, Edith Cowan University; & **Dr. Janis Jansz**, Lecturer, Faculty of Computing, Health & Science, Edith Cowan University.

ABSTRACT

Since 1984 their has been many legislative changes that have aimed to improve occupational safety and health. This article is part 2 of a research report that follows on from part 1 that was published in Vol. XI, No. 1, 2003, edition of the WSO Journal. The research results reported identify the effects of occupational safety and health legislative changes, staffing numbers, hours of work, hazards, injuries reported and the appointment of a Safety Professional to the organisation. It also evaluates the introduction of Occupational Safety and Health Representatives, the Risk Management Unit, a full time Rehabilitation Coordinator and of occupational safety training in a Western Australian University. The consequences of all of these factors are evaluated using the University's Worker Compensation claims records.

Introduction

A retrospective cohort study of workers' compensation indicators was conducted to identify if the introduction of the Robens style occupational safety and health legislation in Western Australia had resulted in improved occupational safety and health for employees at a university. Part one of this report (Verdonk, Nedved & Jansz, 2003) described the background to this research study, the methods used to collect and analyse the research data and the limitations of the research. It also documented the results of the Pilot Study that was conducted at another university to identify ways to improve the data collection and research procedures for the study.

This paper presents an analysis of the research data collected from 1979 to 1998 which has been used to analyse the effects of the many factors that it was considered by the researcher would influence occupational safety and health practices in a university. Over this period of time (1979 – 1998) the studied university prospered and grew in both student and staff numbers.

Staffing Numbers of the University for the Period 1979 - 1998

Table 1 provides the number of staff, and Full Time Equivalent positions (FTE) of the staff, that were employed by the University during the twenty-year study period.

Table 1. Number of Staff, Full Time Equivalent (FTE's) Positions for 1979 through to 1998

Year	Number of Staff	FTE's
1979	2949	1574
1980	3139	1563
1981	3162	1710
1982	3054	1672
1983	2945	1720
1984	3327	1682
1985	3680	1598
1986	3958	1646
1987	4342	1803
1988	4930	2703
1989	5161	1996
1990	5335	1962
1991	5568	2069
1992	5732	2212
1993	5934	2348
1994	6155	2256
1995	6274	2366
1996	6422	2449
1997	6556	2475
1998	6938	2461

Not only did the number of employees increase over this time period, but also the number of hours that they worked increased.

Number of Hours Worked By Staff at the University over the Twenty Years

Table 2 provides the total number of hours per year worked by the staff at the University.

Table 2 Total Number of Hours Worked by the Staff at the University

Year	Hours Worked for the University
1979	2,881,800
1980	2,921,400
1981	2,935,800
1982	3,043,800
1983	3,187,800
1984	3,398,400
1985	3,380,400
1986	3,412,800
1987	3,299,040
1988	3,500,880
1989	3,474,780
1990	3,539,160
1991	3,600,230
1992	3,910,120
1993	4,086,040
1994	3,924,740
1995	4,115,970
1996	4,260,560
1997	4,306,850
1998	4,282,490

Over this period of time there were many hazards reported at this work

place.

Hazards Reported at the University within the Twenty Year Study Period

There were twenty-three categories of hazards (agent) causing injury or disease. The numbers of claims associated to the hazards causing injuries or disease that were reported in the twenty year period are shown, by year, in Table 3.

Table 3 Number of Claims resulting from the Hazard Categories by Year

Hazards	Years																				
	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	Total
Manual Handling	11	29	33	23	23	19	21	19	27	30	29	27	32	56	44	59	33	26	26	29	596
Trip fall	10	28	21	17	14	18	14	16	14	14	20	14	16	22	30	19	18	16	16	26	363
Machinery	4	3	12	10	16	27	36	27	43	33	19	24	25	18	5	4	6	17	10	3	342
Motor Vehicle	9	12	14	25	14	24	15	11	12	21	16	26	25	26	25	7	4		4	3	293
Chemicals	6	20	14	18	15	19	13	11	20	15	20	14	14	14	15	11	13	19	10	9	290
Other Agent	8	7	19	11	11	16	18	12	1	5	9	5	9	3	10	7	11	5	13	5	185
Indoor work				3	15	6	16	11	4	6	10	10	20	6	9	8	11	3	8	2	148
Animal	1	4			2	1	2	1			1	4			1						17
Insect	2	1	1	4	2	2	3		1	4	5		2	3		3	2		1		36
Hot water	1						1							1			1				4
Not known	2	1	3	2				3													11
Hand tool	1	6	6	9	8	6	5	19	6	2	7	12	5	8	10	3	3	5	5	5	131
Typing				3	1	19	45	13		1		1	3	15	9	7	2	6	5	3	133
Workload	1		1		1		1		2	1	3	2	1	2	5	1	4	10	9	11	55
Glass	3	7	8	4	6	10	10	8	5	3	2	1		1	4	3	4	11	9	6	105
Outdoor work				3	8								4	2	2				1		20
Nail						2	2		1				1	1	1						8
Metal work													2	3	2	5		1			13
Sporting eq.													1	1	3						5
Pushbike													1		1		1				3
Wood work															1	1					2
Syringe														1			3				4
Other Person														3	1	4				1	9
TOTAL	59	118	132	132	136	169	202	151	136	135	141	140	161	186	178	142	116	119	117	103	2773

The hazards causing injuries/disease over this 20 year period are ranked from most common cause to least common cause of injury;

1. Manual Handling (21.5%),
2. Trip or fall (13.1%),
3. Machinery (12.3%),
4. Motor vehicle (10.6%),
5. Chemical (10.5%),
6. Other agency (spectacles) (6.7%),
7. Indoor work environment (5.3%),
8. Typing (4.8%),
9. Hand tool (4.7%),
10. Glass (3.8%),
11. Workload (2.0%),

12. Insect (1.3%),
13. Outdoor work (0.7%),
14. Animal (0.1%),
15. Metal work (0.5%),
16. Not Known (before the Act)(0.4%)
17. Nail (0.3%),
18. Other person (0.3%),
19. Sporting equipment (0.2%),
20. Hot water (0.1%),
21. Pushbike (0.1%),
22. Syringe (0.1%),
23. Wood work (0.1%).

Types of Injuries

The number of injuries for which claims were lodged in the twentyyear period is shown in Table 4. Damaged spectacles are paid as a claim through the workers' compensation system and are included in the analysis.

