WHITE PAPER

Zero Harm – Health and Safety in the Workplace
EXECUTIVE SUMMARY

It goes without saying that some jobs are riskier than others: being a member of a bomb disposal squad is inherently riskier than being a librarian. The former has fewer manageable risks and presents more probable and more catastrophic hazards (being blown up) than the latter. But regardless of the industry we are employed in, workers at every level, and in every occupation, have the right to expect to come home safely at the end of the day.

In this paper, we compare the risks and protections that both firefighters and construction workers face. We will investigate how different jurisdictions manage risk, and look at some of the factors that influence health and safety – both positively and negatively - in the workplace.

Find out about:

- Where do the risks lie?
- How the law protects workers
- How technology impacts worker health and safety
- Approaching Zero Harm
WHERE DO THE RISKS LIE?

Working as a cop or as a fire fighter is risky, but law enforcement and public safety agencies have hard-fought understanding of those risks, a healthy regard for preserving their critical resources (people), and well-established processes and tools for keeping their people safe. Manageability is the key here.

In many countries, public sector workers fare better in accident/fatality statistics than workers in private industry. For example, the US Bureau of Labor Statistics for 2015 reports that public sector workers accounted for just 9% of occupational fatalities and had a lower fatal injury rate (1.9 per 100,000 FTEs) than their private sector counterparts (3.6).

Based on employer-reported injuries and deaths, the most dangerous occupations in US private industry appear to be Construction, Transportation, Agriculture, Forestry, Fishing, and Professional Services. Construction recorded the highest number of deaths while the Agriculture/Forestry/ Fishing/ Hunting industry had the highest rate of work-related fatalities.

Of the four industries with the highest fatal injury rates, construction was the only one to see an increase in both fatal occupational injuries counts and rates. The other three industries all decreased in total deaths and fatal injury rates from 2014 to 2015.
Obviously, these figures might be expected to differ across countries for various reasons, such as the national mix of industries and employment (e.g. fulltime vs contracted vs casual) as well how the data are collected and analyzed. Moreover, as occupational safety experts have commented, inaccurate and incomplete occupational injury data is unfortunately a general feature of workplace injury data regardless of where it is collected. Nevertheless, a similar pattern appears across a number of developed countries. With the possible addition of mining, the list of dangerous jobs in New Zealand and Australia closely resembles that of the United States.

Where these countries diverge is how their overall fatality rates are trending. New Zealand’s overall fatality rate is more than double that of Australia’s and two-thirds higher than that of the United States. And while the Australian and US rates are trending downwards, New Zealand’s rate has not declined. Each country’s response to such dismal statistics is determined by their understanding of the underlying causes, how workplace health and safety is monitored, what policies are implemented to improve occupational safety, and what is done to enforce or incentivize improvements.

OCCUPATIONAL HAZARDS – WHAT OUR FIREFIGHTERS FACE

Associated with each occupation is a unique assortment of workplace hazards. If you understand the hazards that each job presents, you begin to identify the causes that underlie the injury and fatality statistics for that occupation. To give a specific example, consider the health and safety hazards faced by firefighters:

- **Biological hazards**
  While helping fire or accident victims, firefighters may be exposed to infectious diseases including blood borne diseases such as AIDS and hepatitis B and C.

- **Chemical hazards**
  Toxic combustion products, including carbon monoxide, hydrogen cyanide, nitrogen dioxide, benzene, and polycyclic aromatic hydrocarbons. Oxygen depletion resulting in hypoxia, confusion and inability to escape.

- **Ergonomic hazards**
  There are many situations where physical demands involve force, repetition, awkward postures and prolonged activities, including overexertion, walking and standing for long periods of time, and lifting heavy objects.

- **Physical hazards**
  Heat stress is common. Heat may come from various sources including the fire and surroundings, but heat is also produced by the body during work (exercise). Heat stress is worsened by protective clothing and continuous physical exertion. Excessive noise exposure with resultant hearing loss and impairment. Extreme temperatures (both heat and cold) from working outdoors. Burn hazards from sudden ignition of products creating flashover and backdraft.

- **Safety hazards**
  In fires, there are risks of injury (from fire itself, structures breaking, unstable floors, falling objects, etc.). Falls from working at heights are also common. Traffic accidents from travel to fires at high speeds and poor weather conditions.

