

August 2019

Development of Benchmarking Reports and a Dashboard to Change the Conversation in Construction: Final Report



Institute
for Work &
Health

Research Excellence
Advancing Employee
Health

Acknowledgements

This research was supported by a grant from the Workers Compensation Board of Manitoba, through the Research and Workplace Innovation Program 2016. All inferences, opinions, and conclusions drawn in this report are of the authors, and do not reflect the opinions of the Data Steward.

The authors thank the Construction Safety Association of Manitoba (CSAM) for their partnership on the study. The authors also give a special thank-you to the organizations that participated in the survey, and to the members of the project advisory committee for offering valuable feedback and input at key points of the study: Michelle Berg, Livingstone Landscaping Ltd.; David Wiebe, Stuart Olson Construction Ltd.; Peter Cooke, Ambassador Mechanical L.P.; Rick Rennie, SAFE Work Manitoba; Don Hurst, Manitoba Heavy Construction Association WORKSAFELY; Sudhir Sandhu, Manitoba Building Trades; Mike Jones, FWS Group of Companies (formerly at the Construction Safety Association of Manitoba).

If you have questions about this report, please contact us at:

Institute for Work & Health

481 University Avenue, Suite 800

Toronto, Ontario M5G 2E9

info@iwh.on.ca

www.iwh.on.ca

Institute for Work & Health

Development of Benchmarking Reports and a Dashboard to Change the Conversation in Construction

Final Report to the Workers Compensation Board of Manitoba

Date: August 2019

Authors:

Benjamin C. Amick III^{1,2}, Colette N. Severin¹, Mike Jones³, Dwayne Van Eerd¹, Christopher B. McLeod^{1,4}, Sabrina Imam¹, Kay Nasir¹, Jonathan Fan^{1,4}, Michael Swift¹, Sara Macdonald¹, Meghan Storey⁵, Daniel Blair⁶

Affiliations:

¹Institute for Work & Health, Toronto, Ontario, Canada

²Robert Stempel College of Public Health and Social Work, Miami, Florida, USA

³FWS Group of Companies, Winnipeg, Manitoba, Canada

⁴Partnership for Work, Health and Safety, School of Population and Public Health, University of British Columbia, Vancouver, British Columbia, Canada

⁵Construction Safety Association of Manitoba, Winnipeg, Manitoba, Canada

⁶Bit Space Development Ltd., Winnipeg, Manitoba, Canada

Correspondence to:

Dr. Benjamin C. Amick III
Institute for Work & Health
481 University, Suite 800,
Toronto, Ontario M5G 2E9
Tel: 416-927-2027, ext. 2115
Email: bamick@iwh.on.ca

Contents

Executive Summary	6
Introduction	10
Methods	11
Study Design	11
Population	11
Sampling	11
Recruitment	12
Data Collection	12
Data Analysis	14
Table 1. Decision Making Criteria for Assessment of Leading Indicator Measures	17
Results	17
Reliability and validity of the OHS organizational and management metrics	17
Table 2. Description of Sample	18
Table 3. Subscale distributions, Cronbach's alpha, ITCs, scaling success	20
Table 4. Confirmatory Factor Analyses Summary	21
Table 5. Summary assessment of applying decision making criteria for each scale / subscale	21
Relationship between past injury and illness claim rates and current leading indicators	22
Table 6. Adjusted Relative Risk All Claim Rates for Scales by Firm Size	25
Table 7. Adjusted Relative Risk Lost-Time Claim Rates by Firm Size	26
Table 8. Adjusted Relative Risk No-Lost Time Claim Rates by Firm Size	26
Table 9. Adjusted Relative Risk Musculoskeletal Injury Claim by Firm Size	27
Figures 1-9. Relative Risk for Categories of Each Leading Indicator by All Claim Rates	28
Cost per Claim	33
Table 10. Adjusted Non-Zero Total Cost per Claim for Leading Indicator Scales by Firm Size	34
Table 11. Adjusted Non-Zero Lost-Time Cost per Claim for Leading Scales by Firm Size	34
Table 12. Adjusted Non-Zero No-Lost-Time Cost per Claim for Leading Scales by Firm Size	35
Development of evidence-based benchmarks for the Manitoba construction sector	36
Benchmarking report distribution	38
Development and testing the usability of a benchmarking dashboard	38
Figures 10-17. Usability Assessment Survey Results	43
Discussion	45
Conclusions	52
Recommendations	53
References	55
Appendix A	56

Executive Summary

Introduction

This research was a collaboration between the Institute for Work & Health (IWH) and the Construction Safety Association of Manitoba (CSAM). The project sought build evidence-based tools to support changing the dialog in the construction sector to focus on leading indicators of occupational health and safety performance. Having a set of tools that the Construction Safety Association of Manitoba (CSAM) and occupational health and safety (OHS) leaders can use will potentially advance OHS management practices, impact workplace hazard reduction, and improve worker health and safety in the Manitoba construction industry.

The purpose of this research was to affect a significant shift in the health and safety culture of construction businesses, especially small firms that have limited time and resources to engage in OHS safety improvements. The research aspired to go beyond simply identifying leading indicators and measurement to build a dashboard to disseminate benchmarking information, so that organizations can manage and improve their occupational health and safety metrics over time and easily identify where to target their efforts to improve their health and safety programs.

Methods

We conducted a cross-sectional study in a representative, stratified random sample of construction organizations across Manitoba. The key informant most knowledgeable about health and safety in each organization completed a safety performance survey, assessing firm-level organizational policies and practices. The data was then used to develop evidence-based organizational benchmarking reports describing firm-level performance and a dashboard to allow firms to manage and improve their occupational health and safety metrics over time.