Table 4. Injuries Experienced Over the Twenty-Year Study Period

Injuries	Years																				Total
	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	
Strain	21	35	46	46	57	57	64	59	67	67	63	65	92	92	96	77	57	49	51	51	1212
Laceration	7	17	17	19	20	28	22	27	22	14	16	28	24	23	23	11	9	19	13	15	374
Bruise	6	16	16	20	16	19	22	19	16	18	20	10	10	20	14	18	13	11	13	7	304
Foreign Body	8	13	10	11	8	12	9	9	12	10	17	9	14	11	11	9	6	9	5	7	200
Spectacles	8	7	19	11	11	17	20	13	2	5	10	5	9	4	10	7	11	5	13	5	192
RSI				3	1	19	45	14		1		1	3	13	8	6	2	6	5	3	130
Burn	1	4	6	3	4	4	6	4	8	4	1	6	3	4	2	2	2	4	4	2	74
Fracture	2	4	4	3	6	4	1		1	6	1	5	1	5	6	1	3		2		55
Stress			1		1				3	1	3	2	1	3	5	1	4	10	9	11	55
Bite (animal or insect)	3	5	1	4	4	3	5	1	1	4	6	4	2	3	1	3	2		1		53
Dermatitis		2	2	3	3	1	2			1	2	1	1	4	1	1	3		1		28
Multiple injuries	2	6	3	4	2		1	1	2	2	1					2				1	27
Respiratory		4		1		3	1	1	1		1		1		1	1	3	6			24
Conjunctivitis		1	2	2				3						1							9
Dislocation		1		1	1		3					1		1			1				9
Hernia		2	1			1			1			3		1							9
Concussion					2	1								1		1					5
Hearing Loss			1							1						2				1	5
Heart Attack	1		1				1														3
Amputation		1		1																	2
Dental injury			1							1											2
Cancer			1																		1
TOTAL	59	118	132	132	136	169	202	151	136	135	141	140	161	186	178	142	116	119	117	103	2773

The results of this study identified that the most common cause of injury at the university was body strain (43.7% of reported injuries).

Rates Calculated from the injury data

Table 5, provides the number and representation of the rates of injuries for the University for each year of the study period. Theses rates are for the cost of workers' compensation claims per $100 payroll, Frequency rates, Incidence rates and Severity rates. These rates allow weighted comparisons of the claims experience along with costs associated with those claims over the years of the study.

Table 5. Rates for each year of the study period Cost of Workers' Compensation Claims per $100 Payroll Frequency Rates, Incidence Rates and Severity Rates

Year	Cost of Workers' Comp Claims per $100 payroll	Frequency Rates	Incidence Rate	Severity Rate
1979	0.2396	9.37	0.56	96.82
1980	0.6054	15.43	1.02	458.34
1981	0.5952	16.34	1.12	81.75
1982	0.3706	15.77	1.16	259.54
1983	0.7721	15.99	1.09	527.64
1984	1.7525	18.24	1.25	1387.12
1985	1.3768	18.93	1.40	1132.71
1986	1.2104	16.7	1.16	929.44
1987	0.3438	12.12	0.74	237.34
1988	0.5923	13.13	0.73	303.35
1989	0.8714	13.52	0.77	646.66
1990	0.6612	12.14	0.62	448.98
1991	0.3573	12.77	0.66	119.16
1992	0.6381	17.64	0.98	471.59
1993	0.3341	12.72	0.74	149.78
1994	0.6458	10.7	0.65	518.25
1995	0.2058	6.31	0.39	140.18
1996	0.4158	3.52	0.24	295.13
1997	0.4667	6.5	0.38	299.29
1998	0.5493	9.57	0.56	537.30

This table shows that the cost of injuries was highest in 1989 and lowest in 1995. The frequency of injuries and incidences was highest in 1985 and lowest in 1996. The severity rate of injuries was lowest in 1979 and highest in 1984, the year that the Robens style occupational safety and health legislation was introduced into Western Australia and a Safety Officer was appointed at the university.

Safety Officer Appointment in 1984

Table 6 represents the statistical results of total Workers' Compensation expenditure, the compensation paid, the rehabilitation, legal and administration costs for the periods before and after the introduction of the Safety Officer and the introduction of the Safety Section to the University in 1984. The study found that there was no statistically reliable difference (at 0.05 level) in the common law claims or the total cost of the claims before and after the introduction of the Safety Officer and the introduction of the Safety Section to the University in 1984. There was however, a reliable difference (at 0.5 significance level) in the mean rank number of claims for lost time claims (LOSTIME), the compensation paid on claims (CPICOMP) and the rehabilitation, legal and administration costs (CPIOTHER) before and after the introduction of the Safety Officer and the Safety Section to the University in 1984.

The Safety Officer and the introduction of the Safety Section to the University in 1984 produced less lost time injuries resulting in less workers' compensation payments. There were more rehabilitation, legal and administration costs after the introduction of the Safety Officer and the Safety Section.

Table 6. The Statistical Results of the Number of Lost time, Common Law and the Total Expenditure on Workers' Compensation Claims Before and After the Introduction of the Safety Section

Ranks

Advisor		N	Mean Rank	Sum of Ranks
LOSTIME	Before Occupational Safety and Health Section	604	1475.22	891035.00
	Occupational Safety and Health Section Established	2169	1362.43	2955116.00
	Total	2773		
COMLAW	Before Occupational Safety and Health Section	604	1382.39	834991.50
	Occupational Safety and Health Section Established	2169	1388.28	3011189.50
	Total	2773		
CPITOTAL	Before Occupational Safety and Health Section	604	1350.35	815610.00
	Occupational Safety and Health Section Established	2169	1397.21	3030541.00
	Total	2773		
CPICOMP	Before Occupational Safety and Health Section	604	1473.35	892921.00
	Occupational Safety and Health Section Established	2169	1361.56	2953230.00
	Total	2773		
CPIOTHER	Before Occupational Safety and Health Section	604	1250.34	755203.00
	Occupational Safety and Health Section Established	2170	1425.06	3090948.00
	Total	2773		

Test Statistics [a]

	LOSTIME	COMLAW	CPITOTAL	CPICOMP	CPIOTHER
Mann-Whitney U	601751.0	652251.5	632900.0	599865.0	572493.000
Wilcoxon W	2955116	834961.5	815610.0	2953230	755203.000
Z	-3.672	-1.019	-1.272	-3.834	-4.744
Asymp.Sig (2-5ailed)	.000	.308	.203	.000	.000