- **Psychological hazards**
  Firefighters are exposed to critical events where there is often grave or uncertain danger. Exposure to serious traumatic events (or consequences of the event) is another cause of stress. As with most emergency services, there are long periods of quiet or routine interrupted abruptly by periods of intense stress or activity. Increased injury hazards from work shifts and extended work days.
Chronic health hazards:
- Cancer, especially genito-urinary (kidney, ureter and bladder), but also brain, lung and lymphatic/hematopoietic system cancers
- Back injuries and other strains.
- Diseases such as AIDS and hepatitis.
- Cardiovascular disease due to carbon monoxide and toxic chemicals.
- Lung diseases from exposure to toxic gases produced during fires.¹

In spite of this forbidding list of serious hazards, firefighting is a considerably safer occupation with much more favourable statistics than the construction industry. When you consider some of the workplace similarities between the two occupations, the discrepancy between their accident and fatality figures is even more surprising. Here’s a list of potential hazards that they share:

- Working with heavy machinery
- Working in hazardous environments
- Working in high places
- Working in extreme temperatures (hot and cold)
- Working with high levels of background noise and limited visibility
- Working often in confined spaces
- Exposure to hazardous substances
- Exposure to electrical current
- Hazards from moving vehicles

Could a difference in workforce be the distinguishing feature? In fact, both occupations employ a variety of workers. In the fire statistics, firefighters include members of local career and volunteer fire departments, seasonal, full-time and contract employees of state and federal agencies, military personnel, members of industrial fire brigades, and even prison inmates seconded to firefighting crews. Construction workers may be full- or part-time employees, trade sub-contractors, casual staff, and more. So workforce composition is probably not the answer. A clue may lie in how the causes of death by injury differ between the two.

Firefighter death by cause - 2015

- Overexertion, stress, medical: 60%
- Rapid fire progress: 1%
- Structural collapse: 9%
- Fatal assault: 1%
- Struck: 9%
- Lost inside: 1%
- Crashes: 12%
- Caught underwater: 1%
- Fell: 6%

Total Fatalities = 68

While the overall number of firefighter fatalities is comparatively low, it could be much lower if the overexertion, stress and medical issues of firefighters were tackled. These issues are associated with the ergonomic, physical, psychological, and health hazards outlined earlier. Digging deeper, it appears that sudden cardiac arrests were the single greatest cause of firefighter deaths (51%). It follows that if measures could be introduced to eliminate the risk of heart failure, fatalities could be significantly reduced.

In contrast, the situation with construction workers is more complicated. Not only is the overall number of the fatalities much higher, but no single factor stands out as a common element among the major causes of death. Falls by roofers accounted for most construction fatalities, followed by highway vehicle accidents, and then being struck by objects, electrocutions and getting caught in or between objects.

Construction deaths by cause - 2015

Perhaps the most telling dissimilarity between firefighting and construction is that firefighting is a public service, whereas construction is run as a commercial enterprise. They operate with different priorities. Top of the firefighter’s list is saving lives and property while the chief objectives of construction are to complete projects within time and cost targets (which is not to say firefighters don’t face budget/performance targets or that construction ignores worker safety.) Expectations are different, too. Firefighters arrive at a fire ground expecting danger and are prepared for it, but construction workers arriving at a site expect ‘business as usual’ to prevail.

As a result, the culture of firefighters is far more focussed on safety. In the US, trade unions such as the International Association of Fire Fighters (IAFF) take a lead in researching health and safety issues, developing safety training programs and lobbying politicians for improved standards.

The National Fire Protection Association (NFPA) is a non-profit trade group which creates numerous codes and standards for use by local fire authorities. These include standards for firefighting equipment, occupational health and safety, and fitness programs. At a government level, the U. S. has several organizations specifically devoted to firefighting research and training. Under the umbrella of the Federal Emergency Management Agency (FEMA) of the US Department of Homeland Security, the Fire Administration (USFA) funds national research on firefighter health and safety and issues guides such as the “Health and Wellness Guide for Volunteer Fire and Emergency Services” while the National Fire Academy (NFA) provides free training courses and programs. Law enforcement enjoys a similar high level of support.

“Top of the firefighter’s list is saving lives and property while the chief objectives of construction are to complete projects within time and cost targets.”
Workers in the construction industry are not served as well as this. Although unions and professional trade organizations offer similar support, services, and training, their delivery is fragmented across individual professional sub-groups:

- Roofers
- Iron and steel workers
- Electricians
- Plumbers and pipelayers
- Carpenters
- Operating engineers and equipment operators
- Painters

The overall effort is not as cohesive, proactive, well-informed, abundant, or as generously funded as the support provided for firefighters. Nor, as the statistics testify, is it as effective:

“The total number of construction worker deaths have steadily increased the past few years. A very small number of construction deaths are the result of true accidents. The industry needs to do more to curb this increasing trend by creating and promoting a safe work environment. Improving construction worker safety is the only way to reduce these numbers and protect all workers.”

