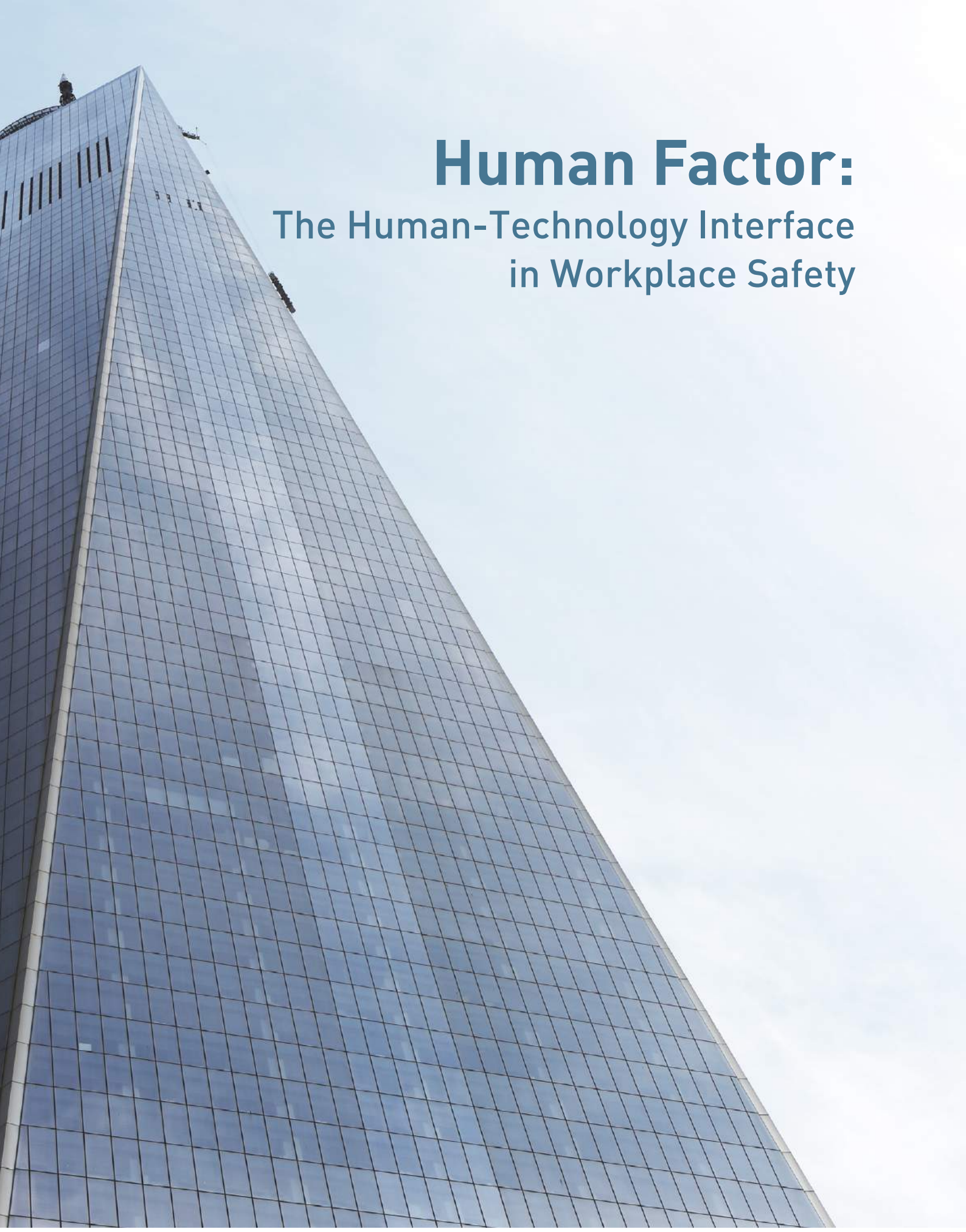

Human Factor:

The Human-Technology Interface in Workplace Safety

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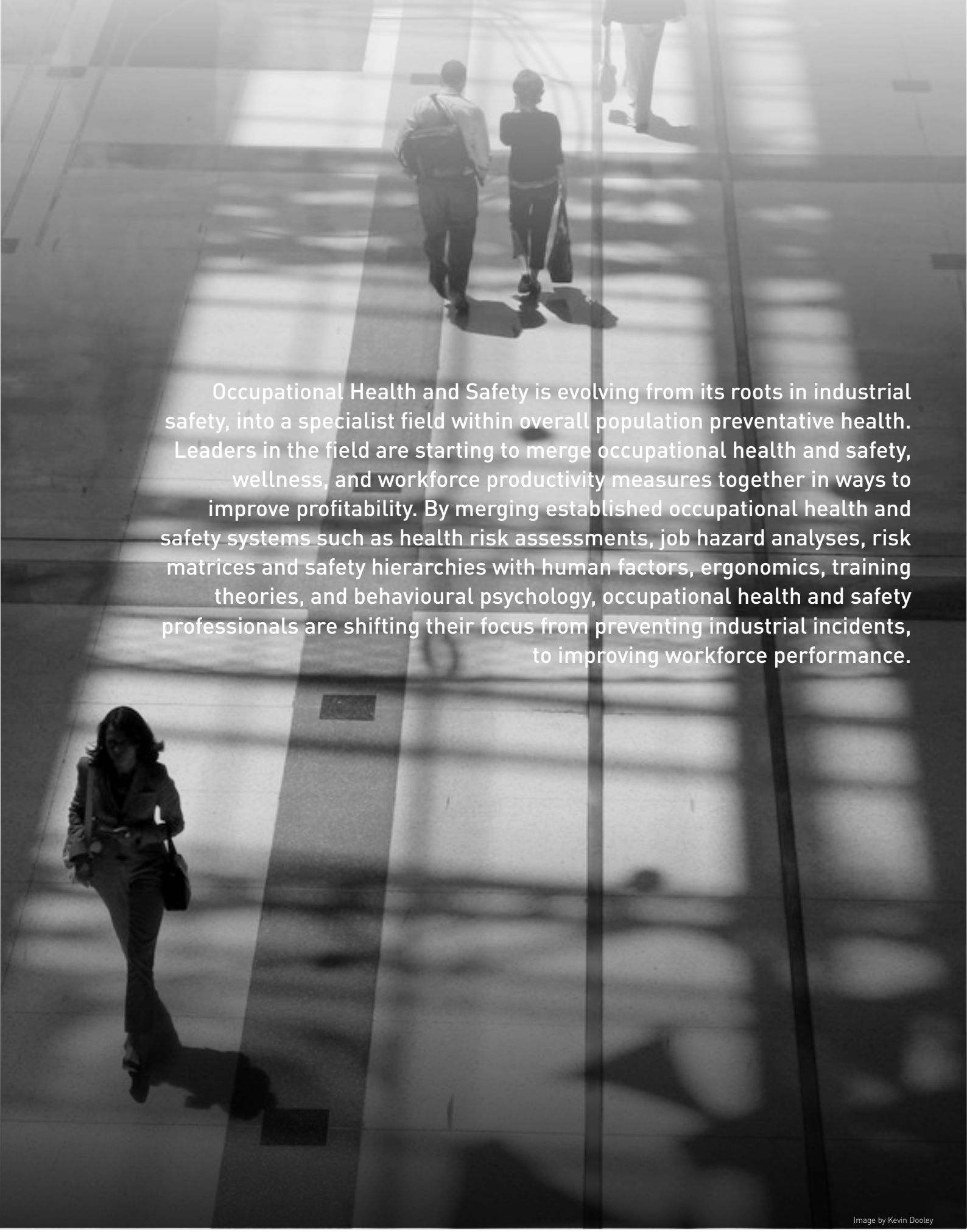


Occupational Health and Safety is evolving from its roots in industrial safety, into a specialist field within overall population preventative health. Leaders in the field are starting to merge occupational health and safety, wellness, and workforce productivity measures together in ways to improve profitability. By merging established occupational health and safety systems such as health risk assessments, job hazard analyses, risk matrices and safety hierarchies with human factors, ergonomics, training theories, and behavioural psychology, occupational health and safety professionals are shifting their focus from preventing industrial incidents, to improving workforce performance.