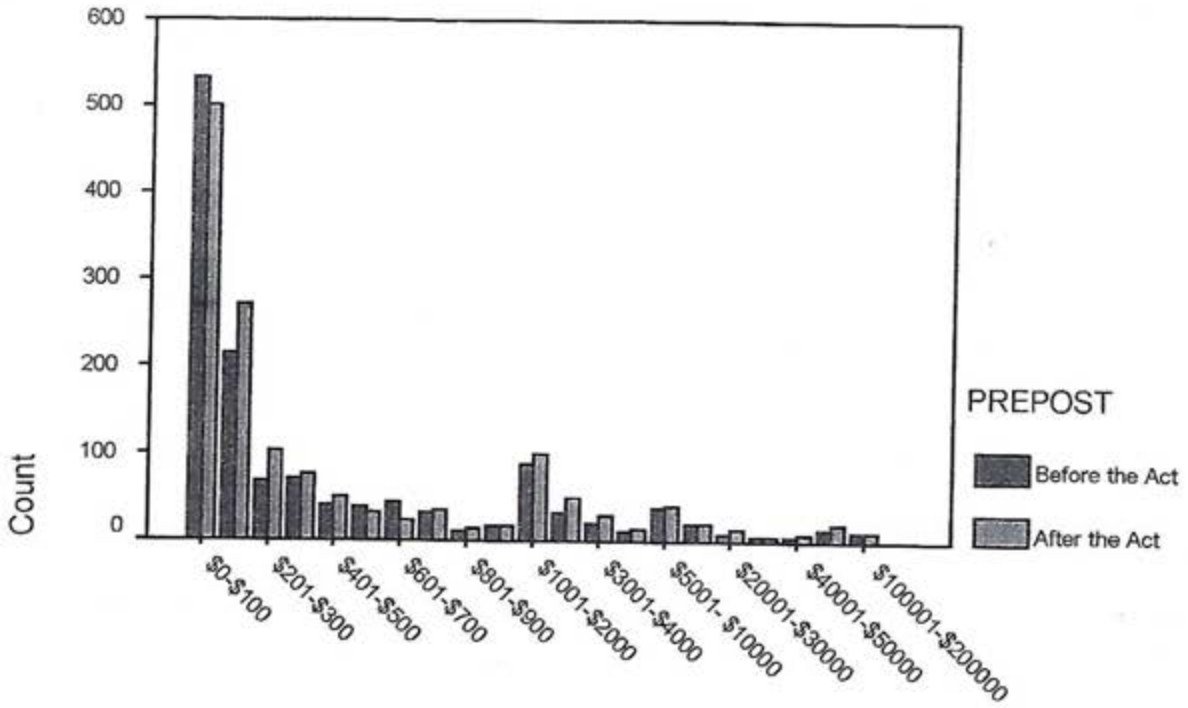
a. Grouping Variable: ADVISOR

There was a considerable increase in the number of strain injuries reported after the Safety Officer and Safety Section was introduced in the University in 1984. RSI and stress also increase in the total number of reported injuries after the introduction of the Safety Officer and Safety Section.

Comparisons of Data Before (pre) and After (post) the Promulgation of The Western Australian Occupational Safety and Health Legislation

The chart below represents the total expenditure of dollars (as categorised in the 1998 Dollar ranking) on workers' compensation. This is shown by before 1988 promulgation of the Western Australian Occupational Safety and Health Act and after 1988 promulgation of the Western Australian Occupational Safety and Health Act.

Chart on Expenditure in Dollar Amounts Indicating the Workers' Compensation Costs Before and After the 1988 Promulgation of the WA Occupational Safety and Health Act



Workers' Compensation Statistical Results Before and After the Act

Table 7 represents the statistical results of total Workers' Compensation expenditure (CPITOTAL), the compensation spent (CPICOMP), and the rehabilitation, legal and administration costs (CPIOTHER) for the periods before and after the Western Australian occupational safety and health legislation.

Table 7. The Statistical Results of Total Workers' Compensation Costing, the Compensation Paid, and the Rehabilitation, Legal and Administration Costs for the periods Before and After the Introduction of the Western Australian Occupational Safety and Health Act, 1984.

	PREPOST	N	Mean Rank	Sum of Ranks
CPITOTAL	Before the Act	1332	1352.20	1801128.50
	After The Act	1441	1419.17	2045022.50
	Total	2773		
CPICOMP	Before the Act	1332	1439.72	1917711.13
	After The Act	1441	1338.27	1928440.00
	Total	2773		
CPIOTHER	Before the Act	1332	1298.51	1729613.00
	After the Act	1441	1468.80	2116538.00
	Total	2773		

Test Statistics [a]

	CPITOTAL	CPICOMP	CPIOTHER
Mann-Whitney U	913350.5	889479.0	841835.000
Wilcoxon W	1801129	1928440	1729613.0
Z	-2.201	-4.031	-5.596
Asymp. Sig (2-tailed)	.028	.000	.000

a. Grouping Variable: PREPOST

There was a reliable difference ($p = 0.05$) in the mean ranking of total workers' compensation expenditure (CPITOTAL), the compensation spent (CPICOMP), and the rehabilitation, legal and administration costs (CPIOTHER) when comparing the periods before and after the 1988 promulgation of the Western Australian occupational safety and health legislation.

It can be seen from Table 7 there was less compensation paid (CPICOMP) before the introduction of the Act than paid after the Act was introduced. There were more total costs (CPITOTAL) as well as the rehabilitation, legal and administration costs (CPIOTHER) paid after the introduction of the Act than before it was promulgated in 1988.

Table 8 represents the statistical results of the number of lost time claims and the number of common law claims for the periods before and after the Western Australian Robens style occupational safety and health legislation introduction.

Table 8. The Statistical Results of the Number of Lost Time claims (LOSTIME) and the Number of Common Law claims (COMLAW) for the periods Before and After the Western Australian Occupational Safety and Health Act

Ranks

	PREPOST	N	Mean Rank	Sum of Ranks
LOSTIME	Before the Act	1332	1441.35	1919878.00
	After the Act	1441	1336.76	1926272.88
	Total	2773		
COMLAW	Before the Act	1332	1378.62	1836325.63
	After the Act	1441	1394.74	2009825.38
	Total	2773		

Test Statistics [a]

	LOSTIME	COMLAW
Mann-Whitney U	887312.0	948547.5
Wilcoxon W	1926273	1836326
Z	-4.122	-3.372
Asymp. Sig. (2-tailed)	.000	.001

a. Grouping Variable: PREPOST

There was a reliable difference ($p = 0.05$) in the lost time (LOSTIME) claims and the claims having a common law component (COMLAW) when comparing the periods before and after the 1988. There were less lost time costs of the claims after the Act and more costs for common law claims after the Act was promulgated in 1988.

One of the strategies introduced by the Western Australian Occupational Safety and Health Act, 1984 was the election for a workplace of Occupational Safety and Health Employee Representatives and their role and involvement in improving occupational safety and health.

Introduction of Occupational Safety and Health Representatives

Table 9 represents the statistical results of total Workers' Compensation expenditure, the compensation paid, and the rehabilitation, legal and administration costs for the periods before and after the introduction of the Occupational Safety and Health Representatives in 1989.

