

Health and Safety Index Development

Technical Paper

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Introduction

The Index

The new Health and Safety Index (HSI) measures the performance of Ontario's health and safety system as a whole in a single metric. Modeled on well-known indices like the UN's Human Development Index and the Organisation for Economic Co-operation and Development's (OECD) Better Life Index, the HSI will be calculated and released by the WSIB each year. Current measures of health and safety performance tend to be single, "after-the-fact" metrics such as the number of fatalities, the number of new claims, or the lost-time injury rate over a given time period. By combining multiple performance indicators into a single measure, the HSI has been designed to offer a more complete and sophisticated picture of progress on occupational health and safety.

The index is made up of the components and metrics collected by the Ministry of Labour, the Ministry of the Attorney General and the WSIB along with a survey that has been stood up to collect information directly from Ontario's workers. Each metric has been "weighted" using a technique called principal components analysis, respecting OECD guidelines. Weights reflect how much the metric overlaps with (is correlated to) other metrics, not how important it is to health and safety.

The index will help system partners to raise awareness about this critical issue and to keep it top-of-mind in the province. It will allow all Ontarians to quickly and easily see whether or not progress is being made in occupational health and safety and to hold system partners accountable for delivering improvement.

Each year the WSIB will release this single holistic measure of Ontario's health and safety system, which is intended to:

- Assess the health and safety system's success at improving outcomes for workers and employers
- Act as a call to action for system partners to improve performance
- Support critical discussions about health and safety among system partners
- Help define and manage system priorities, and
- Allow for potential cross-jurisdictional comparisons.

Background

Global agencies including the World Health Organization (WHO) and the International Labour Organization (ILO) agree that the health, safety, and well-being of workers are of paramount importance. They are important not only to individual workers and their families, but also to the productivity, competitiveness, and sustainability of organizations, and consequently to the national and global economy (Burton, 2010; Ylikoski, 2006).

The WSIB actively supports Ontario's health and safety system by encouraging proactive efforts to reduce workplace injuries and improve return-to-work outcomes. Recognizing the WSIB's role in promoting workplace health and safety in Ontario, Objective 1.1 of the organization's 2016-2018 Strategic Plan states that the WSIB will "Promote strategies to prevent fatalities, injuries and illnesses in Ontario workplaces" (WSIB, 2016). This objective aligns with the WSIB's statutory mandate under the *Workplace Safety and Insurance Act* (WSIA) to promote workplace health and safety.

Over the past several years, Ontario has seen a dramatic shift in workplace safety, with falling lost-time injury rates, decreasing registered claims, and improved return-to-work results (WSIB, 2015). Although these outcomes are a positive sign for Ontario workplaces, much work is left to be done. As a result, the WSIB has begun to look towards the future to promote strategies to improve the safety of workplaces in Ontario.

One way the WSIB is moving towards a proactive strategy is by leveraging data analytics to create the HSI, which reflects Ontario's health and safety performance in one integrated, evidence-based, composite measure. Developing an index of health and safety performance is important for future prevention efforts.

Rationale for HSI Development

Effective strategies for identifying and monitoring workplace health and safety are necessary for prevention efforts and for improving the performance of the system as a whole. Relevant, reliable and valid workplace health and safety performance data is therefore crucial to informing the strategic and operational decisions that will help promote advances in the province's health and safety activities (O'Neill, 2013).

One of the key factors hindering efforts to make advances on these fronts is the lack of standardization of common measures, and an absence of consistent, leading indicators of a jurisdiction's workplace safety performance. Key measures combined into a clearly defined HSI can provide a valuable snapshot of a given jurisdiction's health and safety performance, a way to track its own performance over time, and a basis for comparison with the performance of other jurisdictions and over time. Such feedback is critical to better understanding the strengths and weaknesses of the system and to identifying areas for improvement. As emphasized by the adage "what gets measured gets done," healthy workplace performance monitoring and quality management approaches begin with valid measures of key indicators (IWH, 2000).

The improved financial benefits that an organization may achieve through investing in a health and safety system are numerous. Based on its review of the literature, the Occupational Safety and Health Administration (OSHA) estimates that implementation of injury and illness prevention programs in the United States will reduce injuries by 15 to 35 per cent for employers who do not currently have health and safety programs (OSHA, 2012). At the 15 per cent program effectiveness level, the estimated savings are \$9 billion per year in workers' compensation costs; at the 35 per cent effectiveness level, the savings are estimated at \$23 billion per year (OSHA, 2012).

The cost of workers' compensation and disability absences is often used as a proxy for productivity losses. However, total losses due to such absences are often more than just their direct wage costs. In addition to workers' compensation costs, indirect costs to employers when an employee is injured or ill include non-monetized impacts of workplace injuries and deaths averted, as well as uncompensated lost wages, the loss of human capital assets, the loss of productivity, the cost of other government benefits required by injured workers or their survivors, and other losses not compensated by workers' compensation or other insurance (OSHA, 2012).

In response to the need to advance the measurement and standardization efforts targeting health and safety, the WSIB's Strategic Analytics branch has developed an index based on key indicators. Many of the existing measures that are typically used to assess the health and safety performance of workplaces speak to outcomes (e.g., lost-time injury rate). These indicators alone may not be representative of the performance of the system as a whole. The WSIB is looking towards more appropriate ways to assess the effectiveness of the prevention system. For example, having a low incidence of injury does not necessarily mean that adequate safety systems and controls are in place (O'Neill, 2013).

The general purpose of the HSI is to measure the safety of workplaces in Ontario. Specifically, the objectives are to:

- Promote awareness of workplace health and safety in Ontario
- Act as a call to action for system stakeholders to improve the system's performance
- Facilitate a conversation of health and safety amongst system stakeholders.

This white paper addresses the need for a better understanding of health and safety strategies in the workplace by establishing a replicable framework for advancing the concept of an integrated health and safety measure. It describes a methodological approach and a set of elements that should be considered a part of a composite index, a new measurement tool for the health and safety of workplaces in Ontario. A framework for employers and other stakeholders is offered as a way to better align health and safety strategies and better integrate their health and safety functions.

Literature Review

Health and Safety Approaches in the Workplace

Health and safety are two workplace objectives that, in the past, were treated mostly independently, with separate reporting structures. In recent years, however, the occupational health community has begun to view the traditionally separated domains of health promotion and health protection – or, more simply, health and safety – in a new light, recognizing that their positive impact in the workplace could be enhanced by effectively aligning their strategies (Loeppke, 2015). Two concepts are therefore crucial to the achievement of healthy workplaces: health protection, and safety promotion. A healthy workplace in the broadest sense is also a healthy organization in how it functions and achieves its goals (Burton, 2010).

Health can be considered as freedom from the risk of illness, while safety is viewed as freedom from the risk of injury (Oxford Dictionary, 2004). A healthy and safe workplace is therefore one where hazards that pose a potential risk to workers (and others in the workplace) are controlled or eliminated (O'Neill, 2013). Fundamental to a healthy workplace is the need to protect workers from harm in a potentially hazardous, stressful or unsafe work environment. Safe work can be reinforced through health promotion and work practices that are conducive to good health (WHO, 1999).

Definitions of a healthy workplace have evolved greatly over the past several decades. From a narrow focus on the physical work environment, with traditional occupational health and safety (OHS) dealing with physical, chemical, and ergonomic hazards, the definition has broadened to include health and lifestyle factors, psychosocial factors (work organization and workplace culture), and a link to the community, all of which can profoundly affect employee health (Burton, 2010).

The WHO has developed a Healthy Workplace Model out of the systematic review of literature by leading occupational health experts, which has been peer-reviewed by WHO regions, the ILO, and other key agencies (Burton, 2010). The model covers four important components in a comprehensive approach: physical work environment, psychosocial work environment, personal health resources, and enterprise community involvement.

Based on this model, “a healthy workplace is one in which workers and managers collaborate to use a continual improvement process that protects and promotes the health, safety and wellbeing of all workers and the sustainability of the workplace by considering the following, based on identified needs:

- health and safety concerns in the physical work environment
- health, safety, and well-being concerns in the psychosocial work environment including the organization of work and workplace culture
- personal health resources in the workplace (support and encouragement of healthy lifestyles by the employer)
- ways of participating in the community to improve the health of workers, their families and members of the community.” (*Five Keys to Healthy Workplaces*, WHO 2010)

All four components of the WHO’s Healthy Workplace Model should be considered when assessing the health of a workplace. Although these components are separated in theory, they overlap in practice. For example, stress can be caused by organizational issues in the working environment, but healthy lifestyle habits will increase an individual’s ability to cope with stressful situations.

Potential Elements of the HSI

Through research into various safe workplace frameworks, key components of a safe workplace were identified. These were classified into the following elements:

- existence of a legal framework
- avoiding undue risk
- enforcement
- fair treatment in employment
- leadership engagement
- worker involvement
- following occupational health and safety rules
- supporting and taking responsibility for workers and their families.

Findings and discussion of these concepts are provided in more detail below.

Existence of legal framework

Occupational health and safety legislation and regulation can be regarded as the backbone of the management of health and safety risks at work. Most jurisdictions have some legislation that requires employers to protect workers from risks in the workplace that could cause illness or injury (Burton, 2010). Of those, many have sophisticated regulations. In Ontario, the *Occupational Health and Safety Act* (OHS Act) provides the legal framework and the tools to achieve this goal (OHS Act, 1999). It sets out the rights and duties of all parties in the workplace, establishes procedures for managing workplace hazards, and provides strategies for enforcement of the law where compliance has not been achieved (MOL, 2015).