Image by Kevin Dooley

Introduction

On 8th April, 2013, Indianapolis garbage collector Thomas Welch was killed in a workplace accident when the truck he was working on ran over him. As part of the investigation, a routine blood sample was taken from the driver, and records were secured for worker training and the vehicle's maintenance. The investigators then learned from another employee that records had been falsified: they had been backdated and back-signed. The accident investigation became far more complex.

Accidents and incidents can occur in any workplace, and while it's the spectacular that make it into the nightly news, life-changing incidents can occur anywhere. The nature of the potential incidents and risks are different for different industries, enterprise size, and work scope. Even what constitutes the most likely risks in terms of personal injury can change by industry and the demographics of the worker and workforce (see Lopez-Arquillos & Rubio-Romero, 2016). Occupational Health and Safety is regulated by Governments, but self-regulation by individual enterprises and their collectives such as through industry associations is a component of an effective system, especially for those that operate across national or domestic regulatory borders, such as multinational corporations. This mix of government regulation and self-management, 'co-regulation', provides a foundation of government regulation which acts as a standard level, plus encouragement for excellence, such as financial benefits or other rewards such as excellence awards (Gunningham, 2011: 8).

Avoiding industrial incidents and accidents is one of the key reasons for Occupational Health and Safety, but this foundation is expanding and shifting to a more holistic approach, not just the workplace and its direct-hires. The focus is growing to encompass the wellbeing of service-delivery stakeholders such as those in nearby homes or workers' families; as well as considering longer-term health impacts including risks to health post-employment; and into further areas of information-gathering and dissemination such as social media, and the worker-technology interface, including the use of technologies such as the Internet of Things (IoT). The Zero Accident Vision (ZAV) is now well-known in Australia and around the world as a public road safety initiative, but it is also seen in enterprises who are seeking to implement this greater vision of ongoing health. The focus is shifting to identifying root causes of unsafe situations and incidents, rather than on finding something - or someone - to blame (Twaalfhoven & Kortleven, 2016).

The influence of Occupational Health and Safety is moving the field beyond its traditional 'silo'. As wellness moves to taking a strategic position, so OHS moves towards becoming a specialised component in the public health space, from preventative health to investigating incidents. This is a welcome move for commerce, as evidence is building that workplace health and wellness is connected to positive outcomes in workforce engagement, resilience, and productivity. Social benefits of safe, dignified, and properly remunerated work include the labour market wanting to work for longer, fewer people being forced into retirement due to ill health, and taking less time for illnesses during working life (Harrison & Dawson, 2016). The Basic Occupational Health Services Initiative launched in 2005 by the World Health Organization, International Labor Organization, and International Commission on Occupational Health seems to be part of this new measure, being grounded in primary health, but focused on quality preventative health as well. What it means is a blurring of the lines between occupational and personal health, and the role of occupational health programs becoming part of an overall approach to national health requirements (Harrison & Dawson, 2016: 4).

Cost of Industrial Incidents

Risk Management Matrix

Government	• Policy • Laws
Regulatory Bodies	• Regulations • Codes of Conduct
Company	• Leadership • Strategy
Management	• Policies & Procedures • Supervision
Staff	• Physical Processes • Actions
Work	• Equipment • Environment

During the investigation, it was found that up to 30 trucks had falsified safety records. It was also found that workers had been breaching safety guidelines, such as by remaining on rear-platforms while the trucks drove over the 10mph limit for those positions. It was clear that multiple lines of hazard controls had been breached before and after the accident that resulted in Thomas Welch's death. The incident had brought to light a range of other safety breaches not directly related to the accident itself.

First things first: the concept of Occupational Health and Safety itself is over a century old. The International Commission for Occupational Health was established in 1906, and the Industrial Labor Organization was created after World War Two (Harrison & Dawson, 2016: 1). Occupational health and safety is being redefined, not only as an absence of injury and disease, but rather, health as a positive: physical, mental, and social wellness (Harrison & Dawson, 2016: 1; Burton, 2010: 16; World Health Organization, 2007). In this sense, an occupational health and safety incident is not just where a discrete event results in injury, but can also be the result of an aspect of the workplace that results in a negative impact to workers' positive health and wellness over a longer duration.