Table 9. The statistical Results of the Number of Lost Claims, Common Law Claims, and Total Compensation Expenditure for the periods Before and After the Introduction of the Occupational Safety and Health Representatives in 1989

	REPS	N	Mean Rank	Sum of Ranks
LOSTIME	No Occ S&H Reps	1387	1439.40	1996442.13
	Occ S&H Reps established	1386	1334.57	1849709.00
	Total	2773		
COMLAW	No Occ S&H Reps	1387	1379.50	1913364.50
	Occ S&H Reps established	1386	1394.51	1932786.50
	Total	2773		
CPITOTAL	No Occ S&H Reps	1387	1354.18	1878242.00
	Occ S&H Reps established	1386	1419.85	1967909.00
	Total	2773		

CPICOMP	No Occ S&H Reps	1387	1437.34	1993587.50
	Occ S&H Reps established	1386	1336.63	1852563.38
	Total	2773		
CPIOTHER	No Occ S&H Reps	1387	1304.19	1808918.00
	Occ S&H Reps established	1386	1469.87	2037233.00
	Total	2773		

Test Statistics [a]

	LOSTIME	COMLAW	CPITOTAL	CPICOMP	CPIOTHER
Mann-Whitney U	888518.0	950786.5	915664.0	891372.5	846340.000
Wilcoxon W	1849709	1913365	1878272	1852564	1808918.0
Z	-4.135	-3.142	-2.160	-4.005	-5.449
Asymp. Sig. (2-tailed)	.000	.002	.031	.000	.000

a. Grouping Variable: REPS

There was a reliable difference in the claims data before and after the introduction of the Representative in 1989. There were more lost time claims, less common law claims, the total cost per claim was lower per claim and the rehabilitation, legal and administration costs per claim was lower before the representatives were introduced. Some of these findings were similar to the effects of the introduction to this university of employee safety training.

Introduction of Safety Training

Table 10 represents the statistical results of lost time claims, common law claims, total Workers' Compensation expenditure, the compensation paid, and the rehabilitation, legal and administration costs for the periods before and after the introduction of the Safety Training in 1991.

Table 10. The Statistical Results of Lost Time Claims, Common Law Claims, Total Workers' Compensation Expenditure, the Compensation Paid, and the Rehabilitation, Legal and Administration Costs for the Periods Before and After the Introduction of the Safety Training in 1991

Ranks

	TRAINING	N	Mean Rank	Sum of Ranks
LOSTIME	No Training	1675	1424.52	2386069.00
	Training established & provided	1096	1327.13	1454537.00
	Total	2771		
COMLAW	No Training	1675	1380.29	2311986.00
	Training established & provided	1096	1394.73	1528620.00
	Total	2771		
CPITOTAL	No Training	1675	1349.15	2259819.50
	Training established & provided	1096	1442.32	1580786.50
	Total	2771		
CPICOMP	No Training	1675	1424.55	2386118.50
	Training established & provided	1096	1327.09	1454487.50
	Total	2771		
CPIOTHER	No Training	1675	1308.36	2191501.00
	Training established & provided	1096	1504.66	1649105.00
	Total	2771		

Test Statistics [a]

	LOSTIME	COMLAW	CPITOTAL	CPICOMP	CPIOTHER
Mann-Whitney U	853381.0	908336.0	856169.5	853331.5	787851.000
Wilcoxon W	1454537	2311986	2259820	1454488	2191501.0
Z	-3.757	-2.955	-2.998	-3.791	-6.316
Asymp. Sig. (2-tailed)	.000	.003	.003	.000	.000

a. Grouping Variable: TRAINING

There was a reliable difference ($p = 0.05$) in the claims data before and after the introduction of the safety training in 1991. There were more lost time claim, less common law claims, the total cost per claim was lower per claim, the compensation paid for each claim was higher and the rehabilitation, legal and administration costs per claim was lower before the safety training was introduced.

In an effort to reduce the risk of work related injuries occurring, and to improve the speed at which employees returned to work, in 1993 the university founded a Risk Management Unit and employed a Rehabilitation Coordinator for the university.

Introduction of the Risk Management Unit and Full time Rehabilitation Coordinator

Table 11. The Statistical Results of Lost Time Claims, Common Law Claims, Total Workers' Compensation Expenditure, the Compensation Paid, and the Rehabilitation, Legal and Administration Costs for the Periods Before and After the Introduction of the RMU and Rehabilitation Coordinator in 1993

Ranks

	REHAB	N	Mean Rank	Sum of Ranks
LOSTIME	No Rehabilitation Co-ordinator	1997	1418.73	2833207.50
	Rehabilitation Co-ordinator employed	776	1305.34	1012943.50
	Total	2773		
COMLAW	No Rehabilitation Co-ordinator	1997	1381.05	2757965.50
	Rehabilitation Co-ordinator employed	776	1402.30	1088185.50
	Total	2773		
CPITOTAL	No Rehabilitation Co-ordinator	1997	1347.16	2690282.00
	Rehabilitation Co-ordinator employed	776	1489.52	1155869.00
	Total	2773		
CPICOMP	No Rehabilitation Co-ordinator	1997	1413.54	2822840.50
	Rehabilitation Co-ordinator employed	776	1318.70	1023310.50
	Total	2773		
CPIOTHER	No Rehabilitation Co-ordinator	1997	1316.26	2628561.50
	Rehabilitation Co-ordinator employed	776	1569.06	1217589.50
	Total	2773		

Test Statistics [a]

	LOSTIME	COMLAW	CPITOTAL	CPICOMP	CPIOTHER
Mann-Whitney U	711467.5	762962.5	695279.0	721834.5	633558.500
Wilcoxon W	1012944	2757966	2690282	1023311	2628561.5
Z	-4.016	-3.994	-4.204	-3.386	-7.465
Asymp. Sig. (2-tailed)	.000	.000	.000	.001	.000

a. Grouping Variable: REHAB

Table 11 represents the statistical results of lost time claims, common law claims, total Workers' Compensation expenditure, the compensation paid, and the rehabilitation, legal and administration costs for the periods before and after the introduction of the Rehabilitation Co-ordinator in 1993.

There was a reliable difference ($p = 0.05$) in the claims data before and after the introduction of the full time Rehabilitation Co-ordinator in 1993. There were more lost time claim, less common law claims, the total cost per claim was lower per claim, the compensation paid for each claim was lower and the rehabilitation, legal and administration costs per claim was lower before the rehabilitation Co-ordinator was introduced and a Risk Management Unit was established at this university.

Discussion of the results, conclusions and recommendations from this study will be presented in the next issue of this Journal.

Reference

Verdonk, A., Nedved, M. & Jansz, J. (2003) A Retrospective Cohort Study of Workers' Compensation Indicators (Part 1). *World Safety Journal. Vol. XI*, No. 1 24-28.