One of the primary purposes of the OHS Act is to facilitate an Internal Responsibility System (IRS) in the workplace. While the regulatory framework eliminates risks to health and safety as much as reasonably feasible by assigning general duties to those who are in a position to control the origin of risks, the IRS suggests that everyone in the workplace has a role to play in keeping it safe and healthy.

The IRS is the underlying philosophy of the occupational health and safety legislation in all Canadian jurisdictions (CCOHS, 2016). Its foundation is that everyone in the workplace – employees and employers – is responsible for his or her own safety and for the safety of coworkers. The Act specifies broad obligations to ensure the health and safety of workers, but do not necessarily prescribe the specific steps to take for compliance. Instead, it holds employers responsible for determining such steps to ensure the health and safety of all employees (CCOHS, 2016).

Legislation of occupational health and safety (OHS) and regulatory enforcement to deter workplace injuries and illnesses depend on political, economic, and social processes (MacEachen, 2016). However, research has shown that workplace parties can be encouraged to create and maintain safe workplaces through general awareness of occupational health and safety laws and specific workplace sanctions (Robens, 1972; MacEachen, 2016).

The laws that govern health and safety in the workplace provide a legal framework and a minimum level of protection that must be maintained to ensure workplace health and safety. In Canada, each jurisdiction's OHS laws are supported by a framework of regulations that prescribe duties and provide guidance to employers and

others on how to meet the requirements of the legislation. For the purposes of creating the HSI described in this paper, it is recognized that the existence of a legal framework is an important element of protecting workplace health and safety; however, there are no specific indicators that need to be explicitly measured. Rather, the legislation sets the context in which these measures operate.

Avoiding undue risk

Fundamental to a healthy workplace is the need to protect workers from harm in a potentially hazardous, stressful, or unsafe work environment (WHO, 1999). In Ontario, the failure to control occupational risks and hazards contributes to almost a quarter of a million registered claims per year (WSIB, 2015). However, provincial investments in the prevention system have resulted in substantial improvement in a number of key performance metrics, particularly lost-time injury (LTI) rates.

There is strong epidemiological evidence that higher injury frequencies are associated with exposure to physical, chemical, biological, and psychosocial risk factors or otherwise unsafe working conditions (Linton, 2000; NRC, 2001). There is also convincing evidence that workplace health and safety attitudes, behaviours, and management practices affect injury rates (Vredenburg, 2002; Zohar, 2010).

Work-related injury rate measures, such as the number of work-related injury claims or LTI rates, are essential to understanding the burden of disease or harm to workers, organizations and the economy that result from poor working conditions. For example, the WHO uses injury rates to examine the global burden of disease produced by select occupational risk factors, including occupational carcinogens, airborne particulates, noise, and ergonomic stressors (Concha-Barrientos, 2004). Conversely, reductions in injury frequency rates or severity are typically used to demonstrate the effectiveness of health and safety interventions and prevention efforts. Therefore, injury statistics provide an important measure of risk that results from work health and safety failures (O'Neill, 2013). Among the advantages of this measure is that rates are readily available. In addition, at least in principle, all accidents of a certain severity must be reported.

While LTI rates are often reported as “safety measures,” injuries do not measure safety per se. LTIs can confirm that a risk was present at the time of an injury. These are not measures of the controls in the workplace, but a measure of failure (O'Neill, 2013; Hughes, 2009). Therefore, a measure of injury frequency is an important indicator of risk that should be included in any assessment of workplace health and safety performance.

Enforcement

The *Occupational Health and Safety Act* provides a legal basis for enforcement and ensures that there are consequences to not complying with workplace health and safety regulations. Despite improvements in regulation, the concept of enforcing occupational health and safety has remained generally unchanged (Mischke, 2013).

Studies have considered the effectiveness of enforcement (e.g., inspections, penalties) (Machechen, 2016). One systematic review found evidence that inspections, citations, and penalties actually improved occupational health and safety and reduced injuries (Tompa, 2007).

There is also evidence that inspections decrease injuries in the long term. Specific inspections result in higher compliance rates, while inspections with penalties could result in fewer injuries and more compliance in the short term in small firms (Mischke, 2013). Further evidence shows that enforcement is an effective means of promoting compliance because the fear of enforcement is an important motivator for some employers (Fooks, 2007).

Fair treatment in employment

The influence of organizational work factors on safety behaviors is an important consideration to the overall health and safety performance of workplaces. The “organizational model,” which describes occupational health and safety based on a group of factors, sometimes under the term “management systems,” has been supported by the literature (Hale & Hovden, 1998). Building on the theory of work organization by Hale and Hovden (1998), safety culture or safety climate determine the role of multiple organizational-level factors in health and safety performance. It has been shown that organizational social and physical environments exert considerable influence over the safety choices that employees make, the resources available to make those choices, and the factors that influence health behaviours (Institute of Medicine, 2001; Schneider & Stokols, 2008).

Fair treatment of employees in their workplace (or organizational justice) describes a key element that includes employees’ perceptions of fair or unjust treatment received from their management and their behavioural responses to such perceptions (Gyekye, 2014). When employees’ perceptions of fair treatment at work are favourable, they are more inclined to work safely. Specifically, research demonstrates that workers with positive organizational justice perceptions have positive perspectives about workplace safety, are more compliant with safety policies, and have lower accident rates (Gyekye, 2014). Reviews of literature have confirmed that perceptions of organizational justice create a climate that promotes or hinders positive organizational behaviours, and these perceptions have been found to be related to health and safety attitudes and behaviours (Colquitt, 2001; Gyekye, 2007). Furthermore, fostering a people-oriented organizational culture through supportive management can help prevent and manage injuries, and improve outcomes of the return-to-work process following an occupational injury or illness (Pomaki, 2010). These findings can be explained by the social exchange theory, a key component in explaining the motivational basis for climate perceptions and organizational behaviours (Simons & Roberson, 2003).

Leadership engagement

Evaluating workplace occupational health and safety performance involves understanding its organizational safety climate. Zohar (1980) defined organizational climate as the sum of perceptions that employees share about their work environment. Over the past few decades research has demonstrated safety climate to be a robust leading indicator or predictor of safety outcomes across industries and jurisdictions (Zohar, 2010; Denison, 1996). A common way to assess safety climate is through a survey. Researchers have found that the survey questions or items cluster into five core constructs of safety climate: management commitment to safety, supervisory safety support, coworker (safety) support, employee (safety) participation, and competence level (Zohar, 1980; Seo, 2004).

Unlike injury rates, which are known as lagging indicators, safety climate falls under the category of leading indicators, as it provides a sense of a company’s safety performance and potential for injuries before they occur. A key element of a safe workplace culture is effective leadership. Effective workplace leadership can improve safety behaviours and safety climate. Leaders’ concern for the health of their workers, their relationships with workers, and the value they place on safety are all aspects that contribute to effective workplace leadership (Zohar, 1980).

Leadership strongly influences safety motivation and safe work practices. Managers must express support for safety and follow with real engagement in workplace safety activities (Dunlap, 2011). Senior managers greatly influence behavior simply by demonstrating support for various initiatives. Employees see as important what leaders see as important. When organizational leaders demonstrate the belief that workplace injuries are unacceptable, their behavior is transferred to employees throughout the organization (Dunlap, 2011; Krause & Weekley, 2005).

Worker Involvement

A key component of a safe workplace is involving employees in workplace safety efforts. Employees are engaged in the daily work being performed, and therefore have the most invested in their personal safety (Dunlap, 2011). Wilson and Haines (1997) defined this participatory approach as “the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals.” Giving employees a role in identifying and finding ways to eliminate workplace safety hazards can improve work safety practices and reduce injury rates (Dunlap, 2011; Rivilis, 2008).

A closely related key element of worker involvement is worker empowerment, which encompasses giving employees skills, resources, and a certain amount of autonomy for decision-making in their work tasks. It allows decisions to be made by people who have a unique view of the health and safety issues facing an organization. Empowerment has been viewed as a means of increasing workers’ awareness of hazards, and as a way of promoting workers’ roles as actors in improving their working conditions (McQuiston, 2000).

In a review of 10 studies examining the relationship between workplace and organizational factors and injury rates, Shannon (1997), found that empowering workers and delegating safety activities were consistently related to lower injury rates. Empowered workers have a greater capacity to report unsafe work conditions or practices, and Parker (2001) found in a prospective study that empowerment and job autonomy were positively related to safety behavior.

Following Occupational Health And Safety Rules

A basic concept in the healthy workplace framework is ensuring occupational that OHS rules are followed and proactive steps are taken to respond to safety system failures. This principle corresponds to elements of prevention, workplace culture, and enforcement, as safety rules operate by designing incentives, shaping the organizational culture, and overseeing problems with safety performance (Boardman, 2006). The HSI may measure indicators such as the frequency of internal safety reviews and the workings of the health and safety committee as a way to capture these elements.

Many drivers encourage organizations to take responsibility for the control of health and safety in the workplace. These range from the direct impact on the bottom line from good performance and the avoidance of penalties following safety failures, to moral obligations to care for their workers’ wellbeing (Boardman, 2006).

In Ontario, occupational health and safety legislation imposes duties on a wide range of workplace parties. For example, the new Occupational Health and Safety Awareness and Training Regulation (O. Reg. 297/13) requires employers to make sure staff complete a basic occupational health and safety awareness training program (MOL, 2015). Besides this new requirement, employers continue to have ongoing duties under the Act to inform workers about workplace-specific hazards. This includes the general duty to inform, instruct, and supervise workers in order to protect their health and safety [clause 25(2)(a)].