Results

A total of 910 organizations, distributed across 18 industry rate codes, eight geographical regions, and three firm size groups completed the survey. For claim rates, we found statistically significant effects among large/medium firms for all measures after controlling for a range of covariates, except ergonomic practices, disability management, and workplace safety and health committee functioning. However, there was no consistency and little meaningful relationships for the small and very small firms.

For claim costs, we found no statistically significant effects, only a trend among large/medium organizations, showing organizations with better leading indicator scores have lower costs. Over 90% of the sample consisted of very small- and small-sized organizations, of which many did not have any incurred costs or injuries. This may have contributed to the null findings in our costs analyses. This is, however, the first study to have collected safety performance data from a significant number of very small firms.

Propensity scores were developed using the administrative data provided in the WCB sample. The propensity scores allowed for reweighting the data so information on the non-participants and participants could be used to make the benchmarks representative of firms in the Manitoba construction sector. Benchmarking scores were generated for the 18 CSAM industry rate codes by each leading indicator measure. Overall, the propensity-weighted scores for 'ergonomic practices' and 'disability management' were consistently lower across industry groups, compared to the other leading indicators.

Individual benchmarking reports were developed at IWH using MS Access. The reports were disseminated to participating firms from January to May 2019. Bit Space Development (BSD), a Manitoba-based technology company, led the development of the INDICATOR dashboard for CSAM. Overall, the results of the usability assessment showed that dashboard users were generally satisfied and found the tool easy-to-use and valuable.

Conclusions

This project came at a time when SAFE Work Manitoba was seeking to change safety culture both within businesses and within the province. We are the first study to use the newly developed SAFE Work Manitoba Safety Culture Assessment tool. Our work could help the province by demonstrating the importance of building industry-specific performance benchmarks and providing a model program.

A series of scientifically credible leading indicators and a set of evidence-based benchmarks were developed for use in the construction sector. These leading indicators were associated with historical claims. We sought to have a representative sample of large/medium, small and very small construction firms; and the large and medium firms behaved as expected, but the small and very small firms did not. This is very important for the continued development of these evidence-based benchmarks. For small and very small firms, some survey questions were perceived as not relevant. We likely need to include a 'not applicable' response option for some of the survey measures. Therefore, the approach of one-size-fits-all did not work. The big takeaway is: benchmarks need to be tailored within sub-sectors by firm size.

We had hoped to have a solid foundation for how leading indicators are related to injury costs, but so many firms had no incurred cost; this made it problematic. We also had cost data at the firm-level but may have required individual claimant-level data instead, much the same way cost data is currently being used to evaluate COR™ programs across Canada.

We learned that occupational health and safety professionals want an easy-to-use dashboard and would prefer 'one stop' shopping where both leading and lagging indicators are included.

More research is needed on how this information changes the conversation on occupational health and safety in Manitoba construction. It would also be helpful to show how the leading

indicators predict injuries and costs in the future. This project will allow for an easy linkage to look at these two important outcomes prospectively.

Recommendations

Further work on leading indicators

- 1) We would encourage a follow-up study to assess the predictive validity of the tools, examining the relationship between leading indicators and future claims.
- 2) Ergonomic practices, disability management, and workplace safety and health (WSH) committee/representative functioning were not related to historical injury/illness claims. But these are important leading indicators for the construction industry. There is a need to not only work on these three leading indicators, but to determine what is the best way to collect data from small- and very small-sized firms. Perhaps it would be sufficient to only collect the 8-item IWH-OPM and the 12-item SAFE Work Manitoba Safety Culture Assessment Index from small firms.

Further work using cost of injuries data

- 3) Further work is needed with larger samples, i.e., CSAM needs more companies participating if the industry wants to use cost as a tool to evaluate best practices in managing leading indicators. It may also help to examine WCB cost data at the individual claimant-level, rather than at the firm-level.

Recruitment/data collection suggestions

- 4) Reducing the length of the questionnaire may prove to generate more interest, given that “not having enough time” to participate in the survey was the most common reason for a decline.
- 5) Include “N/A” as a separate response option in the survey scales, as some of the questions were not applicable to the very small-sized firms.
- 6) Offer multiple methods of questionnaire administration (e.g., online, telephone, hardcopy mail-out) to increase survey numbers.
- 7) Repeated contact attempts are encouraged to reach participants, especially the very small-sized firms.
- 8) Offer individual incentives, rather than a lottery-type incentive, to compensate all participants for their time.

Further work on the dashboard and uptake

- 9) Strategies to help promote the use the dashboard include shortening the survey, providing a separate survey tailored to the small-/very small-sized firms, or including a “N/A” response option and/or an option to skip sections if not applicable.
- 10) CSAM may also consider making the survey mandatory for COR™/SECOR™ companies to complete annually as part of the audit.
- 11) Including lagging indicators (WCB claims data) to align with the leading indicators would optimize the functionality and utility of the dashboard.

Introduction

Construction workers in Manitoba experience high rates of injury, death, and disability due to an overwhelmingly high prevalence of hazards in this industry (SAFE Work Manitoba, 2016). Recent declines in the rate of improvements in work exposures have led some to suggest that the resources dedicated to prevention are not sufficient (Butler, Johnson and Baldwin, 1995; Tompa, 2002). As construction remains a high-risk industry, developing strategies to reduce injuries are critical. Having a set of tools that the Construction Safety Association of Manitoba (CSAM) and occupational health and safety (OHS) leaders can use will potentially advance OHS management practices, impact workplace hazard reduction, and improve worker health and safety in the Manitoba construction industry.