ACCIDENT INVESTIGATION

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ABSTRACT

An effective accident-investigation, record keeping and reporting system are the heart of a highly efficient occupational safety and health program. It facilitates the identification of health and safety hazards, enables the design and provision of preventative measures, and helps determine overall safety and health priorities. But most importantly, an accident investigation that is properly and efficiently performed and then followed up by prompt remedial action is one of the most effective methods of reducing workplace accidents. This assignment has been structured so the reader gets an insight into how an accident investigation is performed, the people involved and methods used.

Introduction

Thousands of accidents occur throughout the world everyday. The failure of people, equipment, supplies, or surroundings to behave or react as expected, causes most accidents. Accident investigations determine how and why these failures occur. By using the information gained through an investigation, a similar or perhaps a more disastrous accident maybe prevented. When conducting an accident investigation it is essential that accident prevention be in mind and investigations are not for blaming involved parties. An accident is an unplanned event that results in personal injury or in property damage (OSHA 1996). When the personal injury requires little or no treatment, it is minor. If it results in a fatality or in a permanent total, permanent partial, or temporary total (Lost time) disability, it is serious.

What is an accident investigation?

An accident investigation is the determination of the facts of an accident by inquiry, observation, and examination and an analysis of these facts to establish the causes of an accident and the measures that must be adopted to prevent its recurrence in the workplace (OSHA 1996). An accident investigation has two purposes:

- To determine why the accident happened by identifying all work related facts associated with it.
- And, to if possible modify work conditions and procedures to prevent a similar occurrence.

The estimated total direct cost of workers compensation claims in Western Australia for the financial year 1994/95 was approximately $216,000,000, with an average cost of $7,106 per injured person (Occupational Injuries and Diseases - Western Australia 1995/96) and this does not take into account the indirect or uninsured costs of an accident.

Who is responsible for accident investigation?

There are a number of personal that become responsible and take part in an accident investigation from the start of the investigation to the finish. These include the following personal Management, Supervisors, Investigators, Safety and Health Advisers, Technical Advisers, Specialists, Occupational Safety and Health Committee and Occupational Safety and Health Representatives.

(a) Management

Management has a responsibility to their employees to ensure that an accident investigation is carried out if an employee is injured in the workplace, utilizing all of the companies' resources to reach a positive outcome in which both management and staff can be pleased with the results. Good management practice dictates that investigator's work toward some objectives i.e., that they try to define what they want to have accomplished when their tasks have finished. Both management and employees should review the results of the investigation and be able to freely make comments to each other on ways to improve the findings, taking the company's well being into consideration (PPDCA 2001).

(b) Supervisor

The supervisor, by nature of his or her position, possesses a detailed knowledge of the work and the conditions under which it is performed and is the appropriate person who should conduct the accident investigation (Treasury Board of Canada Secretarial, 2002). The supervisor's responsibility extends beyond determining the cause of the accident and includes exercising supervisory responsibilities to ensure that proper remedial action is taken.

(c) Technical Advisers and Specialists

When investigating accidents of a serious nature, or those that involve highly technical processes, it is appropriate to engage the services of a specialist or technical adviser who have specialized knowledge and experience of an operation that could assist the investigation. Also when dealing with fatalities it may be asking too much in terms of employee morale and relations to have peers conduct the investigation. An "outside" specialist may also provide an additional degree of objectivity to the investigation (Treasury Board of Canada Secretariat, 2002). When a specialist has been brought in to investigate an accident it is essential from an employee perspective that one of their own supervisors collaborates with the acting specialists.

(d) Safety and Health Adviser

Where appropriate, the company safety and health officer can offer guidance in coordinating an accident investigation. The officer cannot be expected to provide technical advise on all the companies operations or to take the place of a senior supervisor concerning the detailed work operation or daily running of procedures throughout the company. However, the safety and health officer can assist to determine the cause of an accident, as a result of general knowledge and experience with similar accidents and their causes. A good Safety and Health Advisor will also have a sound background in the laws, regulations, acts and workers compensation procedures that govern the state.

(e) Occupational Safety and Health Committee and Representative

Where an accident is reported in a workplace that is represented by an Occupational Safety and Health Committee or Occupational Safety and Health Representative, then they must play a part in the accident investigation should there be a requirement for one. It is essential for company morale that Occupational Safety and Health Representatives are activity involved in investigation if one of their fellow employee's has been involved in the accident.

What's the purpose of an accident investigation?

The primary purpose of an accident investigation is to establish the causes as quickly as possible through the identification and examination of all the information associated with the accident. The ultimate purpose is to make the required changes in the work conditions and procedures that have caused this accident to happen so that the risk is eliminated or reduce for a similar occurrence. Other reasons for workplace accident investigations are:

- To fulfill the legal requirements that are expected from company owners
- To determine the cost of the accident
- To determine compliance with applicable safety regulations
- To process worker's compensation claims

Incidents that involve no injury or property damage should still be investigated to determine the hazards that should be corrected (OSHA, 1998).

Action to be taken following an accident

An accident investigation should always be conducted as soon as possible after the event. It is much easier if the investigator finds the situation at the scene of the accident exactly as it was when the accident took place. After an accident, the site should be left undisturbed unless changes have to be made to ensure the safety of person's or to prevent further damage (Taylor, Easter & Hegney, 1998). The names and addresses of all witnesses should be obtained immediately, and the investigation should proceed as soon as possible after the accident.

What should be looked at as the cause of an accident?

Many models of accident causation have been proposed for accident investigation, ranging from Heinrich's domino theory to the sophisticated Management Oversight and Risk Tree (MORT), (CCOHS, 2001). The simple model that is shown below in figure 1 attempts to illustrate that the causes of any accident can be grouped into five categories - Task, Material, Environment, Personal, Management. When this model is used, possible causes in each category should be investigated.