The basic duty of employers for workplace health and safety can be summarized as three core points: Aziz & Yousof, 2015: 799

- Engage competent workers
- Provide a safe environment and safe equipment
- Maintain a safe system of work

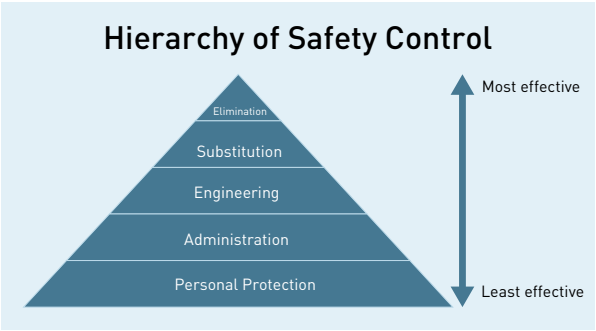
In terms of accidents, it is difficult to talk about actual comparative statistics across borders, or even of comprehensive statistics in one jurisdiction. First, not every country has the same classification system for accidents; the same reporting system; or even, the same level of employer vicarious liability for accidents. For example, Ghana is not a signatory to the International Labor Organization Convention 155, and does not have a standardized national workplace incident reporting system (Annan et al, 2015: 147). Indeed, Convention 155 has only been ratified by 64 countries to date (International Labor Organization, 1981). While this does not speak to an individual country's occupational health and safety system's quality, it does at least demonstrate how little cross-border standardisation there might exist between one jurisdiction and another; a key challenge in managing workplace risk for multinationals. In a further example, under Malaysian law, employers have a duty of care to employees as they travel to and from the workplace such as to their usual place of residence (Aziz & Yousof, 2015). With such different systems, comparing workplace-related travel accidents in say, Australia and Malaysia could be a problem.

When we consider comprehensive statistics, this is likewise limited. For example, Occupational Health and Safety costs are varied, and include:

Maryani et al, 2015: 394

- **Direct costs** such as fines, investigations, or workplace shutdowns
- **Indirect costs** such as loss of productivity, higher insurance premiums, or loss of business
- **Program costs** such as training, administration, and prevention

An example of the difficulties in producing more comprehensive records is shown by the work undertaken by Olivares et al (2015) where they constructed a database of incidents that occurred between 1998 and 2014 in fuel ethanol facilities. Their work involved collecting a variety of sources; analysing those sources; and classifying and categorizing information into a usable database resource. Even in a nation such as Australia, where the Model Work Health and Safety Act 2011 has created a uniform set of workplace health and safety laws and has been in force for several years, the statistical information available can be quite limited: while data on current deaths, serious injuries, and compensation by industry are available, these are based on legal reporting requirements and do not hold information about issues such as indirect costs (Safework Australia).

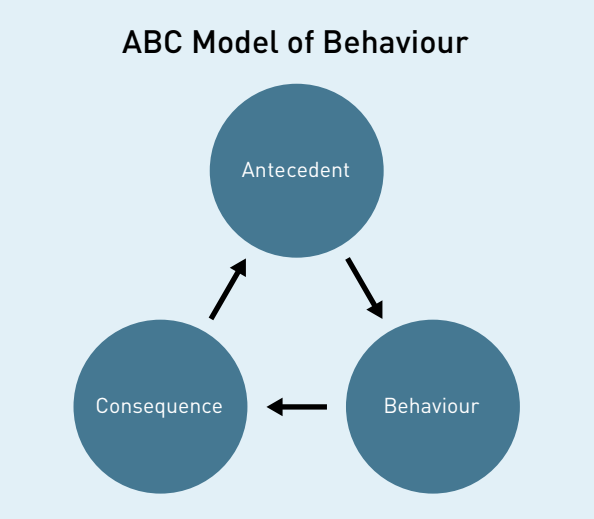


It may be worthwhile to consider a 'near hit' as an actual collision, in terms of approaching it... the fact it wasn't was potentially not due to the available systems: ask whether something needs to change.