Instead, many private industries – not just construction - rely on regulatory authorities, such as the US Occupational Safety and Health Administration (OSHA), to tell them what to do. Protecting worker health and safety is treated mainly as an exercise in compliance with regulatory standards. Globally the same pattern appears, with the burden of upholding occupational health and safety falling disproportionately on regulatory authorities, rather than on employers and workers.

1 (“Construction Leads All Industries in Total Worker Deaths” posted on December 20, 2016 by Kendall Jones (Editor-in-Chief of the ConstructConnect blog) http://www.constructconnect.com/blog/construction-news/construction-leads-industries-worker-deaths/)
HOW THE LAW PROTECTS WORKER HEALTH AND SAFETY

If you are going to work or set up a business in another country, it is a very good idea to check out the relevant labor laws. As an employee, you want to know what protections you have under the local law. And as a prospective employer, you need to be aware of your legal obligations for the health and safety of your workers. You cannot assume that everything will be as it is at home. Countries vary widely.

- Regulatory bodies responsible for occupational health, safety, and workplace environment (HSE)
- HSE Regulations
- Reporting requirements for worker injuries, illness or death
- HSE data collection and analysis
- Enforcement of HSE regulations

Countries also differ in the quality and effectiveness of their HSE bodies, regulations, procedures and enforcement.

Briefly, HSE standards can work at an international level, national level, or state/provincial level and the bodies responsible for them can operate at each of these levels. An example at the international level is the ISO 45001 Occupational Health and Safety Standard which has been proposed as a replacement for the OHSAS 18001 Occupational Health and Safety Management standard. The effectiveness of these standards is determined by a certification and audit process rather than by legal enforcement.

National and state/provincial HSE standards, however, can have the force of law. They can take the form of regulations with a system of permits and compliance checks required for a public sector agency or private company to legally operate. Or they can be included in legal statutes that are tested in a court when accidents have occurred. Under-regulated industries will rely heavily on court cases to sort out HSE issues while over-regulated industries will find that compliance requirements and costs are too hard to bear and will be inclined to cut corners.

A country can rely totally on national HSE standards and regulations. New Zealand is a case in point, with a Crown agent, WorkSafe New Zealand, implementing the Health & Safety at Work Act (2015).

Australia, on the other hand, has both a federal agency (Safe Work Australia) and state Workplace Health and Safety (WHS) authorities with responsibilities for enforcing WHS acts and regulations. For example, the State of Victoria has

- Act: Occupational Health and Safety Act 2004 (Vic)
- Regulation: Occupational Health and Safety Regulations 2007 (Vic)
- Codes: Vic Compliance Codes
- Regulator: WorkSafe Victoria

The various state acts and regulations that are developed out of a model WHS Act and model WHS Regulations are harmonised through national legislation to ensure a consistent approach to compliance and enforcement across the states.

In the United States, the Occupational Safety and Health Administration within the Department of Labor is responsible to national HSE legislation. In addition, individual states maintain their own HSE legislation. Thus the New York state Department of Labor has a New York Public Employees Safety and Health Bureau (PESH) that has adopted most of the OSHA standards applicable to state and local government employees, but has also added some alternative standards.

As a last example, although Brazil has state governments, its HSE legislation is administered almost entirely at a national level under the oversight of the Ministry of Labor and Employment (MIT). The National Regulatory Standards (NR), which

"Under-regulated industries will rely heavily on court cases to sort out HSE issues while over-regulated industries will find that compliance requirements and costs are too hard to bear and will be inclined to cut corners."
are modelled on European directives, are in thirty-six parts (Sections NR1 – NR36), each applicable to a specific safety topic (e.g. NR12 relates to machinery). Chapter 5 of the Consolidation of Labor Laws (CLT) mandates all companies to follow and enforce these standards. In addition, there are HSE ordinances (acts) issued by Ministers. The MIT and the Labor Inspection Secretariat (SIT) are the government agencies responsible for enforcing HSE legislation and imposing penalties for violations. A novel feature of the Brazilian system is that each workplace in a company must have an Internal Commission for Accident Prevention (CIPA). This is a group of company workers trained in accident prevention by security engineers and occupational doctors. Half the group is appointed by the company while the other half is elected by the workers. Each CIPA must meet monthly to review accidents, inform the employer and provide suggestions for improvement.