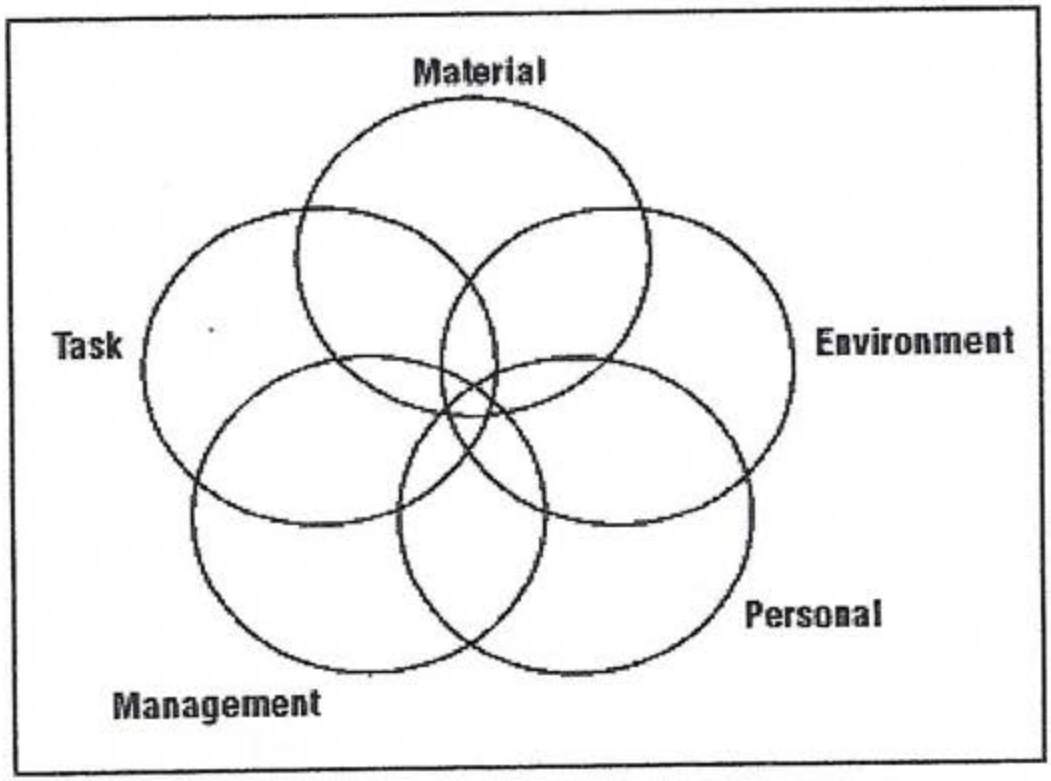

Figure 1. Accident Causation Model

Source: Canadian Centre for Occupational Health and Safety (2002)

(a) Task

Here the actual work procedure being used at the time of the accident is explored. Members of an accident investigation team will look for answers to questions such as:

- Was a safe work procedure used?
- Had conditions changed to make the normal procedure unsafe?

- Were the appropriate tools and materials available?
- Were they used?
- Were safety devices working properly?
- Was lockout used when necessary?

For most of these questions, an important follow-up question is "If not, why not"

(b) Material

To seek out possible causes resulting from equipment and products used, investigators might ask:

- Was there an equipment failure?
- What caused it to fail?
- Was the machinery poorly designed?
- Were hazardous substances involved?
- Were they clearly identified?
- Was a less hazardous alternative substance possible and available?
- Should personal protective equipment (PPE) have been used?
- Was PPE used?

Again, each time the answer reveals an unsafe condition; the investigator must ask why this situation was allowed to exist.

(c) Environment

The physical environment, and especially sudden changes to that environment are factors that need to be identified and recorded. The situation at the time of the accident is important so investigators can access if environmental factors played a part in the accident. Accident investigators may want to know the following:

- What were the weather conditions?
- Was poor housekeeping a problem?
- Was it hot or too cold?
- Was noise a problem?
- Was there adequate light?
- Were toxic or hazardous gases, fumes or dust present?

(d) Personnel

An investigator might ask the question about the physical and mental condition of those individuals directly involved in the accident. The purpose for the investigating the accident is not to establish blame against someone, but the inquiry will not be complete unless personal characteristics are considered. Some factors will remain essentially constant while others may vary from day to day.

- Were workers experienced in the work being done?
- Had they been adequately trained?
- Can they do physical work?
- What was their health status?
- Were they tired?
- Were they under stress (work or personal)?

(e) Management

Management holds the legal responsibility for the safety of the workplace and therefore the role of supervisors and higher management must always be considered in an accident investigation. Answers to any of the preceding types of questions logically lead to further questions such as:

- Was safety rules communicated to and understood by all employees?
- Were written procedures available?
- Were they being enforced?
- Was there adequate supervision?
- Were the workers trained to do the work?
- Had hazards been previously identified?
- Were unsafe conditions corrected?
- Was regular maintenance carried out on equipment?
- Were regular safety inspections carried out?

This model of accident investigations provides a guide for uncovering all possible causes and reduces the likelihood at facts in isolation. This is only an example and it should be emphasized that the sample questions do not make up the complete checklist and a lot more can be added to this accident causation model.

How the facts are collected?

Gathering evidence comes from many sources during the investigation. Information needs to be obtained from injured personal, witnesses and reports as well by observation. The site where the accident occurred needs to be examined before any changes occur and if possible sketches and photographs need to be taken. It is also good practice to get copies of all reports, documents containing normal operating procedures, flow diagrams, maintenance charts, or reports of difficulties or abnormalities can be very useful in an investigation. It is also essential to keep accurate notes, which should contain information like pre accident conditions, the accident sequence, and post accident conditions. In addition, document the location of victims, witnesses, machinery, energy sources, and hazardous materials. It is important also to look at the range of hazards and risk factors in detail to get a clearer picture of what the results of exposure to the hazard could be, and how serious the resulting harm, injury or damage might be (Jeynes, 2002).

Interviewing Witnesses

In general, experienced personal should conduct interviews with witnesses and where possible the person conducting the interview should have some legal experience. There are certain proven techniques for a successful interview. The following elements form the basic approach to investigation interviewing (Taylor, Easter & Hegney, 1998):

- Conduct the interview in private at the workplace
- Put the interviewee at ease, and don't rush things
- Ask the interviewee's version of what happened
- Only ask necessary questions
- Repeat the interviewee's story as you (the interviewer)
- Close the interview on a positive note. Thank the witness.

The final Accident Investigation Report

When the final report is drafted there are a number of elements the investigator has to put in the report. The investigator must assume the reader does not have any knowledge about the workplace or the type of work practices being carried out. Every aspect of the investigation needs to be spelt out. The report needs to be methodical, systematic, unemotional records of the facts and events that led to the accident, description of evidence and exhibits collected, together with an analysis of the causal factors and recommendations for preventative measures (Safetyline, 1999). If the investigator finds after a thorough worksite accident investigation that some person or persons among management, supervisor, and the workers were apparently at fault, then this fact should be pointed out. The intention of the accident investigation is to remedy the

situation, not to discipline an individual. Failing to point out human failings that contributed to an accident will only downgrade the quality of the investigation. Furthermore, it will also allow future accidents to happen from similar causes because they have not been addressed (CCOHS, 1997).

Conclusions

An effective accident investigation requires strong employer and employee commitment and steady involvement. Management must be prepared to support the investigation process and be willing to act on the final results. Management must make sure that investigators have the experience and sufficient resources available to them to capable of carrying out an adequate investigation. It is management's responsibility to evaluate the final outcome of the investigation and to determine in consultation with its safety advisor, safety and health committee and employees on prevention strategies, which will hopefully prevent such an accident from ever occurring again.

References & Bibliography

Canadian Centre for Occupational Health and Safety (CCOHS). (1997). *Accident Investigation*__[On-line]Available at http://www.ccohs.ca/oshanswers/hsprograms/investig.html (2002, August, 7th).