In partnership with CSAM, the Institute for Work & Health (IWH) set out to identify relevant leading indicators to assist prevention efforts. These organizational and management metrics were used to measure how well construction employers perform, compared to similar firms within their industry group. Validating a set of commonly agreed upon indicators relevant to construction employers of all sizes and in all industry-groups was a first step in creating a common occupational health and safety language for leading change to improve worker health and safety in Manitoba.

Rationale

The purpose of this research was to affect a significant shift in the health and safety culture of construction businesses, especially small workplaces that have limited time and resources to engage in OHS safety improvements. The research aspired to go beyond simply identifying leading indicators and measurement to build a dashboard to disseminate benchmarking information, so that organizations can manage and improve their occupational health and safety metrics over time and easily identify where to target their efforts to improve their health and safety programs.

Goals and Objectives

The primary research goal was to identify relevant leading indicators of injury and illness in the construction sector using the Organizational Policies and Practices (OPP) Questionnaire, the IWH-OPM tool, the SAFE Work Manitoba Safety Culture Assessment, and a tool assessing Workplace Health and Safety Committee functioning.

The project aimed to accomplish four specific objectives.

- 1) To examine the reliability and validity of nine OHS leading indicator metrics.
- 2) To examine the relationships between historical Workers' Compensation Board (WCB) claim rates and the leading indicators.
- 3) To develop and disseminate evidence-based benchmarks representative of all companies in all regions in the Manitoba construction sector.

- 4) To develop and test the usability of a benchmarking dashboard to help companies improve their OHS performance over time.

Methods

Study Design

To accomplish the project's objectives, the research team conducted a cross-sectional study in a representative, stratified random sample of construction organizations across Manitoba. The key informant most knowledgeable about health and safety in each organization completed a 15-minute safety performance survey, assessing firm-level organizational policies and practices. The data was then used to develop evidence-based organizational benchmarking reports and a dashboard to allow firms to manage and improve their occupational health and safety metrics over time.

Population

The study population consisted of construction firms registered for workers' compensation coverage in Manitoba from January 1, 2012 to December 31, 2016 that fell under one of 18 CSAM industry codes: building construction (401-02); flooring and tiling (401-03); installing metal products (401-04); painting and decorating (401-05); wrecking and moving buildings (401-06); drywall and stucco contracting (401-08); installing doors and windows (401-09); concrete work (401-10); installing case goods and fixtures (401-12); landscaping (401-15); electrical contracting (402-03); plumbing, insulating and mechanical (402-04); roofing and eaves-troughing (404-03); constructing dams, wharves, bridges and steel (405-02); installing elevators (406-02); installing heavy machinery (406-03); tower and energy construction (409-03); and, railway construction (409-04).

Sampling

Our sampling approach was to establish strata that were relevant for benchmarking purposes while allowing for generalizability and adequate sample size across groups. Specifically, we aimed to obtain a sample of small, medium and large firms that were representative of the range of construction industry sub-sectors operating across all geographic regions in Manitoba. Then we determined the key stratification variables by considering a three-way combination of construction sub-sectors (18 industry codes), firm size (large/medium: ≥ 20 FTEs, small: 5 to 19.99 FTEs, very small: >0 to 4.99 FTEs), and geographic regions (7 regions and 1 group for out-of-province firms) in Manitoba. Using these key stratification variables, we enumerated the eligible population of target firms within each of the cells defined by the combined strata. Based on anticipated resources and previous experience with similar research projects, we then created a set of sampling rules to obtain a random sample of firms from the pool of eligible firms within each cell. Random sampling was conducted using the 'surveyselect' procedure with an initial seed value of 11801585.

Recruitment

The research team obtained a list of organizations from WCB Manitoba containing the name, address, and phone number of the key contact at each organization. Participants were recruited by two research assistants from IWH. A script was followed at the time of initial contact. The person on the phone was informed about the study and asked for their help in identifying and providing IWH with the contact information of the person who is most knowledgeable about occupational health and safety within the organization. Once the appropriate key informant was identified, the recruiter made at least three contact attempts to reach them. Recruitment was conducted from November 20, 2017 to October 31, 2018. Any construction organization in Manitoba that wanted to participate was permitted to do so, even if they were not from the study sample list. During the recruitment phase, CSAM advertised the study to their membership by posting promotional materials in targeted magazines, on their website, and via social media. A short recruitment video was also developed to help promote the study.

Data Collection

Data were collected using Qualtrics™ (www.qualtrics.com), an online survey software platform. Research assistants recorded responses directly into Qualtrics for surveys administered over the telephone. Surveys completed by participants online were recorded into Qualtrics via a survey link sent in an email from the research assistants. Online respondents were required to enter their unique 4-digit study ID number provided to them in the recruitment email to access the survey. Participants also had the option to complete a hardcopy paper questionnaire, which was mailed to them in a package containing the informed consent, cover letter, and a preaddressed and stamped return envelope.

Participants were offered a free benchmarking report comparing their safety performance to other organizations in the industry. In the benchmarking report, an organization's scores are averaged across questions in each of the survey measures. The scores were shown against scores of all participating organizations and against scores of comparable organizations in their industry group. A colour-coding scheme was used to categorize an organization's performance and to help them better understand their results. The report was further used to identify gaps and opportunities in their OHS programs and to suggest areas to improve their future OHS performance. The University of Toronto's research ethics review board approved the study protocol.