While it is not within the scope of this paper to give an in-depth discussion of the core systems used to develop or establish a safety system, it's worth briefly outlining those which should be the foundation of any system. A Job Safety Analysis (also known as a Job Hazard Analysis or Task Safety Analysis) is an essential component of a workplace health and safety system. Job Safety Analyses have become a staple of the occupational safety system. Ideally, every job and every piece of equipment would have a Job Safety Analysis attached to it. Likewise, every fault or potential problem would be identified and corrected. However, for many enterprises this is simply impractical. Instead, priorities are commonly set using tools such as a Risk Matrix. These are often tailored for the specific needs of an enterprise, using the two axes of 'likelihood', and 'potential outcome' to identify whether a risk is catastrophic, serious, or low (or some other set of categories appropriate to the enterprise). The Job Safety Analysis and Risk Matrix help in assessing what might go wrong, what the consequences would be, what would contribute, and its likelihood. Regular reviews of policies and procedures by dating each document, and scheduling regular reviews, ensures these documents do not go out of date.

Workplace hazards are the result of a mix of factors: equipment, environment, systems, the people who use them, and the work itself (Annan et al, 2015). Similarities of incidents can be considered in terms of the risk factors present in any workplace: the type, extent, and frequency of worker exposure to chemical, physical, ergonomic, and biological hazards (Annan et al, 2015: 146). It may take specialized knowledge to manage the risk of some of these risks. For this reason, Occupational Health services should be multidisciplinary especially in specialized or heavy industries (e.g. safety engineering, chemistry, toxicology, physiology, psychology, etc.) with a team of experts comprising generalists and specialists. In other words, occupational health and safety is a specialised system, not a stand-alone role (Harrison & Dawson, 2016: 5).

Human Factors



After the accident, the impact of the workplace culture and human factors that came to light included the failure to properly sign records and the failure to maintain safety checklists for trucks including checking safety equipment such as mirrors. The driver of the truck did not see Thomas Welch in the mirror, so assumed he was on the step. Then, the driver reversed.

The Human Factors approach can be used to ensure the benefits of using the machinery, processes, and environment: resilience to minor human errors, and to enhance human performance (Leva et al, 2015: 95). In terms of incident reporting, Human Factors can provide an explanation for why some interfaces between human and machine work better than others. The Human Factors Analysis and Classification System (HFACS) is another model in the arsenal of managing the human factor in occupational health and safety. Based on the 'Swiss Cheese' model of accidents, HFACS looks at the various conditions needed through a system of five causal factors in 19 categories under which human error or intentional wrongdoing can occur - from supervision and other preconditions through to the unsafe act itself (Ergai et al, 2016). The variables that human factors present to the occupational health and safety equation include the individual's awareness of safety; experience and education; work ethic; level of attentiveness or fatigue; factors around the work itself

such as the team involved in it; training; and protective equipment (Maryani et al, 2015: 396).

Incidents can be both event-based, or duration-based. Incidents may be because of gaps or weaknesses in the enterprise that finally result in a measurable problem. The importance of rewarding good behaviour as well as punishing bad behaviour can be shown best with asking a simple question: "Why should this person exert themselves to deliver the best outcome to the organisation?"

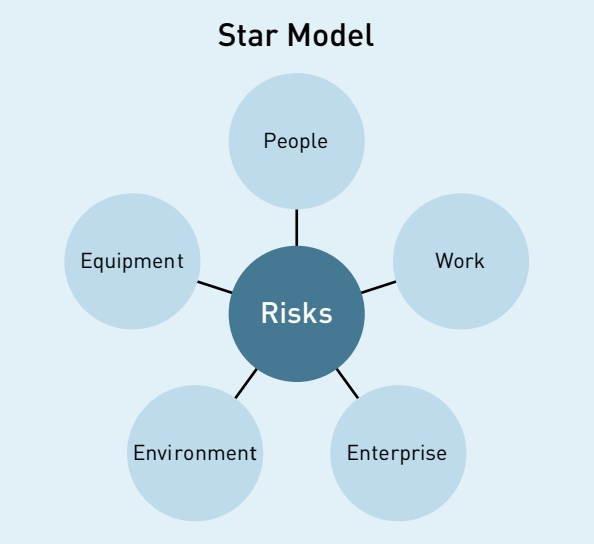
The ABC Model of Behaviour is useful for this question:

1. What are the preconditions or precursors to the decision?
2. What is the behaviour?
3. What are the consequences to this decision?