Supporting and taking responsibility for workers and their families

Workplace injuries and diseases can cause a significant burden to the individual and their family. Effective organizational leaders are those who can focus on the result of not only saving money through loss prevention but on a greater quality of life for the worker and their family by promoting a culture aimed at safety (Dunlap, 2011). In particular, after a work-related injury or illness, providing employees with effective return-to-work strategies ensures job security and financial support through restored income. Research has also shown that the number of lost work days after a disabling injury was significantly reduced when companies implemented modified work programs (Franche, 2005). Understanding the return-to-work (RTW) process is therefore necessary to better appreciate the extent to which workplaces will try to accommodate their injured workers.

Methods

Steps to Designing the Index

In developing the HSI, we followed the Network on Development Evaluation framework for designing a composite index (OECD, 2007), as follows:

► **Theoretical framework**

The first step in developing the HSI was defining the concept to be measured and ensuring that different contributing components are independent of each other. We considered the WHO model for a healthy workplace and the IWH's Ontario Leading Indicators Project (OLIP) survey tool for organizational leading indicators for the prevention and management of injuries and illnesses (Severin, 2014), and conducted intensive research into other possible sources of key components of a safe workplace, as described in the literature review section above.

► **Item Selection**

The next step in designing the Index was selecting indicators and unique metrics that correspond to the identified elements to be included. An indicator can be defined as “a quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement, to reflect changes connected to an intervention, or to help assess the performance of a development actor” (OECD, 2004). Our aim was for the selected metrics to provide a range of values and accurately measure the desired concepts. The measures identified are based on the theoretical framework of the elements that constitute a healthy and safe workplace as reflected in the research literature. The calculated outputs of each of the items were reviewed to confirm statistical independence from each other.

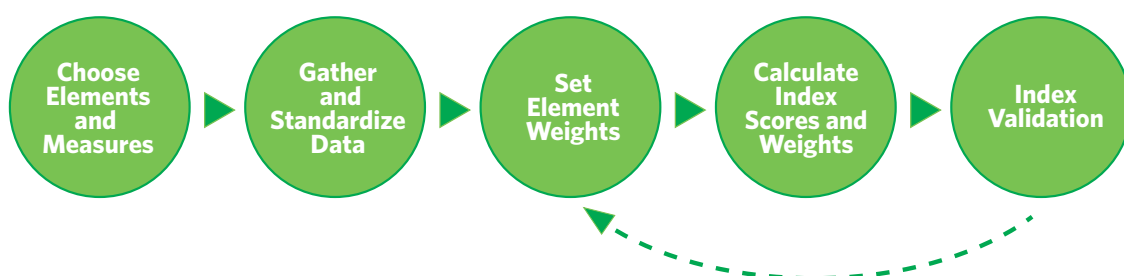
► **Scoring and Weighting**

We considered several issues when deciding on a total score and how selected items contribute to it. These included applying appropriate weights to the various components of the Index, and normalizing the data so that the metrics can be combined. We used principle component analysis to help assign weights to items based on their correlation, so that we could remove any remaining bias that may have occurred during the Index's design. We also added a modifier to the weights that reward measures that are stable over multiple periods..

► **Validation**

The final step in the development of the Index was to back-cast it and review for alignment with past health and safety system performance.

Figure 1. Steps to Designing the H&S Index




Proposed HSI Measures

A working group from the WSIB's Strategy Cluster was put together to investigate options for creation of the Index. In order to measure health and safety comprehensively, it was thought best to examine all relevant dimensions simultaneously, since no single indicator can provide a complete view of trends in health and safety performance (Hughes, 2009; UNECE, 2015).

Indicator development started with consultation of the available literature and development of a theoretical framework. Seven components were identified that aligned to the researched frameworks on health and safety performance reviewed in the section above (see Table 1). The main elements that the HSI focuses on are indicators such as prevention activities, worker empowerment, and workplace culture, and others such as injury frequency and severity. These particular metrics were chosen because they were found to be statistically unique and allowed measurement of the elements laid out in the safe-workplace framework.

Table 1. HSI component alignment to health and safety frameworks

	H & S Index Indicators				
	Prevention	Worker Empowerment	Workplace Culture	Enforcement	Injuries
Elements of a Healthy Workplace					
Leadership engagement			✓		
Worker involvement		✓	✓		
Avoiding undue risk	✓				✓
Fair treatment in employment		✓			
Supporting and taking responsibility for workers and their families			✓		
Following occupational health and safety rules	✓		✓	✓	
Enforcement	✓			✓	
Existence of legal framework					

 Not measured, but exists in Ontario

 Much of the requirement is taken on by Ontario's legal framework

The HSI aims to capture metrics that are concrete, that can be effectively measured across different jurisdictions, and that emphasize quality improvement. The indicators that were included are those that have been found in previous research to have an impact on workplace health and safety performance and best practices. Certain indicators were not of direct interest because they are beyond the scope of our influence, such as the OHS legal framework. Other metrics were rejected because they were deemed either lagging, or significantly complex to the point where their real contribution to the Index could not be identified (e.g., industry mix, claim management practices), or because they were found to be highly correlated with other measures that were included.

Prevention

The prevention indicator of the HSI will be captured through several quantitative and qualitative measures that align with the elements of enforcement, following occupational health and safety rules, and avoiding undue risk as reviewed in the framework above. Specifically, we identified the following unique measures: workplace prevention activities, the number of inspections, and workplace safety support. These are all statistically independent measures that capture various activities undertaken to prevent workplace accidents, illnesses or fatalities and promote workplace health.

Workplace prevention activities are an important element within the HSI. This is a measure of activities that are undertaken by an organization's health and safety system. While other organizations, such as the IWH, have completed their own measurements of prevention activities in the past, the WSIB has determined that it is necessary to create and run a survey that will support the Index's need for consistent measurement (see Data Sources, 19-26, for discussion of survey methods). These activities are assessed qualitatively through a set of validated questions based on the IWH's survey of leading indicators, the Organizational Performance Metric (OPM) (Severin, 2014). The OPM is a questionnaire that is based on more than 800 workplaces representative of different sectors in Ontario, where respondents in each workplace assessed the degree to which their organization adhered to optimal occupational health and safety policies and practices (IWH, 2014). These eight questions provided a measure of workplace health and safety performance. An example of workplace prevention activity includes the number of safety audits done within a company.

Inspections continue to constitute the main formal means of promoting compliance with workplace safety legislation and regulations. According to an interjurisdictional review by the Health and Safety Executive in the UK (Fooks, 2007), the basic aims of the inspection process were shared across different jurisdictions, and include the following elements: determining underlying factors of occupational incidents, identifying associated compliance issues, helping to ensure compliance with the law, providing recommendations to prevent future injury and illness, and, finally, referring cases for prosecution or administrative penalties, when necessary. The HSI will incorporate the number of inspections, standardized to the number of workplaces, as a quantitative indicator of prevention. Two main types of inspections that occur in Ontario are integrated in the Index. Proactive inspections, which are often aligned to larger initiatives at the Ministry of Labour (MOL), are carried to manage risk management and promote occupational health and safety in specific, high-risk, areas. For example, to raise awareness and educate about safe practices if falls are targeted for preventative action, MOL will proactively visit more job sites where they suspect an increased risk of falls exists. The other type of inspection results from complaints, and is a regulatory vehicle to identify violations for potential enforcement action.

Workplace safety support is another measure of the element of prevention in the HSI. This captures the size and quality of the health and safety support in the organization, such as the number of health and safety representatives, and the degree to which the organization values safety and quality in the way the work is done. It is being assessed through the newly piloted WSIB survey, which also incorporates

the OPM (IWH, 2014). In contrast to the OPM methodology, the HSI surveys not only members in the health and safety team of an organization, but any participant in Ontario's workforce contacted through our sampling process (described in Data Sources). The different questions will therefore not result in a quantifiable number, but in workers' assessments of how strong or weak workplace safety support is. This section should not be confused with management or employee interaction in the system or the existence of a workplace culture, both of which are being assessed elsewhere in the Index.

Worker Empowerment

The worker empowerment indicator of the HSI is captured through several quantitative and qualitative measures that align with the elements of fair treatment in employment and worker involvement as per the health and safety framework discussed previously. Worker refusals, as reported to MOL, are used, like complaints, as an indicator of worker empowerment, as it is understood that empowered workers have a greater capacity to speak up and report unsafe work conditions or practices. As discussed in the review of literature above, empowerment is positively related to safety behavior (Parker, 2001). Workers' ability to bring up safety issues speaks highly about their ability to participate in the workplace's health and safety program and culture.

Involvement in the health and safety of the workplace is an additional key indicator in the HSI based on the extensive literature that demonstrates the positive impact of worker involvement as an indicator for safety outcomes like injuries and incidents. Many of the necessary measurements needed to assess the scope of worker involvement, however, are not consistently collected or readily available; the creation of the survey tool therefore allows us to qualitatively capture this element.

Workplace Culture

Indicators of workplace culture are captured in the HSI through qualitative survey measures that align with the health and safety framework elements of leadership engagement, worker involvement, adherence to occupational health and safety rules, and employers' supporting and taking responsibility for workers and their families. The general objective of this measure is to capture workers' overall impressions of a culture of safety that exists in the workplace. This measure, as well as leadership's involvement in the organization's health and safety, is identified in the literature as an important element of a healthy workplace (Vredenburg, 2002; Zohar, 2010). Since there is currently an absence of consistent measures in place to collect this data, the survey captures these key elements.