Organizational and Management Metrics

Organizational policies and practices were measured using the Organizational Policies and Practices (OPP) Questionnaire. The OPP has been shown to be reliable and valid (Amick, 2000; Williams, 2005; Cullen, 2005). For this project, we augmented the OPP with a hazard identification and control measure based on the OSHA Form 33 (Occupational Safety and Health Administration, 2008). We expected hazard identification and control to be an important policy within a broad spectrum of injury and illness prevention programs. There are six dimensions of the OPP:

- 1) *Safety practices (SP)*: Practices that an organization engages in to protect employee safety, including maintaining safe work environments and taking corrective and proactive actions to rectify unsafe conditions (6 items).
- 2) *Hazard identification and control (HDC)*: Practices in support of identifying hazards in the workplace and then reducing hazard risk through engineering controls, personal protective equipment or administrative controls (10 items).
- 3) *Ergonomic practices (EP)*: Practices aimed at reducing ergonomic hazards through job design, redesign and procurement policies and practices (4 items).
- 4) *Safety leadership (SL)*: Upper management's commitment and participation in safety issues, which is visible in management's involvement, commitment of organizational resources and people's time to promote safety, and active efforts to balance economic and OSH actions (6 items).
- 5) *Disability management policies and practices (DM)*: Policies, procedures and practices to support early intervention post-injury and communication and coordination of care with health-care providers for timely return to work, including education and accommodation in and after return to work to support staying at work (7 items).
- 6) *Employee engagement (EE)*: The extent the organization involves employees in meaningful decision-making, where there is trust between management and employees, and openness to share information in a cooperative work environment (4 items).

IWH Organizational Performance Metric (OPM): Safety culture was captured using the IWH-OPM, which has been shown to be reliable and valid (Amick B and Saunders R., 2013). The IWH-OPM is brief inventory of key characteristics of an organization's OHS performance to understand and classify an organization as a high, medium or low performer. For each of 8 questions, the respondent endorses the percent of time on a five-point scale from 0-20% to 80-100% for each question (8 items).

Safety Culture Assessment (SCA): This is a measure used by SAFE Work Manitoba to assess the strength of an organization's safety culture and how it changes in the province over time. Safety culture is defined by SAFE Work Manitoba as a set of shared values and beliefs that influence actions and practices regarding workplace safety and health, shaping how decisions are made, how the organization operates, and how peers and leadership build safe and healthy workplaces (12 items).

Workplace Safety & Health Committee (WSHC) or Representative (WSH): Practices that examine how well your committee/ representative is functioning in supporting to build a safe and healthy workplace (5 items).

Each scale was scored as a summated average, with any scale with less than 80% of the information complete assigned as 'missing'.

Dependent Variables

For examining the relationship of the leading indicators to lagging indicators we used the following measures constructed from the WCB claims data.

- 1) *Total Claim Rate*: This rate was our primary outcome, as it is the key metric all stakeholders use to assess OHS performance. For each year under study, this rate was constructed as the count of allowed claims (both loss-time and no-loss-time) from a firm with accident date during the year of interest divided by an estimate of the number of full-time equivalents (FTEs) at the firm during the year of interest.
- 2) *Loss-Time Claim Rate*: This outcome is similar to total claim rate but included only allowed loss-time claims in the numerator.
- 3) *No-Loss-Time Claim Rate*: This outcome is similar to total claim rate but included only allowed no-loss-time claims in the numerator
- 4) *Musculoskeletal Injury Claim Rate*: This rate is similar to the lost-time claim rate but included only allowed lost-time claims for musculoskeletal disorders in the numerator.
- 5) *Claim Costs*: The cost amounts were aggregated at the level of the employer-CU-year, i.e., rolled up across all claims for a given employer + CU + accident year combination, and broken down by both expense group (wage loss, healthcare, vocational rehab, fatality, daily living support, impairment awards, pension expenses, all other [e.g., legal fees]) and subgroup (i.e., for each employer + CU + year, there was one observation containing the aggregated costs across all associated claims, broken down by the expense categories).

Covariates

The following covariates were obtained from the WCB administrative data: industry rate group and geographic region.

Covariates were also obtained from the questionnaire: number of workers at jobsite in an average week (<5, 5-19, 20-99, 100-299, 300-500), jobsite type (new construction, maintenance, renovation), jobsite position of respondent (prime contractor, general contractor [non-prime], sub-contractor/trade contractor), number of types of safety training employees received (0-13), and whether company's health and safety management system was COR™/SECOR™ certified.

Data Analysis

In preliminary analysis, we examined the data for missing values and created a merged de-identified dataset. We assessed the inter-item correlation matrix to observe how well the items relate to one another. The data analysis for this project was generated using SAS software Version 9.4. Copyright © 2013 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.

Objective 1: To examine the reliability and validity of the OHS organizational and management metrics.

Cronbach's alpha and the corrected item total correlation (ITC) were used to assess scale internal consistency (Cronbach, 1951). Internal consistency is a measure of the precision. An ITC of each item with its theoretical subscale should be at least 0.40 (Ware 1997). Cronbach's alphas should be greater than 0.7, but some proposed scales measure broad concepts with few items and thus alphas may be in the 0.6 to 0.7 range. We examined the properties of the original scales and the final scales that emerge from the confirmatory factor analysis (CFA).

Objective 2: To examine the relationships between historical Workers' Compensation Board (WCB) claim rates and organizational and management metrics.

We modelled the relationship between current organizational policies and practices, safety culture, SAFE Work Manitoba Safety Culture Assessment, and workplace health and safety committee functioning and injuries and illnesses using Negative Binomial regression (SAS® GlimMix module™), with claim rates and costs per claim by firm as the dependent variable and the firm's leading indicator score as an independent factor. GlimMix provides external studentized residuals for each observation. The benefit of studentized residuals is that they quantify how large the residuals are in standard deviation units, and therefore can be easily used to identify outliers. If an observation has a studentized residual that is larger than 3 (in absolute value) it is considered to be an outlier. Subsequent regression removing these outliers provides evidence whether these are influential (i.e., the relative risk changes dramatically by deleting these outliers).