This model of behaviour suggests that what may seem poor behaviour may be the result of correct or incorrect assumptions. For example, if the preconditions to a decision on safety is that speed is preferred over safety by management, and that speed is rewarded while safety breaches are ignored, then the consequences of breaching safety rules in favour of speed is rewarded. Engagement is an important component of a safety culture, because discretionary effort is how workers move from focusing on delivering a basic standard, to achieving excellence (Jaroslawska-Sobor, 2016: 6). Moving beyond the concept of worker as 'machine operator', people are best understood in terms of their role as Intellectual Capital. Individuals bring in two types of capital to an enterprise: Human Capital, and Structural Capital. Human Capital comprises what people bring and maintain within the enterprise: their experience, knowledge, and skills; while Structural Capital is what people impart in more permanent form, such as policies and procedures. A third form of capital, Relational Capital, is brought in through relationships with other workers, clients, suppliers, and other interpersonal ties (Jaroslawska-Sobor, 2016: 4).

Shifts in the use of technology and machinery mean that people have gone from being operators to supervisors of the technology, using the procedures and systems in place; and as a result the role of many people now is to monitor the machines for signs of problems during operation. This is exacerbated when advances in technology occur so frequently that the people supervising the machinery have difficulty keeping up with the changes in procedures, levels of complexity, or simply differences in how the latest machine works (Leva et al, 2015: 94). This is a challenge not just for individual enterprises but global industry. Under the auspices of the United Nations' International Maritime Organization, the maritime industry has begun to address the challenges of increased complexity in ships and shipboard equipment by focusing more on the human factor. Addressing crew-centred design is more than replacing people with machinery; it is about considering human and machine to be part of a single 'socio-technical system'. In this system, the interface between human and machine becomes the weak link: two-thirds of incidents in the maritime industry are at the interface between person and equipment (Praetorius et al, 2015). Having workers feel comfortable in reporting difficulties at this face is a real challenge. Workers must feel that reporting problems is necessary to improve safety and productivity, while not feeling that their own productivity will be questioned. Keeping safety systems and discipline systems as separate as possible can help. Especially during an investigation after an incident, if they are seen as having a primary purpose of finding a 'culprit' to 'punish' then investigators risk having their inquiries thwarted by a lack of voluntary information that would help to find the real problems. The purpose of any investigation should not commence with questions of 'who' is responsible, but rather, 'what'.

Avoiding a Bad Day



A man was killed. A months-long investigation was underway. Realizing the records were incomplete, they were falsified. Upon discovering this, the City fired two administrators. The Indiana Occupational Safety and Health Administration finally found that there were four 'knowing' violations of the Code, plus a further five 'serious' violations and fined the City $80,000.

You do not need to wait until there is an actual incident before making improvements. Investigations can occur when there are near-accidents, when machinery or situations are reported as dangerous, processes can be put into place to invite front-line workers to report the potential for problems. For example, some mining enterprises have established Ethics Counsels to invite reports of potentially unethical behaviour, which are then investigated by an independent arbiter and reported upon as a general report on the company every two to three years. This allows for issues to be investigated and resolved before they become problems, and for gaps to be closed company-wide in a form of ongoing quality improvement (Jaroslawska-Sobor, 2016: 5).