However well designed, HSE legislative frameworks are useless unless the responsible bodies are adequately resourced; there is good reporting of worker injuries, illnesses, and deaths; HSE data are properly harvested and analysed; and HSE laws and regulations are effectively enforced. It is in these areas, rather than through inadequate legislation, that HSE management typically falls apart.

Top of the list of problem areas is under-reporting. In some countries, this is endemic throughout all sectors. In developed countries, under-reporting is characteristic of particular industries but not others. Construction, agriculture, fishing, and transportation are high on the list of offenders. The reasons for underreporting are many and varied. Around 2008 the U. S. the Bureau of Labor Statistics (BLS) did not even count self-employed workers or public employees. In the private sector casual or part-time workers may hide injuries to keep their jobs. If self-reporting is the norm for companies, then there is a strong incentive to under-report and to actively discourage accurate reporting. Whatever the reasons, underreporting distorts the statistics and impedes attempts to find solutions for hidden high injury rates.

The BLS underreporting also illustrates a failure of data collection and analysis. If collection policies ignore counting certain classes of workers, then the input to any analysis is already tainted by omissions and recommendations issuing from these analyses may easily miss the mark.

Under-resourcing the bodies responsible for HSE can also undercut the value of an otherwise good regulatory framework. To give one example, the 2010 Pike River mining disaster in New Zealand cost the lives of 29 coalminers. One contributory factor behind the disaster was a revision of the Coal Mines Act (1979) which led to reducing the size and role of the mining inspectorate for checking mine safety. The failure of the Department of Labor to adequately support this specialist role meant that gross compliance violations by the mining company fell through the cracks. If funding and staff are not available to follow up on HSE issues, then the framework is impotent.

Finally, enforcement of regulations and laws is essential to force necessary changes in workplace health and safety. Whether through independent audits and inspections or prosecutions and penalties, enforcement ensures that some urgency is brought to employers improving the safety of their workplaces. The Pike River disaster revealed major deficiencies in existing enforcement but ultimately resulted in a landmark sentence against the company of NZD$4.17 million in fines and reparation, personal liability for the directors, and stronger mine safety laws. (To be fair to the New Zealand mining industry, whose accident rates are below the top six, Pike River was a particularly egregious offender.)
HOW TECHNOLOGY IMPACTS WORKER HEALTH AND SAFETY

Technological change goes hand in hand with transformations in occupational health and safety. Technology developments bring new risks, but can at the same time drive improvements in equipment, knowledge, and communication for HSE. These examples can illustrate how the same technology development can create both new risks and new opportunities for HSE.

Mobile radio communications

The development of mobile radio communications meant that workers could better coordinate their work, respond to emergencies, and pass on situational information without talking face-to-face. One benefit was that police and fire operations became faster, more effective and safer as a result.

But in the presence of inflammable gases, a spark from a radio could trigger an explosion. Intrinsically safe radios were a response to this introduced hazard, but the protection they offer is limited to where the hazard has already been identified.

Computers

Much of modern HSE management depends on the use of computers to store and process data, share complex information, and to communicate. Big data, which integrates huge chunk of data from multiple sources at high speed, uses complex algorithms to deliver assessments, conclusions or recommendations, and can even trigger actions.

This is the likely future of how large companies would like to manage their workforce, how they make hiring and firing decisions, tweak work schedules, set worker performance targets and so on. But reliance on complex algorithms to replace human decision making can create new risks when bad or dangerous decisions (for example, overloading a worker’s shift schedules) emerge from the computer.

Manufacturing automation and robotics

Automation has removed human workers from many repetitive and dangerous manufacturing operations. But human workers still remain on the factory floor, either to perform tasks currently not automated, or to service the automated machinery. While modern workers may be removed from some of the more obvious workplace hazards of days gone by, working beside complex, high-speed manufacturing chains introduces a new set of hazards for machinery operators and maintenance personnel.

In fact, in a 2015 tragedy, a maintenance technician performing routine duties on an auto-parts assembly line was ‘trapped by robotic machinery’ and crushed to death. Lawsuits continue.

Driverless vehicles

Trials are already underway with driverless vehicles, not only for the trucking industry but also for mining. While this may eventually reduce highway fatalities (at least by removing the truckers altogether), not all trucking jobs will vanish. Many truckers, particularly on construction sites, do more than just drive. Even if construction site vehicles were to be fully automated, they constitute a new risk for other workers at the site. Similarly, at mines, driverless vehicles will be a new hazard for the reduced workforce of human employees at the pit either to work around or to service. As yet, it is unclear what system would be used to manage a pool of driverless vehicles and what failure scenarios could arise.