Enforcement

Enforcement is a known deterrent to poor health and safety practices and, as discussed previously, research has shown that a strong enforcement program (including inspections, citations, and penalties) improves health and safety outcomes (Tompa, 2007; Mischke, 2013). In the HSI, enforcement is captured through several statistically unique, quantitative measures, including the number of convictions, orders per inspection, and the average value of fines. Convictions data is taken from the Ministry of the Attorney General (MAG) with the assistance of MOL. The Ministry of the Attorney General is also responsible for laying the charges that result in convictions. These convictions will generally arise from problems identified during inspections or as a result of criminal activity. Another metric that is collected as part of the enforcement element is orders per inspection, which indicates how often an inspection results in an order being created. The third identified measure of enforcement is the average value of fines. The fines, managed by both ministries, may be for occurrences such as not wearing a hard hat on a job site through to fatality on a job site.

Injuries

Injury frequency, severity, and duration aim to measure how well the health and safety system has avoided risks. This is the one area of the HSI that uses WSIB data; however, a focus on information captured at the time of injury registration or shortly afterwards avoids the potential for the WSIB to heavily affect the outcomes of these measures through its internal policies and practices. Three metrics are used: event frequency, event severity, and short-term return-to-work rates.

Event frequency captures all allowed claims received by the WSIB for workers in the province of Ontario. The advantage of the injury frequency metric is that it provides an easily interpretable, quantitative measure that is consistently captured across the various jurisdictions by the Association of Workers' Compensation Boards of Canada (AWCBC). Event severity is the count of injuries that get classified as "severe" when the injury possesses specific attributes. Classifying injuries according to their attributes (e.g., body part, nature of injury) can provide valuable insight into the causes and contributing factors for work health and safety failure (O'Neil, 2013). This measure of risk in the Index is assessed by the frequency of severe injuries and fatalities, which are combined into one measure using the WSIB's new severe injury and fatality rate.

To develop a serious injury rate measure that could be incorporated in the HSI, an analysis was conducted to determine methodologies used by other jurisdictions. Various models were used to determine characteristics which identify a claim as having a high probability of being a "serious injury"¹. Canadian Standards Association (CSA) codes that successfully predicted severe claims, with a low chance of mislabeling, were then selected to determine the serious injury rate. This rate includes all traumatic fatalities, but excludes disease claims. To produce an easy-to-apply method of identifying serious injuries at the time of claim allowance, we used the properties of the injury or accident to set indicators of a serious claim and label historic claims as "severe" or "not severe." Claims were labeled severe based on the following criteria: high number of days lost, high health and drug costs during first year of a claim, a permanent impairment allowance, and/or the presence of hospital stays in the first week. For the purpose of generating a predictive model of labeled "severe" claims, a list of properties of an injury or accident was composed, which can be used to identify future severe claims.

RTW

The inclusion of a RTW metric is necessary to understand the extent to which workplaces will try to accommodate their injured workers. This measure aligns with the elements of fair treatment in employment and supporting and taking responsibility for workers and their families. A quicker return to work will benefit the worker in the long run, as understood through the WSIB's "better at work" philosophy. As stated by the American College of Occupational and Environmental Medicine (ACOEM, 2006), "Strong evidence suggests that activity hastens optimal recovery while inactivity delays it... Other evidence indicates that remaining at or promptly returning to some form of productive work improves clinical outcomes as compared to passive medical rehabilitation programs."

The measure of RTW included in the HSI is the percentage of injured workers off compensation at 30 days. A number of similar measures use other durations; however, 30 days was chosen because it will be impacted the least by changes in WSIB policy and practice and more by the changing actions and culture of Ontario's workplaces. Also, this measure is consistently captured across Canadian jurisdictions by the AWCBC.

Table 2. HSI metric's desired change over time. Change in that direction increases the HSI score.

Indicator	Metric	Desired Change Direction
Prevention	# of inspections	Increase
	workplace prevention activities	
	workplace safety support	
Worker Empowerment	# of complaints	Increase
	# of workers refusals	
	Involvement in the health and safety of the workplace	
Enforcement	Average value of fines	Increase
	# of convictions	
	# of orders per inspection	
Workplace Safety Awareness and Culture	Worker awareness of OHS and WSIB legislation	Increase
	Leadership involvement in the organization's health and safety	
	Worker's experience of a workplace culture aimed at safety	
Injuries	# of injuries per 100 workers	Increase
	Severe injuries and fatalities	
	% of injured workers off compensation at 30 days	

Data Sources

Data for the HSI is collected primarily from six sources: MOL, MAG, existing WSIB metrics, AWCBC, Statistics Canada, and a survey conducted by the WSIB. Each of these data sources is limited by its organization's mandate, which states what portions of the workplaces of Ontario for which it is responsible. For example, the WSIB covers about 70 per cent of Ontario workplaces because the *Workplace Safety and Insurance Act* does not include workplaces in some industries, such as finance, or those that are under federal jurisdiction. We continue to use these data sources as approximations of the performance of the entire province's health and safety system.

Table 3. Metric descriptions and summary of data sources

Indicator	Description	Metric	Data Source
Prevention	Activities undertaken to prevent workplace accidents/ illnesses or fatalities	# of inspections	MOL
		workplace prevention activities	Survey
		workplace safety support	Survey
Worker Empowerment	The ability to provide input and have control over one's work, including the ability to report unsafe work practices	# of complaints	MOL
		# of workers refusals	MOL
		Involvement in the health and safety of the workplace	Survey
Enforcement	Ensuring compliance to health and safety regulations	Average value of fines	MAG
		# of convictions	MAG
		# of orders per inspection	MOL
Workplace Safety Awareness and Culture	Overall impression by a worker of a culture of safety in the workplace	Worker awareness of OHSA and WSIB legislation	Survey
		Leadership involvement in the organization's health and safety	Survey
		Worker's experience of a workplace culture aimed at safety	Survey
Injuries	The frequency and severity of accidents occurring in workplaces	# of injuries per 100 workers	WSIB
		Severe injuries and fatalities	WSIB
		% of injured workers off compensation at 30 days	WSIB

Survey

Some indicators in the Health & Safety Index were found not to have satisfactory data available, such as worker empowerment, workplace safety awareness and culture, and certain elements of prevention

(workplace safety support, workplace prevention activities). Since surveys of the workforce may expose important indicators about attitudes about health and safety, a survey was created to capture qualitative and quantitative indicators of workplace safety as well as new metrics that were not previously captured elsewhere. The quantitative measures are similar to those originally included in the IWH's OPM survey (IWH, 2014), whereas the qualitative indicators are new and the survey is therefore the only source for this input.

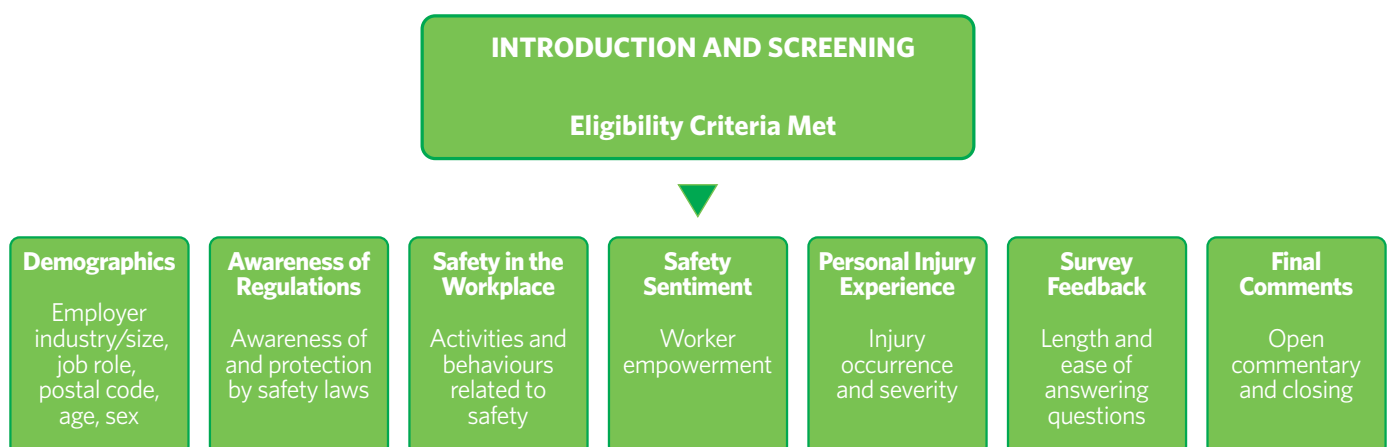
The survey was conducted by trained interviewers on the WSIB's survey research team. Landline and cell phone samples were generated using random digit dialing procedures, provided by Survey Sampling International, LLC (SSI). To ensure that the overall demographic composition of the sample is representative of Ontario's workforce (in terms of age, geography, race/ethnicity, and education), a minimum number of cell phone-only respondents in the survey is maintained.

In order to obtain respondents representative of the working population in the province, the following eligibility criteria were applied for inclusion in the survey: individuals who are currently working in the province of Ontario (excluding retirees), are paid workers (not volunteers), and are of working age (at least 14 years old). As many as five attempts were made to contact every sampled telephone number. Approximately 400 surveys are to be completed each quarter for a total of 1,600 completed surveys each year. This completion quota allows sufficient power in data analysis, assuming a 95 per cent level of confidence. Sample demographics (e.g., age, sector) will be assessed against population proportions, and weighting will be used to ensure the sample reflects the Ontario population of working adults.