Firm rates were calculated as the sum of claims over a 5-year period (2012 – 2016) divided by 5*FTE1 (i.e., average FTE for the same time period) and multiplied by 100. Costs for injury and illness were also summed over the same time period.

Ten observations had extreme (some nonsensical) outliers for all (lost time and no-lost time) claim rates (60,800.00 claims per 100 FTE, 2,857.14 claims per 100 FTE, 1,194.87 claims per 100 FTE, 260.59 claims per 100 FTE, 245.39 claims per 100 FTE, 196.33 claims per 100 FTE, 190.33 claims per 100 FTE, 160.00 claims per 100, 143.15 claims per 100 FTE and 126.42 claims per 100 FTE). They were deleted from further analysis. Any firm that had a missing or zero value for FTE1 was also deleted.

Objective 3: To develop and disseminate evidence-based benchmarks representative of all organizations in all regions in the Manitoba construction sector.

Post-sampling weights were introduced to account for the observed differential non-response that would potentially bias population estimates. For this study, we also needed to account for the sampling strategy, as we had different sampling percentages by strata. The aim of weighting is to make the selected sample approximate the reference population from which the data was sampled, so that the results will be generalizable to the reference population. A weight is given to each respondent in the sample. A weight can be used as an expansion weight to calculate

population totals, means, and ratios. To be used in regression analyses, the weight has to be adjusted so that the sum of the weights equal to the sample size for a given analyses. This is accomplished by dividing each weight by the mean weight.

In this case, all organizations identified were stratified by industrial rate group, region, and firm size (population open). Among these, a number of firms in each stratum were identified as open for sampling (sample open). The probability of a firm in a given stratum being selected is the ratio of the sample open to population open. The inverse of this probability was our stage 1 weight. In stage 2, firms identified in the open sample were contacted and some completed the survey (completed surveys). The probability of completing the survey within stratum was the ratio: (completed survey)/ (sample open). The inverse of this probability was the stage 2 weight. Multiplying the two weights forms the final weight for analysis.

Because there was variability in the participation rates by industry rate code, region, and firm size, the Institute for Work & Health took advantage of the administrative data provided in the WCB sample to develop propensity scores. The propensity scores took in to account a range of factors including firm size, and historical claims rates, to examine what predicted whether a firm participated or did not participate. The propensity scores also took in to account the region and rate code. These scores have been used to ensure the benchmarks are as representative as possible of all firms in the participating rate codes.

Objective 4: To develop and test the usability of a benchmarking dashboard to help organizations improve their OHS performance over time.

A dashboard was developed using the information on benchmarks for the leading indicators in a common platform for developing dashboards. A dashboard is a technology for presenting information to a user community. Much the same way we think about an automobile dashboard, a performance dashboard monitors the major functions at a glance to gauge exactly how well an organization is doing, providing a “snapshot” of an organization’s performance. The dashboard was developed to support construction firms in the assessment of their organizational occupational health and safety performance. IWH partnered with CSAM to complete a simple usability assessment of the beta version of the dashboard before it went live. We targeted leaders across sub-sectors to participate in the usability assessment. All participants were asked to use the tool and complete a short survey, writing their comments to specific questions about the dashboard design, functionality, and usefulness. Based on the input from the participants, the dashboard was made available to all employers in the construction sector. Importantly, the research data behind the dashboard was aggregated as benchmarks and fully de-identified. We used propensity weights to make the benchmarks representative of the firms in the WCB MB sampling frame.

Decision-Making Criteria

The research team used the critical criteria developed from the Ontario Leading Indicator's Project (OLIP) to guide our decision logic on selecting key leading indicators and making recommendations to key stakeholders (see below Table 1).

Table 1. Decision Making Criteria¹ for Assessment of Leading Indicator Measures

	Measurement Attribute	Required Criteria	Priority
Item Level	Missing Data	> 20% missing responses on an item (relative to # responding to any portion of that scale) suggests problematic item, consider removing	Secondary
Item Level	Distribution Across Response Options	-some response options with 0% endorsement suggests problematic item	Secondary
Item Level / Relative to Scale	Internal Consistency	For items, values below bottom cut-off suggest lack of relationship, above highest cut-off suggest redundancy: -Inter-item correlations for items on same scale lie between 0.20 and 0.50 with none > 0.70 -Item total correlations lie between 0.40 and 0.60 with none > 0.90 -Cronbach's a does not improve > 10% upon removal of an item	Secondary
Scale Level	Scaling Success	Scaling success defined as % of scale items with item-to-scale correlations (ITC) higher than all correlation with other scales + 2 standard errors, with cut-off of 90% to demonstrate item alignment with subscales is good.	Secondary
Scale Level	Internal Consistency	Cronbach's a > 0.70	Primary
Scale Level	Ceiling / Floor Effects	Scales have <15% of respondents scoring at ceiling or at floor	Secondary
Scale Level	Structural Validity	In confirmatory factor analysis, look for adequate fit to the originally proposed structure: - Overall χ^2 statistic: non-significant overall χ^2 test - Standardized Root Mean Residual (< 0.08) - Root Mean Square Error of Approximation (RMSEA): 0.05 to 0.08 - Parsimonious Goodness-of-fit (PGFI): 0.90 to 1.00 - Comparative fit (CFI): 0.90 to 1.00	Primary

¹Citations to support criteria provided in methods section

Results

Reliability and validity of the OHS organizational and management metrics

Table 2 provides summary descriptive statistics of the participating firms. Based on our sampling approach, a total of 4,198 firms (69%) were selected for recruitment out of the 6,122

population of target firms. Overall, 828 firms from the purposefully drawn sample participated representing 19.7% of the random sample and 22.1% of the 3,739 firms that were contacted for participation. An additional 82 volunteer firms also participated yielding 910 responses overall. Data about firms, derived from the WCB administrative data, were not available for the 33 of the 82 volunteer firms. The firms were distributed across 18 industrial rate groups and 8 geographic regions.