The hazards in a workplace relate to the key classifications of a workplace: the work itself, plus the equipment, environment, systems, and people. Accident prevention is about looking at these individually and collectively. For example, training is about providing the knowledge and skills needed to work with the equipment, in the workplace environment, within the scope of the enterprise's systems. Training itself is a system - policy, procedure, perhaps using equipment, and provided within a real or virtual environment - that uses four processes: defining the need and the kind of training required; securing trainers with appropriate skills and experience; a training guide comprising goals, plans, materials; and conducting the training, including reviewing and evaluating it to keep it relevant and successful (Aziz & Yousof, 2015: 801). But if training either does not occur, occurs haphazardly, or the records are not kept, then this creates a gap in the records at the least, and potentially a dangerous worker without the knowledge to properly operate the equipment they are permitted to use.

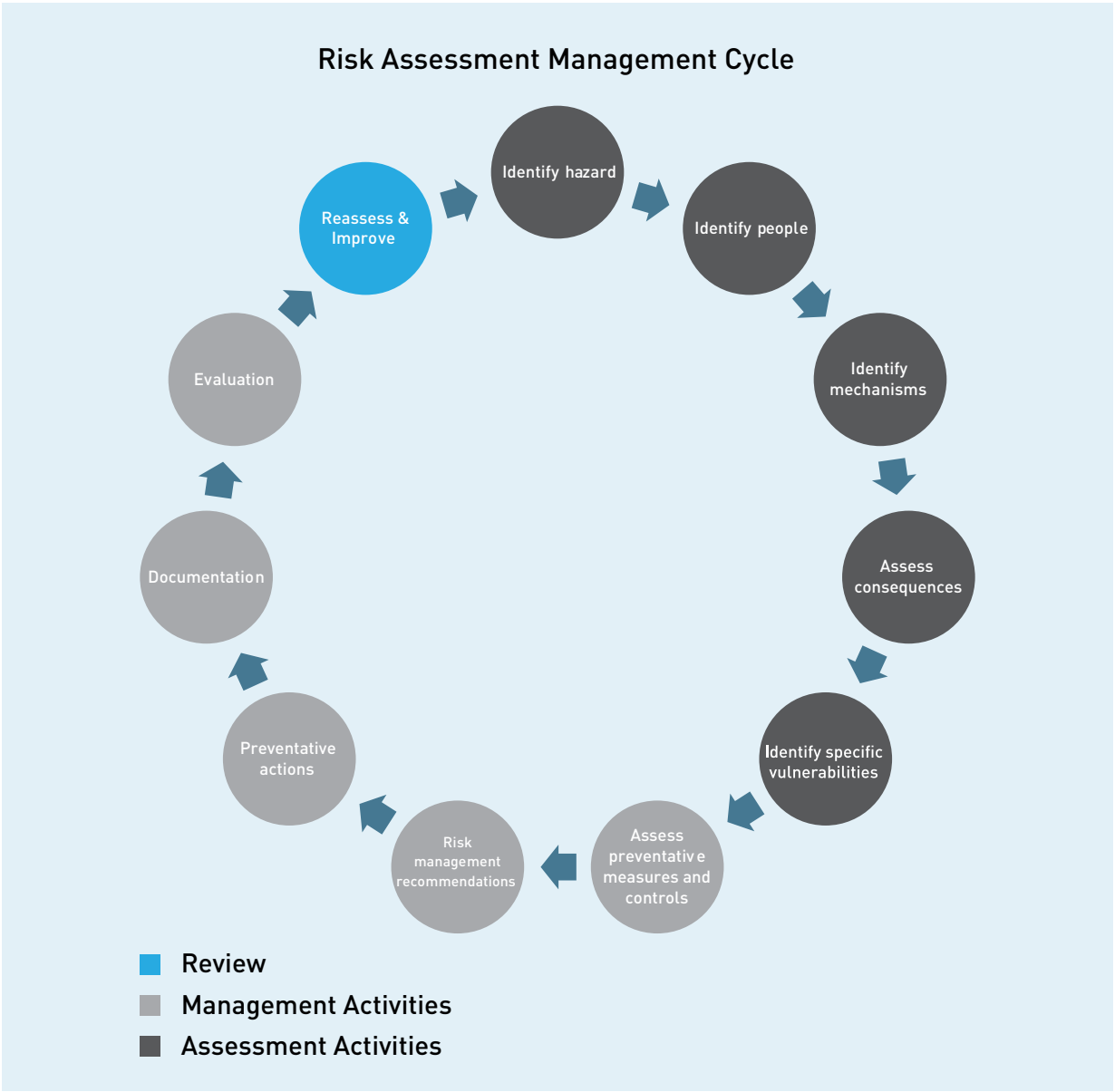
Using multiple methods simultaneously to investigate incidents can help to uncover the true nature of what happened, especially when there are multiple unexpected circumstances such as human factors or natural events such as weather (Nyman & Johansson, 2015). There are a wide variety of accident investigation methods, and models of accidents available to inform occupational health and safety professionals (Sklet, 2002).