If there is a general moral to be drawn from these examples, it is this: technological change may mean that zero harm is ultimately unachievable since the goal post is ever shifting, but it also enables us to get ever closer to zero harm.
APPROACHING ZERO HARM

Let’s return to the main health and safety problem facing firefighters: namely, how to reduce the number of fatalities due to cardiac failure, stress, overexertion and medical problems. Solve this and you cut firefighter casualties by over 50%. A number of measures are available.

1. **Improve fitness.** It comes as no surprise that improved fitness dramatically reduces the probability of cardiac death. This translates into designing fitness programs for firefighters including special exercise regimes, dietary advice, plans to stop smoking, scheduled medical checks to screen out incipient medical problems and so on.

2. **Improve risk and hazard assessment.** In Australia, the Country Fire Authority (CFA) puts considerable effort, including trying artificial intelligence applications, to accurately characterize the likely behaviour and prognosis of a wild land fire event. The goal is to make better decisions about where to send fire fighters while minimizing the risk to them.

3. **Improve communications.** Modern communications solutions now include location services, constantly updated site and status maps, and better in-building coverage solutions. Staying continuously in contact with the rest of the team and the command center, as well as being better informed must obviously reduce stress. Worn cameras can relay in real time from multiple perspectives the changing situation as a fire develops as well as providing valuable knowledge for post-event reviews.

4. **Improve monitoring, including monitoring exposure to hazards (such as heat, toxic chemicals, gases) and bio-monitoring.** Recent designs in firefighting personal protection equipment (PPE) include biosensors to monitor such vital signs as heart rate, blood pressure, body temperature, respiration etc. Readings from these biosensors can identify symptoms like overexertion or stress in a firefighter and can alert colleagues and commanders in advance of a problem, enabling them to perform a rescue before another casualty is added to the statistics. A health monitoring regime can identify any changes in a firefighter’s health and emotional status because of exposure to certain health hazards.

5. **Improve training** to drill every firefighter in how to better assess hazards during a fire event and how to survive in a fire ground.

Taken together, these measures could offer a means of getting closer to zero harm in this most dangerous of professions.
While the specific measures target firefighters, the general recipe (improving fitness, risk assessment, communications, monitoring, and training) is broadly applicable to a number of industries. The National Institute for Occupational Safety and Health has proposed the following widely accepted system of hazard controls that industries can use to minimize or eliminate exposure to occupational hazards by implementing suitable controls. As NIOSH describes their methodology:

“Following this hierarchy normally leads to the implementation of inherently safer systems, where the risk of illness or injury has been substantially reduced.”

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<th>Most effective</th>
<th>ELIMINATION: Physically remove the hazard</th>
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<td>SUBSTITUTION: Replace the hazard</td>
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<td></td>
<td>ENGINEERING CONTROLS: Isolate people from the hazard</td>
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<tr>
<td>Least effective</td>
<td>ADMINISTRATION CONTROLS: Change the way people work</td>
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<td></td>
<td>PPE: Protect people with personal protective equipment</td>
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Even now, with decades of experience behind us, and heroic attempts by various governments, regulators, unions and employers, there remain many questions to be answered, and there is still a long way to go before the goal of zero harm in the workplace is achievable.

Regardless of the industry we work in, or the role we play, it remains the responsibility of us all to continue to strive toward the common goal of zero harm in the workplace.

If you’d like to learn more about improving health and safety in your workplace, you can review the sources below or contact us at Tait Communications.
Sources

2. FEMA/USFA “Health and Wellness Guide for Volunteer Fire and Emergency Services”
5. Philip Gunby "How Bad is the State of Occupational Fatalities in New Zealand?"; New Zealand Journal of Employment Relations 36(1) pp 35-51
20. Herbert K. Abrams – A Short history of Occupational Health
21. Hidden Tragedy: Underreporting of Workplace Injuries and Illnesses; A Majority Staff Report by the Committee on Education and Labor US House of Representatives; June 2008


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Dr Jan Noordhof is an independent consultant based in New Zealand. He was previously Principal Consultant for Tait Communications (Americas), specializing in technical solutions for public safety, utilities, mining, oil and gas sectors. Other roles at Tait included VP Product Marketing, VP Sales Engineering and Marketing (for Latin America, Africa, Middle East, and Indian Sub-continent). Dr Noordhof was responsible for bringing the Tait APCO P25 system product to the global market.

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