Table 2. Description of Sample

Attribute	Level	N=910	%
Sampling Source	Sampled from Sampling Frame	828	91.0%
	Sampled from Non-Sampling Frame	49	5.4%
	Volunteer	33	3.6%
Rate Group	Building Construction	268	29.5%
	Concrete Work	39	4.3%
	Constructing Dams, Wharves, Bridges & Steel	18	2.0%
	Drywall & Stucco Contracting	36	4.0%
	Electrical Contracting	126	13.8%
	Flooring & Tiling	28	3.1%
	Installing Case Goods & Fixtures	24	2.5%
	Installing Doors & Windows	14	1.5%
	Installing Elevators	5	0.5%
	Installing Heavy Machinery	19	2.1%
	Installing Metal Products	24	2.6%
	Landscaping	34	3.7%
	Painting & Decorating	38	4.2%
	Plumbing, Insulating & Mechanical	121	13.3%
	Railway Construction	5	0.5%
	Roofing & Eaves-troughing	47	5.2%
	Tower & Energy Construction	21	2.3%
	Wrecking & Moving Buildings	10	1.1%
	Unknown	33	3.6%
Geographical Region	Brandon & Steinbach	91	10.0%
	Dauphin & Neepawa	10	1.1%
	Pas & Flin Flon & Thom & Swan River	19	2.1%
	Portage & Selkirk & Morden-Winkler	53	5.8%
	Winnipeg	372	40.9%
	North Rural	16	1.8%
	South Rural	207	22.7%
	Out-of-Province	109	12.0%
	Unknown	33	3.6%
Firm Size (derived)	Very Small (< 5 FTE)	390	42.9%
	Small ($\geq 5 - 19$ FTE)	310	34.1%
	Large/Medium (≥ 20 FTE)	177	19.5%
	Unknown	33	3.6%
Number of company employees and sub-contractors at job site	Less than 5 workers	524	57.6%
	5 to 19 workers	289	31.8%
	20 to 99 workers	81	8.9%
	100 to 299 workers	11	1.2%
	300 to 500 workers	3	0.3%
	More than 500 workers	1	0.1%
	Unknown	1	0.1%

Scale/subscale level findings for scaling success and internal consistency are presented in Table 3. Regarding scaling success, all ITCs lie between 0.4 and 0.9 for the items from each scale/subscale, with 90% of ITCs higher than all correlations with others scales/subscales + 2 standard errors for every scale/subscale except Safety Practices (83%), Hazard Detection and Control (90%), and Safety Leadership (83%). Cronbach's α is > 0.70 for all scales/subscales, and in fact is > 0.80 for all but Safety Practices and Workplace Safety and Health Committee/Rep, indicating adequate to good internal consistency for all.

Structural validity was assessed using Confirmatory Factor Analysis (CFA) with model fit results presented in Table 4. The χ^2 goodness of fit criterion was not met for any of the ten CFA models but significant χ^2 may arise for reasons other than poor fit (Bollen, 1989). All other goodness of fit indices (RMSEA, SRMR, CFI and GFI) were at least adequate for all ten models (Hu and Bentler, 1999), with several reaching "good fit" criteria, suggesting that the proposed factor structure for the four measurement instruments is valid for this sample of workplaces. The factor loadings were all clean (no complex loadings) and above 0.4. The simple factor structures fit the data well and no item-level correlations were required to improve model fit.

Table 5 presents a summary of the assessment of each scale/subscale in relation to each decision-making criterion. Generally, the secondary criteria were met by all scales/subscales with exceptions for scaling success for two of the subscales. All scales/subscales met the criterion for missing data. The criteria for item distribution were met, although most of the items showed a skewed distribution with the majority of responses in the top two categories. Item-level internal consistency criteria were met, although some of the inter-item correlations and item-total correlations were high (>0.70) suggesting that some items could be eliminated without affecting measurement performance. The criterion for internal consistency, a priority consideration, was met for all scales/subscales. CFA demonstrated at least adequate fit for all four measurement instruments indicating structural validity.

Overall, the scales show good reliability and acceptable validity.

Table 3. Subscale distributions, Cronbach's alpha, ITCs > 0.40 and ITCs > 0.90, scaling success
 (% of item scale correlations at least 2 standard errors greater than the correlation of the item to other scales)