The elements making up the survey in the pilot phase are illustrated in Figure 2 (the full survey is included in Appendix 1). Once inclusion criteria are confirmed and those who are ineligible for the survey are screened out, the interviewers collect demographic information including industry sector, employer size, job role (owner/supervisor/worker), region, age, and sex. Subsequent sections of the survey focus on:

- Awareness of, and the feeling of being protected by, the province's workplace health and safety laws
- Safety activities in the workplace mirrored in the OPM survey, including several additional questions on safety behaviours
- Feelings of workplace empowerment, such as how likely workers are to refuse unsafe work
- Personal experience with work-related injury or illness (that required medical attention) and the severity of that injury, to assess previous interaction with the workers' compensation system
- Open-ended comments about workplace safety.

Figure 2. Pilot survey elements



We recognize a number of potential biases introduced by using a telephone survey methodology. As with any telephone survey, the main issue encountered is low response rates. Generally, response rates tend to be lower when respondents have no prior knowledge that they will be contacted for a study (“cold contact” surveys) (Aday, 2006). Timing of data collection is another important consideration for this survey. Since the target population of this survey is individuals who participate in the Ontario workforce, calls were scheduled during day and evening hours to ensure that those who are employed during the day have a chance to respond to the survey. Since the survey is conducted in English only, a potential bias may be introduced by excluding workers who cannot speak English. Another potential limitation is the inability to survey those who are unreachable by phone (e.g., migrant workers).

Grouping Survey Questions

The survey is composed of a variety of questions that support different metrics within the Index. A factor analysis was used to check for construct validity and to understand how the different questions grouped together. It was found that each of the factors identified aligned to the survey metrics they supported. There was evidence that work culture and workplace safety activities could be combined, but as they supported different elements of the Index, one being prevention and the other being culture, they are being kept separate.

Normalizing and Scoring Data

As stated at the outset, the goal of the Health and Safety Index is to measure the change in the health and safety system over time. To allow the comparison of the Index between years and jurisdictions, many measures are normalized by dividing their volume by an appropriate denominator (e.g., showing the rate of an activity per worker). This normalization is only performed on metrics that are not already captured as rates or survey data. Not all denominators are the same, as this would encourage normalized metrics to be correlated to each other. Providing measures such as fines per order and orders per inspection, enables the Index to offer a more robust measure of enforcement in Ontario. To ensure that this assumption was correct, the Index was attempted with a uniform denominator of total workers in Ontario; however, as suggested above, colinearity was a major problem.

Table 4. Normalization of metrics summary

Indicator	Metric	Numerator	Denominator
Prevention	# of inspections	Inspections	Ontario Workers
Worker Empowerment	# of complaints	Complaints	Ontario Workers
	# of worker refusals	Work Refusals	Ontario Workers
Enforcement	Average value of fines	Total Fines	Orders
	# of convictions	Convictions	Ontario Workers
	# of orders per inspection	Orders	Inspections
Injuries	# of injuries per 100 workers	Total Registered Claims	Ontario Workers
	Severe injuries and fatalities	Severe Claims	Ontario Workers

By performing this transformation, the Index will do a better job of measuring the health and safety system rather than the growth of Ontario’s economy, which may show volumes of complaints as increasing, while complaints per worker decrease. This transformation will also allow a better scoring of the various metrics. By normalizing them, the comparison of the metrics values between periods will show change in the

system as a whole.

The score for each metric is the measure of these normalized values over time. With the exception of the survey data, each measure is scored as the current year's percentage change from the average of the four previous years' normalized values. For survey data, it is measured as the change from the previous year's value. This method of scoring is used because it aligns with the goal of the Index, which is to measure change in the system. This method also gives a common unit of measurement for all metrics, change over time, which allows comparison and aggregation of very different measures into a composite Index.

Change was calculated against the average of the previous four years' normalized values. This duration was decided upon because it addresses a number of potential problems. Two other options were considered, and ultimately rejected: scoring all metrics as year-over-year change, and scoring all metrics as change from a common baseline year. The problem with scoring year over year is that some metrics are more volatile than others and so would cause a great deal of variability in the Index, despite the possibility that the result may just be oscillating around an average value. The other option, scoring from a baseline year, had two limitations. First, all data had to be available and accurate to whatever the baseline year was. This would make future inter-jurisdictional comparison nearly impossible. And second, some metrics, such as the number of injuries, have been declining steadily over time. The use of a baseline year would cause the score to increase each year and continue to compound on past success to the point that it would have too large an influence on the total Index score after a number of years.

A four-year average was chosen because it provides the best compromise between the two options. There is stability in the measure in that it avoids rapid shifts that may be due to natural oscillation in some metrics, while also preventing those measures that may have a steady change every year from compounding on past successes. The use of four years was chosen because it was found to be the shortest period that resisted the effect of some of the more variable metrics.

Survey data is the exception and is calculated year over year. This is done partially due to the practical constraint that historic survey data does not exist. The literature review above shows that the activities that happen in the workplace are an important part of the health and safety system, and so changes in these metrics need to be reflected quickly in the Index as a whole, which is better accomplished with a year-over-year comparison.

The last concern for scoring the metrics was determining the desired direction for each change. An increase in the amount of enforcement is desirable, but would be a problem if injuries were observed to increase. To account for this, some scores are multiplied by negative one to cause all metrics' scores to change in a common direction, and to allow better comparison between measures and the aggregation of the Index as whole. The only data for which this additional transformation was performed is the injury section, with the number of injuries, severe injuries and percentage of workers on benefits at 30 days all being metrics that we would like to see decrease over time.

Weighting

A great deal of effort has been put into ensuring that no bias was involved in the design of the Index. However, it is recognized that some bias may be introduced that can cause the Index to under- or over-represent some part of the system. Such bias may result either from the design of the Index, or from the types of metrics that were available due to the activities performed by the participating agencies and ministries. Weights were therefore determined and applied that to remove any such potential bias.

To arrive at the specific weights, a principal component analysis was performed on all scored data. The weight that was used is the average of the absolute value of the first three eigenvectors² for each

measure. This activity was first performed for each group of metrics and then between the weighted score of each group. Where three or fewer metrics were available, the number of eigenvectors used would be equal to the number of metrics less one.

This methodology is consistent with that prescribed by the OECD in the Network on Development Evaluation framework for designing a composite index (OECD, 2007). Principal component analysis is used to create groups of metrics that each maximizes its individual contribution to the variation in the studied population or sample, with the first component describing the most variation. By using the eigenvector scores we can produce a weight to calculate each measure's contribution to describing the health and safety system (i.e., difference from other measures), while the contribution of those metrics that have some level of correlation with other metrics is reduced. The first three eigenvectors are used to ensure that even the contribution of those metrics which may be secondary in describing variation is captured through the other components.

Calculating Survey Data Weights

Since no historic scores were available at the time of the weighting exercise, a method of capturing the different survey metrics' tendency toward variation was used to understand how they would contribute to general weighting. Two things can explain a change in a survey score from one period to the next: first, a shift in the average sentiment of the workers of Ontario; and, second, the expected error that will occur when surveying a population (e.g., sampling error, non-response error). To capture both reasons, a Monte Carlo scenario was set up to generate new potential survey scores based on the distribution of current individual survey responses. By generating new metric scores randomly based on the distribution of responses, the scores can be used to calculate the change between the generated score and this year's survey results. This change was then used to generate the weights using the previously described method. As each survey metric will interact and contribute uniquely to the variation in the population, the weights were calculated for the randomly generated survey results 100,000 times and the final weights used were the averages of all iterations. We also used the inverse of the variation of these generated scores as part of the weight, with 50 per cent coming from the principal component analysis and 50 per cent from the measure's share of the total of all measures inverse of variation. This is done to encourage a stable index. If a measure is both unique and stable it will have a high score, whereas if it varies wildly and is similar to other measures, it will have a low score. Stability is desired because it allows easier interpretation of the index and removes the likelihood of random noise in the data, rather than real improvements in Ontario's health and safety, changing the index.

Generating potential survey scores using current responses will capture the change caused by survey error. The second reason for variation is a real change in sentiment. This requires that an assumption be made about the likelihood for that sentiment to change. It is assumed that a question with a large variety in responses is more likely to shift from one period to the next than is one with very similar responses. The kurtosis³ of the distribution of the collected survey responses describes a probability curve of potential shift in actual sentiment in future years. Through the Monte Carlo exercise, the generated survey responses will capture both the likelihood of error, and our assumed likelihood of actual sentiment change. The average weights produced for all metrics and groups will then successfully account for the tendency toward variation in scores, and can be used in scoring the Index in the future.

To be clear, the generated survey results are not used to calculate the Index, but merely to find the appropriate weighting of elements of the Index to reduce any remaining bias that may exist.

H&S Index Element Weights

More highly weighted items have a greater contribution to the total variation in the population; the

weight gives no indication of any applied level of importance of one element over another. By applying the weighting, scoring, and normalizing methods discussed, we were able to generate the weights that are used in the Index (see Figure 4). Of the five indicator groups, prevention and culture had the highest contribution to total variation, with injury being the lowest in its contribution to total variation. An integrated weight can be calculated by multiplying the metric's weight within a group by the group's overall weight to understand how individual metrics contribute to the Index. The three most highly weighted metrics are number of workplace activities, worker awareness of legislation, and involvement in the health and safety of the workplace. All three are derived from the survey. These higher weights are being driven by similarities in the remaining metrics in the group, not necessarily by a special property of that metric.