Jeynes, J. (2002). *Risk Management 10 Principles.* Oxford. United Kingdom: Butterworth-Heinemann.

Occupational Injuries and Diseases, Western Australia (1995/96) Publication, [On-line] Available at http://www.safetyline.wa.gov.au (2002, August, 7th).

Occupational Safety & Health Administration U.S. Department of Labor (OSHA) (1996). *Section 6: Accident Investigation.* [On-line] Available at http://www.osha-slc.gov/SLTC/smallbusiness/sec6.html (2002, August, 7th).

Painting and Decorating Contractors of America. (2001). *Accidents, what went wrong?* [On-line] Available at http://www.pcda.com/safety/accidents.htm (2002, August, 7th).

SLI/ Accident Prevention and Investigation/Accident Investigation and Reporting. (2001) [On-line] Available at http://www.safetyline.wa.gov.au/institute/level1/course11/lecture32/132-02 (2002, August, 7th).

Taylor, G, Easter, K. & Hegney, R. (1996). *Enhancing Safety.* Perth. Western Australia: Training Publications.

Treasury Board of Canada Secretarial (nd) *5-02 A Guide to Accident Investigations* [On-line] available at http://www.tbs-sct.gc.ca/pubs-pol/hrpubs/tbm-119/CHAPS5-2-e.html (2002, August, 7th).

WSO Awards Program and Nomination Procedure

I. List Of Awards:

- WSO Environmental/Occupational Safety Person of the year
- WSO James K. Williams Award
- WSO Concerned Citizen Award
- WSO Concerned Professional Award
- WSO Concerned Company/Corporation Award
- WSO Concerned Company/Corporation Honorable Mention Certificate
- WSO Educational Award
- WSO Concerned Organization Award
- WSO Chapter/National Office Of The Year Award
- WSO Award For Achievement In Scientific Research And Development
- WSO International Award

II. Criteria For The WSO Awards:

Listed below are some criteria used in the selection of individuals, companies, corporation organizations, etc., for the awards of the World Safety Organization, also listed are the number of awards to which these presentations are limited. The support of the WSO purpose "...to protect people, resources, environment and property" and the support of the WSO motto "Making Safety A Way Of Life...Worldwide" are nominal for all awards.

World Environmental/Occupational Person of the year: (one award per year)

- *Individual, working full time in the field of environmental/occupational safety/health, hazardous materials management, or allied field, with national and international experience, etc.* *

Nominator: May be nominated by an individual or organization with an in-depth knowledge of the nominee's accomplishments.

Criteria for Nomination: An individual who has shown above average support and dedication to the protection of people, property, resources and the environment on an international basis, fulfilling at least three of the following requirements (may be retired, does not have to be practicing full time in the safety profession at the time of nomination):

- can document continuous involvement in safety or allied profession for a period of at least 10 years;
- participated in a significant manner in the safety discipline work in at least five countries worldwide;
- authored book(s)/articles/texts in his/her field of expertise, significant in nature, published in at least five countries worldwide; or an international publication distributed in at least 5 countries;
- designed concept, process or some other notable invention, within the safety disciplines;
- shown a significant support for the promotion of safety education and discipline;
- other significant accomplishments may be submitted for review.

WSO James K. Williams Award: (one award per year)

- *Active Member of the WSO who has shown above average support and cooperation for the organization and was actively involved in the WSO programs, operations, etc., on a volunteer assistance and work basis.*

Nominator: May be nominated by any member of the WSO with an in depth-knowledge of the nominees's accomplishments on behalf of the World Safety Organization.

Criteria for Nomination: A member in good standing with the World Safety Organization, who has unselfishly provided significant assistance with and support of the programs of the WSO, as well as a strong dedication to the WSO purpose of protection of people, property, resources and the environment, and with a full support of the WSO motto "Making Safety A Way Of Life...Worldwide".

WSO Concerned Citizen Award: (one award per year)

- *Active Member of the WSO, who has shown above average support and cooperation for the community organizations and programs, volunteered his/her time to those programs, served on community boards, provided training etc.*

Nominator: Must be nominated by an individual(s) from one of the organizations which benefitted from that individual's support, and who is familiar with and has an in-depth knowledge of the nominee's accomplishments in conjunction with the above volunteer work.

Criteria for Nomination: A member in good standing with the World Safety Organization, who has unselfishly provided significant assistance with and support of the local community programs where safety was the most important aspect, as well as a strong dedication to the WSO purpose of protection of people, property, resources and the environment, and with a full support of the WSO motto "Making Safety A Way Of Life...Worldwide".

(two awards per year)

WSO Concerned Professional Award:

- *Active Member of the WSO, who has shown above average skills in design, leadership and supervision of environmental/occupational safety and health programs, hazardous materials management programs, transportation safety programs, etc.*

Nominator: Must be nominated by an individual with an in-depth knowledge of the nominee's accomplishments, such as the Company/Corporation's Chief Executive Officer, Owner, Mayor, a group of co-workers with an approval of the immediate supervisor and company/corporation's head, Member of the Advisory Body of the WSO Chapter, etc.

Criteria for Nomination: A member in good standing with the World Safety Organization; who exhibits total dedication and commitment to the protection of people, property, resources, and the environment through participation and personal involvement in professional safety activities.

(six awards per year; seven if no non-industrial entity is selected)

WSO Concerned Company/Corporation Award:

- *Company or corporation with an excellent safety program, safety record, etc., industrial in nature, with programs on off-the-job safety, environmental programs, etc.* *
- *Company or corporation non-industrial in nature, with an excellent safety or environmental program, safety record, etc**

Nominator: May be nominated by any individual or organization with an in-depth knowledge of the nominee's accomplishments.

Criteria for Nomination: Company or corporation who is actively (and above average in) contributing to protection of people, property, resources and the environment through innovative programs; shows distinctive concern for the well-being of its employees and local community.

(two awards per year)

WSO Concerned Company/Corporation Honorable Mention Certificate:

- *Company or corporation with commendable support of environmental, occupational, safety, etc., programs. Industrial or non-industrial;* *

Nominator: May be nominated by any individual or organization with an in-depth knowledge of the nominee's accomplishments.

Criteria for Nomination: Institution, company, training entity, individual, etc., with an above average program of educational nature in the fields of environmental/occupational safety and health, fire science and safety, public safety, healthcare safety, transportation safety, or similar programs; actively (and above average in) contributing to the protection of people, property, resources and environment through innovative programs; with distinctive concern for the education of professionals and general public in the disciplines of safety and allied fields.

(three awards per year)

WSO Educational Award:

- *Institution, company, training entity, individual, etc., with an above average program of educational nature in the fields of safety, environment, public safety, healthcare safety, transportation safety, etc.* *

Nominator: May be nominated by any individual or organization with an in-depth knowledge of the nominee's accomplishments.