Scale	Subscale	# Items	Mean	SD	Range	Missing		Ceiling		Cronbach's α	ITCs for the scale > 0.40		ITCs for the scale > 0.90		Scaling Success %
						N	%	N	%		N	%	N	%	
OPP	Safety Practices (SP)	6	3.62	0.51	[0,4]	9	1.0	337	37	0.77	6/6	100	0/6	0	83
	Hazard Detection and Control (HDC)	10	3.38	0.70	[0,4]	25	2.7	191	22	0.85	10/10	100	0/10	0	90
	Safety Leadership (SL)	6	3.48	0.73	[0,4]	26	2.9	330	37	0.83	6/6	100	0/10	0	83
	Ergonomic Practices (EP)	4	2.82	1.04	[0,4]	27	3.0	178	20	0.83	4/4	100	0/10	0	100
	Disability Management (DM)	7	3.06	1.33	[0,4]	38	4.2	337	37	0.95	7/7	100	0/7	0	100
	Employee Engagement (EE)	4	3.54	0.70	[0,4]	33	3.6	408	47	0.88	4/4	100	0/4	0	100
IWH-OPM	Organizational Performance Metric	8	3.66	0.48	[0,4]	40	4.3	316	36	0.83	7/8	88	0/8	0	N/A ²
SCA	Safety Culture Assessment	12	3.64	0.48	[0,4]	40	4.3	233	27	0.87	11/12	92	0/12	0	N/A ²
WSH ¹	Workplace Safety and Health Committee/Rep	5	3.49	0.67	[0,4]	10	1.6	251	42	0.76	5/5	100	0/5	0	N/A ²

¹ Only organizations with a Workplace Safety and Health Committee or Workplace Safety and Health Representative were asked to complete the WSH questions. (n=610)

² Not Applicable as there is only one scale.

Table 4. Confirmatory Factor Analyses Summary¹

Scale	χ^2	df	p-value	RMSEA	(95% CI)	SRMR	Adjusted GFI	Bentler CFI
OPP	7181.75	629	<.0001	0.11	(0.11, 0.11)	0.10	0.51	0.57
➤ SP	71.78	9	<.0001	0.09	(0.07, 0.11)	0.03	0.94	0.96
➤ HDC	184.33	35	<.0001	0.07	(0.06, 0.08)	0.04	0.93	0.96
➤ EP	67.52	1	<.0001	0.19	(0.15, 0.23)	0.02	0.82	0.97
➤ SL	56.30	9	<.0001	0.08	(0.06, 0.10)	0.02	0.95	0.98
➤ DM	278.91	14	<.0001	0.15	(0.13, 0.16)	0.01	0.82	0.98
➤ EE	68.47	2	<.0001	0.19	(0.16, 0.24)	0.02	0.80	0.98
IWH-OPM	154.54	20	<.0001	0.09	(0.08, 0.10)	0.04	0.92	0.95
SCA	468.59	54	<.0001	0.09	(0.09, 0.10)	0.05	0.88	0.88
WSH	13.61	5	0.022	0.05	(0.02, 0.09)	0.02	0.97	0.99

¹ Fit using robust method

Table 5. Summary assessment of applying decision making criteria for each scale / subscale

(✓ indicates basic criteria met, ✓✓ good to excellent criteria met, xx or gray shading indicates criteria not met, NA means Not Applicable)

	Missing Data <20% (✓)	Item Distribution No response option with 0% (✓)	Item Level Internal Consistency item correlations >0.2 (✓) <0.7 (*) 0.4<ITC<0.9	Scale Distribution < 15% at ceiling or floor (✓)	Scaling Success >90% (✓)	Scale Level Internal Consistency Cronbach's $\alpha > 0.70$ (✓)	Structural Validity				
							CFA fit Not Met (xx) Acceptable (✓) Good (✓✓)				
							χ^2	RMSEA	SRMR	GFI	CFI
<i>Priority</i>	<i>secondary</i>	<i>secondary</i>	<i>secondary</i>	<i>secondary</i>	<i>secondary</i>	<i>primary</i>	<i>primary</i>				
OPP SP	✓	✓	✓*			✓	xx	xx	xx	✓	xx
OPP HDC	✓	✓	✓*		✓	✓	xx	✓	✓	✓	✓✓
OPP EP	✓	✓	✓*		✓	✓	xx	xx	✓	xx	✓✓
OPP SL	✓	✓	✓			✓	xx	✓	✓	✓	✓✓
OPP DM	✓	✓	✓		✓	✓	xx	xx	✓	xx	✓✓
OPP EE	✓	✓	✓		✓	✓	xx	xx	✓	xx	✓✓
IWH-OPM	✓	✓	✓*		NA	✓	xx	✓	✓	✓	✓
SCA	✓	✓	✓		NA	✓	xx	✓	✓	xx	xx
WSH	✓	✓	✓*		NA	✓	xx	✓✓	✓	✓✓	✓✓

Relationship between past injury and illness claim rates and current leading indicators

The dataset containing claim rates included N=812 observations, which were grouped into Large/Medium firms (n=177), Small firms (n=255) and Very Small firms (n=380). Thirty-three of the firms were not in the sample and were subsequently deleted from the dataset when calculating regressions for rates and costs by scales and other covariates. A Negative Binomial distribution for the rates was used in Proc GlimMix to calculate the regressions for claim rates.

We used the WCB dataset for sampling firms (N=6,122) and obtained a subset of the data for survey respondents. The WCB has about 2% of the firms in the sampling frame which are separated into 2 or more different industries. Our survey was conducted at the firm-level and did not consider if an organization belonged to different industries. Most of the 812 firms in the study operated under only one industry. There were 31 (3.8%) firms with multiple industries (determined from WCB dataset); 30 firms with 2 industries and 1 firm with 3 industries. For these firms, FTE was associated with the industry that was deemed most relevant based on either having the largest FTE size, or where FTE was missing, the largest payroll size as provide by WCB. The FTE's were determined for 2016, annual FTE's for the 5-year period were **not** available in the dataset. The 31 firms with multiple industries were classified as Large/Medium (n=12), Small (n=13), and Very Small (n=6).

The FTE used in calculating claim rates was multiplied by 5 to represent the total FTE in a 5-year window. (Note this assumes the firms were in operation during the entire 5-year period and the annual FTE's did not change much yearly). Claims are also summed over the 5-year period. $\text{Claim Rates} = \text{Sum of claims over 5-year period} / (5 * \text{FTE}) * 100$. For the 31 firms with multiple industries, claims were summed over all their industries and assigned to the industry deemed most relevant.