The purpose of accident investigation is to:

1. Describe exactly what happened
2. Identify the underlying causes
3. Prevent future accidents by describing measures to reduce the risk of the events and causes occurring again.

This is done in three phases: collecting all the evidence; analysing that evidence to develop conclusions; and judging what is needed to achieve improved safety (Sklet, 2002). This method can be used to investigate near hits as well, or to allow for a culture of safety by providing a standard report form for potential problems in the safety system.

The People Aspect



An investigation may start with the question 'What went wrong?' It may result with identifying faults with the Human Factor. But that may be only part of a wider picture: the City was found to have knowingly allowed its garbage collectors to remain on the rear platforms when the trucks were going too fast. The City's processes did not quickly identify when safety records were incomplete. There may have been people who did wrong things, but the problems did not start or end there.

Many enterprises say, 'The greatest value of our company are our employees' to the point where it has become a cliché. The question is, how is this being translated into whether to fire someone after an incident? Taking this to the next step, the questions to ask include whether the company mission, vision, values, policies and procedures reflect, and are they reflected by, everyday operations, or are they a bureaucratic set of statements used on the occasions needed to impress or punish? (Jaroslawska-Sobor, 2016). There may be a need to bring in specialist knowledge on the human factor when investigating incidents. However, as a starting point, occupational health and safety practitioners can commence by considering whether the assumptions and expectations surrounding the human factor were realized, or

whether the human factor operated in a way that was not expected and accommodated in the risk analyses (McLeod, 2015). The simple answer to this question is, 'it depends on what the investigation found'. If that happens, then perhaps the more difficult question becomes, 'how can it be prevented from happening again with someone else?'

Conclusion

The role of OHS is changing, and with it, the role of OHS professionals. The question of whether a particular worker's association with an enterprise should be terminated after a safety incident is not just a question for human resources: the role of OHS is central to such questions. Safety incidents and industrial accidents can occur anywhere, and something as seemingly minor as looking into a rear-view mirror and understanding what the driver sees (or not) can be a matter of life-or-death. In other industries such as the maritime and aviation sectors, the increasing complexity of the technology means that the interface between the human and the machine is becoming a key risk factor, and the difficulties in properly assessing the human side of that risk means it's easy to erroneously blame the person, rather than looking more deeply at the full picture of workplace, worker, work, equipment and culture.

Government regulation goes some way to providing the foundation of workplace safety, but tends to be only the 'stick' part of the equation. The enterprise, and its management and staff are core stakeholders: a Zero Accident Vision along with other opportunities helps to provide a 'carrot' that can produce a better safety culture from the level of the enterprise to that of the individual. For Occupational Health and Safety practitioners, the Zero Accident Vision is potentially a route to achieving a more holistic health objective designed to improve workplace productivity and profitability.

Despite the best of intentions and the strongest of systems, accidents will still occur. Direct and indirect costs of a serious incident are heavy, not just in terms of monetary amounts, but also to morale, reputation, and the people involved outside the enterprise. Creating a Zero Accident Vision culture could allow expanding the concept of 'incident' to include the 'near hit' as being a trigger for a report. Hazards need to be prioritised, and knowing what is almost occurring can help with identifying what risks need to be eliminated. When an accident occurs, there are a range of ways to investigate, and having accident investigation and disciplinary procedures as separate as possible helps to support the safety culture, even during such a stressful time.

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