Criteria for Nomination: Institution, company, training entity, individual, etc., with an above average program of educational nature in the fields of environmental/occupational safety and health, fire science and safety, public safety, healthcare safety, transportation safety, or similar programs; actively (and above average in) contributing to the protection of people, property, resources and the environment through innovative programs; with distinctive concern for the education of professionals and general public in the disciplines of safety and allied fields.

(two awards per year)

WSO Concerned Organization Award:

- *Association, Society, Agency, etc., with an above average support of safety, environmental, etc., movement,* *

Nominator: May be nominated by any individual or organization with an in-depth knowledge of the nominee's accomplishments.

Criteria for Nomination: Association, Society, Agency, etc., with an above average support of safety, environmental, etc, movement; actively (and above average in) contributing to the protection of people, property, resources and the environment through innovative programs; with distinctive purpose and goals to enhance the safety awareness.

WSO Chapter/National Office Of The Year Award: (one award per year)

- *The WSO Chapter/National Office of the year award is presented annually to recognize exceptional effort on the part of a WSO Chapter/National Office membership to promote WSO and the organization. Any WSO Chapter/National Office in good standing is eligible for this award.*

Criteria for Nomination: Number of meetings held, ratio of percentage of chapter members attending meetings, quality and number of Chapter/National Office newsletters, special events conducted by the Chapter/National Office, number of activities held to promote WSO and the organization, number of new members, participation in the awards program, articles submitted and published in WSO Journal by Chapter/National Office members.

WSO Award for Achievement In Scientific Research And Development: (one award per year)

- *The WSO Award for Achievement in Scientific Research and Development is presented to an individual or group who have made contributions to the advancement of WSO through research and development programs. Any individual (members or non-member) or a group is eligible. Selection is based on individual or group actions that significantly contributed to the effectiveness of the application of WSO programs in research and development.*

Criteria for Nomination: (a) Direction or coordination of a major research project that led to the development of new approaches to the application of principles/techniques to a major system (transportation, nuclear, etc.) or product (automobile, aircraft, or other major consumer product) where significant increases in the safety of the user can be demonstrated. (b) The development of testing methods or standards that has contributed significantly to the safety interface between the system and the operator of the product and the consumer. (c) The development of testing methods or standards that has clearly enhanced the safety of research and development testing operations. Standards/methods must have been adopted and implemented to standard practice in a major system or organization. (d) Significant development in the process of evolving WSO as a true discipline.

WSO International Award: (one award per year)

- *The WSO International award is presented to a person(s) and or organization(s) for outstanding achievement or performance of special service in the advancement of the disciplines of WSO in a country other than the United State of America. The purpose is to recognize and foster the growth of WSO outside the United States of America (USA). Person(s) or organization(s) residing outside the USA including US citizens are eligible. Non-U.S. citizens are not eligible for work performed in the USA.*

Criteria for Nomination: Selection is based on such issues/contributions as: (a) Significant representation of the international community at International WSO Organization Conferences. (b) Papers on WSO that were published by the nominee in other countries other than the USA. (c) Participation and contribution at other international conferences on safety. (d) Clear demonstration of excellence in the application of WSO in countries other than the USA. (e) Papers submitted and published in the WSO Journal.

**) Membership in the WSO is not a requirement*

III. Nomination Procedures:

The awards cycle is from 1 January to 31 December each year. Nominations for a given year are accepted in the WSO by May 15th, following the end of the award cycle. In order to keep things as simple as possible, a single award nomination process is used for all awards. Please read the instruction carefully and you will find that all the potential situations are covered. A letter format will be accepted as long as all the information is provided in the proper order. It is hard to provide to much justification for your nomination. The most frequent problem is having insufficient information to judge the validity of the nomination.

The submission must contain the following information in the order shown below.

1. Name of the award for which the nomination is being submitted.
2. Name of the individual, group, committee, organization , or firm being nominated.
   a. If nominating an individual: provide name, home address, and phone number and the employer's work address, phone, and email address.
   b. If nominating a group or committee: provide the name of the group or committee and the organization with which it is affiliated and the name, address, telephone number, and email address, of the chairperson.
   c. If nominating an organization or firm: provide the name, address, and telephone of the firm and the name, address phone number, and email address if applicable, of the chief executive officer, president, or owner.
3. Provide the name, address, telephone, and email address, of the person making the nomination.
4. If the nominee is an individual, name the employer and provide a brief description of the nominee's current position. If

the nominee is a group, provide a description of the purpose of the group and the primary organization it supports.

5. Provide a description of the key outstanding accomplishments of the nominee. It must be clear exactly how the nominee meets the criteria for the award nominated.
   a. For individuals, provide a summary of the nominees educational and WSO related professional accomplishments. Enumerate the nominee's contributions to the WSO Organization, safety profession, and his/her employer and community.
   b. For groups, committees, organization, or firms, provide a summary of the nominee's contribution to the advancement of the WSO.
6. Provide the name, address, phone number, and email address if applicable, of three references that can provide comments concerning the nominee's performance. At least one reference must be a WSO organization member. Persons listed as references cannot be related to or employed by the nominee.
7. Provide appropriate supporting documentation to support the nomination. If the nomination is based on published works, provide copies of the document(s).

Submit all nomination to:

WSO World Management Center
WSO Awards Committee
106 W Young Avenue Suite G, PO Box 518
Warrensburg, Missouri 64093 USA

IV. Nomination Form Example:

DATE:

NAME OF THE AWARD:

NOMINEE: Name
Home Address
Home Telephone
Employer
Work Address
Work Telephone
Email address and web site (if applicable)

NOMINATOR: Name
Work Address
Work Telephone
E-mail address

CURRENT POSITION AND EMPLOYER:

KEY ACCOMPLISHMENTS:

REFERENCES: Three required; one of which is a current member of the organization that is being nominated.

SUPPORTING DOCUMENTATION: (Published paper, etc., if applicable):

WSO Code of Ethics

Members of the WSO, by virtue of their acceptance of membership into the WSO, are bound to the following Code of Ethics regarding their activities associated with the WSO:

1. Members must be responsible for ethical and professional conduct in relationships with clients, employers, associates and public.

2. Members must be responsible for professional competence in performance of all their professional activities.

3. Members must be responsible for the protection of professional interest, reputation and good name of any deserving WSO member of member of other professional organization involved in safety or associated disciplines.

4. Members must be dedicated to professional development of new members in the safety profession and associated disciplines.

5. Members must be responsible for their complete sincerity in professional services in the world.

6. Members must be responsible for continuing improvement and development of professional competencies in safety and associated disciplines.

7. Members must be responsible for their professional efforts to support the WSO motto "Making Safety A Way Of Life...Worldwide".

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