The lowest weighted elements are number of complaints, number of convictions, and percentage of injured workers off compensation at 30 days. The number of complaints has a weak correlation to the number of worker refusals, number of convictions to the number of inspections per order, and percentage of workers off compensation at 30 days to number of injuries per 100 workers. This is understandable as all three are correlated to measures captured through similar data sources or base activities. Their low weight indicates that using this weighting method has reduced a structural bias that may have occurred due to the way that some programs in the health and safety system operate. This methodology helps create a well-rounded assessment of the health and safety system as a whole.

Figure 4. H&S Index Weights

Metric	Indicator Group	Metric's Contribution to Group Weight	Group Weight	Integrated Weight
# of inspections	Prevention	40%	24%	10%
# of workplace prevention activities		45%		11%
Amount of workplace safety support (e.g., # of health and safety reps)		15%		4%
# of complaints	Empowerment	4%	19%	1%
Involvement in the health and safety of the workplace		50%		10%
# of worker refusals		46%		9%
# of convictions	Enforcement	7%	19%	1%
Average value of fines		43%		8%
# of orders per inspection		50%		9%

Metric	Indicator Group	Metric's Contribution to Group Weight	Group Weight	Integrated Weight
Worker awareness of OHSA and WSIB legislation	Culture	44%	25%	11%
Worker's experience of a workplace culture aimed at safety		27%		7%
Leadership involvement in the organization's health and safety		29%		7%
# of injuries per 100 workers	Injury	38%	13%	5%
Severe injuries and fatalities		49%		6%
% of injured workers off compensation at 30 days		13%		2%

Notes

¹A Naïve Bayes modeling approach was used to attach probabilities of severe claims to various claim CSA coding combinations to identify codes with high predictive value. The CSA code's standalone propensity to falsely label severe claims was calculated and incorporated into the model.

²Eigenvectors are part of the output of the matrix algebra needed to perform principal component analysis. They are the amount that each variable contributes to a component, with each component explaining a portion of the total variation in the population.

³ Kurtosis is a description of how broad a population is distributed around a mean. A population with a positive kurtosis has a narrow distribution with few outliers.

Summary

In this paper, health and safety is approached as a multidimensional concept, characterized by different elements. To cover all relevant aspects, the WSIB has developed index that includes five indicators of health and safety that align to a healthy workplace framework. By reviewing a wide range of research, metrics have been aligned to the indicators that will best shed light on the changes in Ontario's health and safety system. All efforts have been made to ensure that a fair and unbiased assessment is made with information being gained through all participants in the system, the ministries and agencies that enforce and support the system, and the workers and employers who are present in the workplace, where health and safety begins. The result is a robust measure of health and safety that can be used by all of Ontario for insight into how to make workplaces safer.

References

Aday, L.A., & Cornelius, L.J. (2006). *Designing and conducting health surveys* (3rd ed). San Francisco: Jossey-Bass.

American College of Occupational and Environmental Medicine. (2006). *Preventing needless work disability by helping people stay employed*. Retrieved from <http://www.acoem.org/PreventingNeedlessWorkDisability.aspx>

Boardman, J., & Lyon A. (2006). *Defining best practice in corporate occupational health and safety governance*, prepared by Acona Ltd for the Health and Safety Executive, (Research Report 506). Retrieved from <http://www.hse.gov.uk/research/rrpdf/rr506.pdf>

Burton, J. (2010). *WHO Healthy workplace framework and model: Background and supporting literature and practices*. Retrieved from http://www.who.int/occupational_health/healthy_workplace_framework.pdf

Canadian Center for Occupational Health and Safety. (2016). *OH&S legislation in Canada – internal responsibility system* [Fact Sheet]. Retrieved from <https://www.ccohs.ca/oshanswers/legisl/irs.html>.

Colquitt, J.A., Conlon, D.E., Wesson, M.J., Porter, C.O., & Ng, K.Y. (2001). Justice at the millennium: A meta-analytic review of 25 years of organizational justice research. *Journal of Applied Psychology*, 86(3), 425-445. doi: 10.1037//0021-9010.86.3.425.

Concha-Barrientos, M., Imel Nelson, D., Driscoll, T., Steenland, K., Punnett, L., Fingerhut, M., & Corvalan, C. (2004). Selected occupational risk factors. In M. Ezzati, A.D. Lopez, A. Rodgers, C.J.L. Murray (Eds.) *Comparative quantification of health risks: Global and regional burden of disease attributable to selected major risk factors* (pp.1651-1803). Geneva: World Health Organization. Retrieved from http://www.who.int/occupational_health/publications/quantification/en/

Denison, D.R. (1996). What is the difference between organizational culture and organizational climate? A native's point of view on a decade of paradigm wars. *The Academy of Management Review*, 21(3), 619-654. doi: 10.2307/258997

Dunlap, E.S. (2011). Safety leadership: Finding common ground. *Professional Safety*, 56(9), 42-49.

Fooks, G., Bergman, D., & Rigby, B. (2007). *International comparison of (a) techniques used by state bodies to obtain compliance with health and safety law and accountability for administrative and criminal offences and*

(b) sentences for criminal offences, prepared by The Centre for Corporate Accountability for the Health and Safety Executive, (Research Report 607). Retrieved from <http://www.hse.gov.uk/research/rrpdf/rr607.pdf>

Franché, R.L., Cullen, K., Clarke, J., Irvin, E., Sinclair, S., & Frank, J. (2005). Workplace-based return-to-work interventions: A systematic review of the quantitative literature. *Journal of Occupational Rehabilitation*, 15(4), 607-31. doi: 10.1007/s10926-005-8038-8

Gyekye, S.A., & Haybatollahi, M. (2014). Relationship between organizational justice and organizational safety climate: Do fairness perceptions influence employee safety behaviour? *International Journal of Occupational Safety and Ergonomics*, 20(2), 199-211. doi: 10.1080/10803548.2014.11077045

Gyekye, S.A., & Salminen, S. (2007). Workplace safety perceptions and perceived organizational support: Do supportive perceptions influence safety perceptions? *International Journal of Occupational Safety and Ergonomics*, 13(2), 189-200. doi: 10.1080/10803548.2007.11076721

Hale, A.R., & Hovden, J. (1998). Management and culture: The third age of safety. A review of approaches to organizational aspects of safety, health and environment. In A.-M. Feyer & A. Williamson (Eds.), *Occupational injury: Risk, prevention and intervention* (pp. 129-165). London: Taylor & Francis Ltd.

Hughes, P., & Ferrett, E. (2009). *Introduction to health and safety at work. The handbook for the NEBOSH National General Certificate* (4th ed.). Elsevier.

Institute for Work & Health. (2000). *What gets measured gets done: The healthy workplace balanced scorecard*. Retrieved from <http://www.iwh.on.ca/what-gets-measured-gets-done>

Institute for Work & Health. (2014). *Organizational performance metric*. Retrieved from <http://www.iwh.on.ca/opm>

Institute of Medicine. (2001). *Health and behavior: The interplay of biological, behavioral, and societal influences*. Washington, DC: The National Academies Press. doi: 10.17226/9838

Krause, T.R., & Weekley, T. (2005). Safety leadership: A four-factor model for establishing a high-functioning organization. *Professional Safety*, 50(11), 34-40.

Linton, S.J. (2000). A review of psychological risk factors in back and neck pain. *Spine*, 25(9), 1148-1156. doi: 10.1097/00007632-200005010-00017

Loeppke, R.R., Hohn, T., Baase, C., Bunn, W.B., Burton, W.N., Eisenberg, B.S., & Siuba, J. (2015). Integrating health and safety in the workplace: How closely aligning health and safety strategies can yield measurable benefits. *Journal of Occupational & Environmental Medicine*, 57(5), 585-597. doi: 10.1097/JOM.000000000000046

MacEachen, E., Kosny, A., Ståhl, C., O'Hagan, F., Redgrift, L., Sanford, S., Mahood, Q. (2016). Systematic review of qualitative literature on occupational health and safety legislation and regulatory enforcement planning and implementation. *Scandinavian Journal of Work Environment and Health*, 42(1), 3-16. doi: 10.5271/sjweh.3529

McQuiston, T.H. (2000). Empowerment evaluation of worker safety and health education programs. *American Journal of Industrial Medicine*, 38, 584-597. doi: 10.1002/1097-0274(200011)38:5<584::AID-AJIM11>3.0.CO;2-H

- Mischke, C., Verbeek, J.H., Job, J., Morata, T.C., Alvesalo-Kuusi, A., Neuvonen, K., & Pedlow, R.I. (2013). Occupational safety and health enforcement tools for preventing occupational diseases and injuries. *Cochrane Database Systematic Review*, 30(8): CD010183. doi: 10.1002/14651858.CD010183.pub2
- National Research Council. (2001). Panel on Musculoskeletal Disorders. Musculoskeletal disorders and the workplace, low back and upper extremities. National Research Council, National Academy Press, Washington, D.C., 301-329.
- Network on Development Evaluation (OECD/DAC). (2004). *Glossary of key terms in evaluation and results based management*. Stockholm: SIDA.
- O'Neill, S., Martinov-Bennie, N., Cheung, A., & Wolfe, K. (2013). *Issues in the measurement and reporting of work health and safety performance: A review*. Sydney, NSW: Macquarie Lighthouse Press.
- Occupational Health and Safety Act, R.S.O. (1990) c.O.1. Retrieved from https://www.ontario.ca/laws/statute/90o01?_ga=1.98954652.346888864.1444744906
- Occupational Safety and Health Administration. (2012). *Injury and illness prevention programs* [White paper]. Retrieved from <https://www.osha.gov/dsg/InjuryIllnessPreventionProgramsWhitePaper.html>
- OECD, Joint Research Centre. (2008). *Handbook on constructing composite indicators: Methodology and user guide*. Paris: OECD Publishing. doi: 10.1787/9789264043466-en
- Ontario Ministry of Labour. (2015). *A guide to the Occupational Health and Safety Act*. Retrieved from <https://www.labour.gov.on.ca/english/hs/pubs/ohsa/>
- Health. (2004). In *Oxford Dictionary* (4th ed). Melbourne: Oxford University Press.
- Safety. (2004). In *Oxford Dictionary* (4th ed). Melbourne: Oxford University Press.
- Parker, S.K., Axtell, C.M., Turner, N. (2001). Designing a safer workplace: Importance of job autonomy, communication quality, and supportive supervisors. *Journal of Occupational Health Psychology*, 6(3), 211-228. doi: 10.1037//1076-8998.6.3.211
- Pomaki, G., Franche, R.-L., Khushrushahi, N., Murray, E., Lampinen, T., & Mah, P. (2010). Best Practices for return-to-work/stay-at-work interventions for workers with mental health conditions. Vancouver, BC: Occupational Health and Safety Agency for Healthcare in BC. Retrieved from http://www.ccohs.ca/products/webinars/best_practices_rtw.pdf
- Rivilis, I., Van Eerd, D., Cullen K., Cole, D.C., Irvin, E., Tyson, J., & Mahood, Q. (2008). Effectiveness of participatory ergonomic interventions on health outcomes: A systematic review. *Applied Ergonomics*, 39(3), 342-58. doi: 10.1016/j.apergo.2007.08.006
- Robens, A. (1972). *Safety and health at work: Report of the committee*. London: Health and Safety Executive.
- Schneider, M. & Stokols, D. (2008). Multilevel theories of behavior change: A social ecological framework. In S.A. Shumaker, J.K. Ockene, & K.A. Riekert (Eds.), *The handbook of health behavior change* (3rd ed.) (pp. 85-105). New York: Springer.
- Seo, D.C., Torabi, M.R., Blair, E.H., & Ellis, N.T. (2004). A cross validation of safety climate scale using confirmatory factor analytic approach. *Journal of Safety Research*, 35(4), 427-445. doi: 10.1016/j.jsr.2004.04.006

Severin, C. (2014). Ontario leading indicators project. Institute for Work & Health. Retrieved from http://www.iwh.on.ca/system/files/documents/olip_survey_2014.pdf.

Shannon, H.S., Mayer, J. & Haines, T. (1997). Overview of the relationship between organizational and workplace factors and injury rates. *Safety Science*, 26(3), 201-217.

Simons, T. & Roberson, Q. (2003). Why managers should care about fairness: The effects of aggregate justice perceptions on organizational outcomes. *Journal of Applied Psychology*, 88(3), 432-43. doi: 10.1037/0021-9010.88.3.432

Tompa, E., Trevithick, S., & McLeod, C. (2007). Systematic review of the prevention incentives of insurance and regulatory mechanisms for occupational health and safety. *Scandinavian Journal of Work, Environment and Health*, 33(2), 85-95. doi: 10.5271/sjweh.1111

United Nations Economic Commission for Europe. (2015). *Handbook on measuring quality of employment: A statistical framework*, prepared by the Expert Group on Measuring the Quality of Employment. Retrieved from http://www.unece.org/fileadmin/DAM/stats/publications/2015/ECE_CES_40.pdf

Vredenburg, A.G. (2002). Organizational safety: Which management practices are most effective in reducing employee injury rates? *Journal of Safety Research*, 33(2), 259-276. doi: 10.1016/S0022-4375(02)00016-6

Wilson, J.R., & Haines, H.M. (1997). Participatory ergonomics. In G., Salvendy (Ed.), *Handbook of human factors and ergonomics 2nd Ed.* (pp.490-513). New York: Wiley.

World Health Organization. Regional Office for the Western Pacific. (1999). *Regional guidelines for the development of healthy workplaces*. Retrieved from http://www.who.int/occupational_health/regions/en/oehwproguidelines.pdf

World Health Organization. (2010). Five keys to healthy workplaces [Brochure]. Retrieved from http://www.who.int/occupational_health/5_keys_EN_web.pdf

Workplace Safety and Insurance Board. (2015). *By the numbers - 2014 statistical report*. Retrieved from <http://www.wsibstatistics.ca/>

Workplace Safety and Insurance Board. (2016). *2016-2018 WSIB strategic plan*. Retrieved from http://www.wsib.on.ca/WSIBPortal/faces/WSIBDetailPage?cGUID=WSIB064555&rDef=WSIB_RD_ARTICLE&_afLoop=1298302991086716&_afWindowMode=0&_afWindowId=vfobcmbef_1#%40%3FcGUID%3DWSIB064555%26_afWindowId%3Dvfobcmbef_1%26_afLoop%3D1298302991086716%26rDef%3DWSIB_RD_ARTICLE%26_afWindowMode%3D0%26_adf.ctrl-state%3Dvfobcmbef_29

Ylikoski, M., Lamberg, M., Yrjänheikki, E., Ilmarinen, J., Partinen, R., Jokiluoma, H., & Vainio, H. (Eds). (2006). Health in the world of work: Workplace health promotion as a tool for improving and extending work life, (Reports of the Ministry of Social Affairs and Health 2006:62). Helsinki: Finnish Institute of Occupational Health.

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology*, 65(1), p. 96-102.

Zohar, D. (2010). Thirty years of safety climate research: Reflections and future directions. *Accident Analysis & Prevention*, 42(5), p. 1517-22. doi: 10.1016/j.aap.2009.12.019

Appendix 1.

Workplace Health & Safety Index Telephone Survey			
Theme	Question Number	Introductions and Questions	Survey Notes / Questions for Client Review
Survey Intro		Good morning/afternoon/evening, my name is _____. I am calling from the Survey Research team at the Workplace Safety & Insurance Board. Today we are calling to conduct a quick survey on perceptions and opinions about safety in the workplace.	
		<p>Would I be able to speak with someone in your household that is currently part of Ontario's workforce?</p> <ul style="list-style-type: none"> ▪ 1 Yes, speaking ▪ 2 Yes, but not now/another time. ▪ 3 No 	<p>2- schedule call back</p> <p>3- Thank you 1</p>
		The Workplace Safety & Insurance Board is interested in learning about how people feel about safety in the work place. We are talking to workers across the province to get their feedback on this important issue facing Ontario's workforce.	
		<p>Would you be willing to complete a 5-minute survey to share your experiences and opinions about safety at work?</p> <ul style="list-style-type: none"> ▪ 1 Yes ▪ 2 No 	
Call Back		<p>Would there be another time that would be more convenient for you to complete the survey?</p> <ul style="list-style-type: none"> ▪ 1 Yes ▪ 2 No 	
Eligibility Criteria (Screening)	S1	<p>Before we move onto the survey, I'd like to confirm a couple of points with you:</p> <p>First of all, are you currently working in the province of Ontario?</p> <ul style="list-style-type: none"> ▪ 1 Yes ▪ 2 No 	If No Go To Thank you 2

Workplace Health & Safety Index Telephone Survey

Theme	Question Number	Introductions and Questions	Survey Notes / Questions for Client Review
	S2	<p>Are you paid for your work or are you a volunteer?</p> <ul style="list-style-type: none"> ▪ 1 Paid ▪ 2 Volunteer If answer 	If answer No Go To Thank you 3
	S3	<p>Are you 14 years of age or older?</p> <ul style="list-style-type: none"> ▪ 1 Yes ▪ 2 No 	If answer No Go To Thank you 4
		Great. First, I'd like to assure you that all of your answers to the survey will be confidential. Your responses will be used for research purposes only and all of the survey results will be reported at a summary level.	
		If respondent asks for verification of the validity of the survey, ask them to contact Survey Administration Co-ordinator.	
Thank you 1		For research purposes we record reasons why individuals choose not to complete surveys. May I ask why you are not interested in this survey?	
		Okay, thank you very much for your time	
Thank you 2		Thank you for your time, but only those currently working in the province of Ontario are eligible to complete this survey.	
Thank you 3		Thank you. Although your contributions are very important, this survey is focused on paid workers in Ontario. Thank you for your time.	
Thank you 4		Thank you for your time, but only those 14 years or older are eligible to complete this survey.	
<p>Interviewer direction for use when worker has multiple jobs:</p> <ul style="list-style-type: none"> ▪ Please think about the job you work most hours doing on a weekly basis ▪ Where equal hours, please think about the job where you had your most recent shift 			

Theme	Question Number	Introductions and Questions	Survey Notes / Questions for Client Review
Demographics	Section A	To start with, I'd like to ask a few question that will help us help categorize your responses:	
Industry	Q1	<p>In what industry sector do you work? (What is your current job? What field to you work in?)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Agriculture, Forestry, Fishing and Hunting (NAICS 11) <input type="checkbox"/> 2 Mining and Oil and Gas Extraction (NAICS 21) <input type="checkbox"/> 3 Utilities (NAICS 22) <input type="checkbox"/> 4 Construction (NAICS 23) <input type="checkbox"/> 5 Manufacturing (NAICS 31-33) <input type="checkbox"/> 6 Wholesale Trade (NAICS 41) <input type="checkbox"/> 7 Retail Trade (NAICS 44-45) <input type="checkbox"/> 8 Transportation and Warehousing (NAICS 48-49) <input type="checkbox"/> 9 Information and Cultural Industries (NAICS 51) <input type="checkbox"/> 10 Finance and Insurance (NAICS 52) <input type="checkbox"/> 11 Real Estate and Rental and Leasing (NAICS 53) <input type="checkbox"/> 12 Professional, Scientific and Technical Services (NAICS 54) <input type="checkbox"/> 13 Management of Companies and Enterprises (NAICS 55) <input type="checkbox"/> 14 Administrative and Support, Waste Management and Remediation Services (NAICS 56) <input type="checkbox"/> 15 Educational Services (NAICS 61) <input type="checkbox"/> 16 Health Care and Social Assistance (NAICS 62) <input type="checkbox"/> 17 Arts, Entertainment and Recreation (NAICS 71) <input type="checkbox"/> 18 Accommodation and Food Services (NAICS 72) <input type="checkbox"/> 19 Other Services - except Public Administration (NAICS 81) <input type="checkbox"/> 20 Public Administration (NAICS 91) <input type="checkbox"/> 97 Other (specify _____) <input type="checkbox"/> 98 Don't know <input type="checkbox"/> 99 Refused 	<p>Do not read categories</p> <p>Interview training required</p> <p>Interviewers will be instructed to record verbatim response if doubt to categorization</p>

Theme	Question Number	Introductions and Questions	Survey Notes / Questions for Client Review
Employer Size	Q2	<p>And how many people work in your company? If your company has more than one location, we are interested in the total number of people who work for the company.</p> <p><input type="checkbox"/> 1 Less than 5 employees</p> <p><input type="checkbox"/> 2 5 to19 employees</p> <p><input type="checkbox"/> 3 20 to 99 employees</p> <p><input type="checkbox"/> 4 100 to 299 employees</p> <p><input type="checkbox"/> 5 300 to 499 employees</p> <p><input type="checkbox"/> 6 500 to 999</p> <p><input type="checkbox"/> 7 More than 1000</p> <p><input type="checkbox"/> 97 Other (specify _____)</p> <p><input type="checkbox"/> 98 Don't know</p> <p><input type="checkbox"/> 99 Refused/Don't know</p>	<p>Do not read categories</p> <p>Record all responses in 'other category</p> <p>Interviewer - if respondent does not know ask for an estimate to be able to categorize</p>
Worker Title	Q3	<p>At your current workplace, are you a:</p> <p><input type="checkbox"/> 1 Worker</p> <p><input type="checkbox"/> 2 Supervisor/manager</p> <p><input type="checkbox"/> 3 Owner</p> <p><input type="checkbox"/> 97 Other _____</p> <p><input type="checkbox"/> 98 Don't know</p> <p><input type="checkbox"/> 99 Refused</p>	<p>Read list down to owner</p> <p>Pilot to determine other categories needed</p> <p>If answer "Owner" skip Q11C and Q11D</p>
Geographic Location	Q4	<p>To give us a sense of where you live, what is the first letter of your postal code?</p> <p>Record letter _____</p> <p><input type="checkbox"/> 98 Don't know</p> <p><input type="checkbox"/> 99 Refused</p>	

Theme	Question Number	Introductions and Questions	Survey Notes / Questions for Client Review
Age	Q5	<p>And, can you share your year of birth with me? (preferred)</p> <p>Record year of birth_____</p> <p>OR</p> <p>And, can you tell me your age? I'll read some age ranges and you can stop me when I get to yours:</p> <p><input type="checkbox"/> 1 14 to 19</p> <p><input type="checkbox"/> 2 20 to 24</p> <p><input type="checkbox"/> 3 25 to 29</p> <p><input type="checkbox"/> 4 30 to 34</p> <p><input type="checkbox"/> 5 35 to 39</p> <p><input type="checkbox"/> 6 40 to 44</p> <p><input type="checkbox"/> 7 45 to 49</p> <p><input type="checkbox"/> 8 50 to 54</p> <p><input type="checkbox"/> 9 55 to 59</p> <p><input type="checkbox"/> 10 60 to 64</p> <p><input type="checkbox"/> 11 More than 65</p> <p><input type="checkbox"/> 99 Refused</p>	Pilot testing to determine if respondents are willing to disclose age.
Sex	Q6	<p>Do not read, interviewer record respondent sex:</p> <ul style="list-style-type: none"> ▪ 1 Male ▪ 2 Female ▪ 97 Other _____ ▪ 98 Don't know 	Do not read
Awareness of Regulations	Q7	<p>Overall, how familiar would you say you are with Ontario's safety laws and regulations for workplaces?</p> <p>Please rate your level of familiarity on a scale from 1 to 5 where 1 means you are not at all familiar and 5 means you are very familiar of Ontario's safety laws.</p> <p><input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> Not Applicable</p> <p>Not at all Familiar Very Familiar</p>	

Theme	Question Number	Introductions and Questions	Survey Notes / Questions for Client Review
Feeling of Protected by Legislation	Q8	<p>And, how protected do you feel by the province’s workplace health and safety laws?</p> <p><input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5 <input type="checkbox"/>DK</p> <p>Not at all Protected Very Protected</p>	
Awareness of OHS Regulations	Q9	<p>I’m going to read you a number of statements. For each one, please tell me if you think the statement is true or false.</p> <p>T <input type="checkbox"/>1 F <input type="checkbox"/>2 DK/Ref <input type="checkbox"/>9</p> <p>a) Ontario employers are required by law to make employees aware of hazards they may encounter on the job or in the workplace</p> <p>T <input type="checkbox"/>1 F <input type="checkbox"/>2 DK/Ref <input type="checkbox"/>9</p> <p>b) Employees in all Ontario workplaces have the right to refuse work that they believe is dangerous to themselves or other workers</p> <p>T <input type="checkbox"/>1 F <input type="checkbox"/>2 DK/Ref <input type="checkbox"/>9</p> <p>c) Only workplaces with over 100 employees must have a Joint Health & Safety Committee</p> <p>T <input type="checkbox"/>1 F <input type="checkbox"/>2 DK/Ref <input type="checkbox"/>9</p> <p>d) According to Ontario law, health & safety reps must inspect the physical condition of the workplace on a daily basis</p> <p>T <input type="checkbox"/>1 F <input type="checkbox"/>2 DK/Ref <input type="checkbox"/>9</p> <p>e) It is a worker’s legal responsibility to report workplace hazards to their supervisor</p> <p>T <input type="checkbox"/>1 F <input type="checkbox"/>2 DK/Ref <input type="checkbox"/>9</p>	<p>Answers: (a) T (b) T (c) F (d) F (e) T</p>

Section D		This next section is about your opinion and activities around safety in your workplace.	
H&S Climate Questions	Q10	I'm going to read you a list of statements about safety, and for each one, please answer with, 'Never, Rarely, Sometimes, Often, or Always' based on your workplace's Health & Safety practices. <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> Not Applicable Never Rarely Sometimes Often Always	Probe: 'in your opinion, or based on your opinion' Repeat options as required.
	a.	Formal safety audits at regular intervals are a normal part of your business.	Ontario Organizational Performance Metric (OPM) Questionnaire
	b.	Everyone in your organization values ongoing safety improvements within your company.	OPM
	c.	Your organization considers safety at least as important as production and quality in the way the work is done.	OPM
	d.	Workers and supervisors have the information they need to work safely.	OPM
	e.	Employees are involved in decisions affecting their health and safety.	OPM
	f.	Those in charge of safety have the authority to make the changes they have identified as necessary.	OPM
	g.	Those who act safely receive positive recognition.	OPM
	h.	Everyone has the tools and/or the equipment they need to complete their work safely.	OPM
	i.	You are personally involved in health and safety activities in your workplace	
	j.	Your workplace counts good health and safety performance in performance reviews and promotions	OPM follow up question
	k.	Top management is actively involved in the safety program.	
Section E		In this last set of questions, I would like to get your opinion of your personal safety in your workplace.	
H & S Empowerment	Q11	For each statement that I read, please tell me the extent to which you agree on a scale of 1 to 5 where 1 means you strongly disagree and 5 means that you strongly agree. <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 Strongly Disagree Strongly Agree	Randomize questions
	A	Overall you feel your workplace is a safe place to work	

	B	You feel your workplace is as safe as it can be	
	C	You feel comfortable enough in your workplace to bring safety issues up to the supervisor, manager or owner.	Skip if owner
	D	If you were asked by your supervisor to do a task that you felt was not safe, you would refuse to do it	Skip if owner Ask if supervisor or manager
	E	You make it a point to find out about potential dangers in your workplace.	
	F	You feel you work safely	
Personal Injury experience	Q12	Have you experienced a work-related injury or illness that required medical attention?	
	a	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> Yes No Don't Remember NA/Ref	
	b	In your opinion, how severe was this injury on a scale of 1-5. '1' being not severe at all, and '5' being very severe? <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> Not severe at all Very severe NA/Ref	Only if answer 'yes' in the previous question, ask questions b and c, otherwise skip to next section
	c	c. Did this injury or illness occur within the last 5 years?	
Ease of answering survey questions	Q13	Lastly, I'd just like to get your opinion on this survey:	Only asked during the pilot phase
	a	Were the survey questions easy to understand? (Read options) <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 Yes Somewhat No	
	b	Regarding the length of this survey, did you feel that the survey was (Read options): <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 Too long Too Short Just the right	
Section F Final Comments	Q14	And do you have any other comments you would like to share about workplace safety? _____	
Exit		Thank you for your time! Your feedback is appreciated.	