Covariates for Regressions of Claim Rates and Costs

Covariates from the WCB administrative data were included in the regressions of claim rates and costs of injuries to produce adjusted regressions. These covariates included 18 construction industry groups and 8 geographical regions, which were used in defining stratum for data collection.

Industry Rate Group	Description	Number in Population Sample	Surveys Completed (N = 910) # (%)
40602	Installing Elevators	13	5 (38.5%)
40904	Railway Construction	26	5 (19.2%)
40103	Flooring & Tiling	239	28 (11.7%)
40112	Installing Case Goods & Fixtures	172	24 (14.0%)
40115	Landscaping	325	34 (10.5%)
40203	Electrical Contracting	419	126 (30.1%)
40102	Building Construction	1,063	268 (25.2%)
40105	Painting & Decorating	235	38 (16.2%)
40204	Plumbing, Insulating & Mechanical	479	121 (25.3%)
40603	Installing Heavy Machinery	108	19 (17.6%)
40903	Tower & Energy Construction	86	21 (24.4%)
40104	Installing Metal Products	90	24 (26.7%)
40108	Drywall & Stucco Contracting	265	36 (13.6%)
40109	Installing Doors & Windows	105	14 (13.3%)
40110	Concrete Work	227	39 (17.2%)
40502	Constructing Dams, Wharves, Bridges & Steel	34	18 (52.9%)
40106	Wrecking & Moving Buildings	28	10 (35.7%)
40403	Roofing & Eaves-troughing	284	47 (16.5%)
Total		4,198	877 (20.9%)
Not in Sample			33

Region	Number in Population Sample	Surveys Completed N = 910 # (%)
R1 Winnipeg	1418	372 (26.2%)
R2 Brandon & Steinbach	429	91 (21.2%)
R3 Portage & Selkirk & Morden-Winkler	330	53 (16.1%)
R4 Pas & Flin Flon & Thom & Swan River	121	19 (15.7%)
R5 Dauphin & Neepawa	66	10 (15.2%)
R6 North Rural	132	16 (12.1%)
R7 South Rural	1120	207 (18.5%)
R8 Out-of-Province	582	109 (18.7%)
Total	4,198	877 (20.9%)
Not in sample		33

Covariates were also obtained from the survey:

Covariate Description	Response Levels	N (%)
Job Site		
<i>Number of Workers</i>	Less than 5	524 (57.6%)
	5 – 19	289 (31.8%)
	20 - 99	81 (8.9%)
	100 - 299	11 (1.2%)
	300 - 500	3 (0.3%)
	More than 500	1 (0.1%)
	Missing	1 (0.1%)
<i>Jobsite Type</i>	New Construction	500 (54.9%)
	Maintenance	104 (11.4%)
	Renovation	304 (33.4%)
	Missing	2 (0.2%)
<i>Respondents Jobsite Position</i>	The prime contractor	288 (31.6%)
	A general contractor, non-prime	72 (7.9%)
	A sub-contractor/trade contractor	530 (58.2%)
	Other	17 (1.9%)
	Missing	3 (0.3%)

Covariate Description	Response Level	N (%)
Company		
<i>No. of Types of Safety Training Received</i>	0	64 (7.0%)
	1	35 (3.8%)
	2	25 (2.7%)
	3	33 (3.6%)
	4	38 (4.2%)
	5	56 (6.2%)
	6	61 (6.7%)
	7	63 (6.9%)
	8	98 (10.8%)
	9	90 (9.9%)
	10	143 (15.7%)
	11	165 (18.1%)
	12	23 (2.5%)
	13	16 (1.8%)
	Missing	37 (4.1%)
<i>COR™/SECOR™ Certification</i>	Yes	520 (57.1%)
	No	390 (42.9%)

Claim Rates (Adjusted Regressions)

For claim rates, we found statistically significant effects consistently among large/medium organizations for all measures after controlling for a range of covariates, except ergonomic practices, disability management, and workplace safety and health committee/representative. This is presented in Tables 6-9 below. Relative risk estimates and their lower and upper confidence limits were produced by the GlimMix procedure and are presented in the regression tables that follow. These estimates are interpreted: (i.e., upper confidence limit less than 1 implies a significant inverse relationship, if lower and upper confidence limits contain the value 1 then the estimate is not significant, if the lower confidence value exceeds 1 then it implies a significant direct relationship). If $RR < 1$ %decrease = $(1 - RR) * 100$ (e.g. $RR = 0.80$ means a 20% reduction in rates) and if $RR > 1$ %increase = $(RR - 1) * 100$ (e.g. $RR = 1.20$ means a 20% increase in rates).

Table 6. Adjusted* Relative Risk (95% Confidence Interval) All (Lost-Time & No-Lost-Time) Claim Rates for Scales by Firm Size

Scale	Lost-Time & No-Lost-Time Claim Rates		
	Large Firms N=177	Small Firms N=255	Very Small Firms N=380
Safety Practice Residuals > 3 Removed	0.60 (0.45 – 0.81) 0.54 (0.41 – 0.71)	0.93 (0.71 – 1.21) 0.96 (0.75 – 1.23)	1.41 (0.97 – 2.07) 1.39 (0.96 – 2.02)
Hazard Detection and Control Residuals > 3 Removed	0.68 (0.52 – 0.90) 0.63 (0.49 – 0.82)	0.94 (0.75 – 1.19) 0.99 (0.79 – 1.23)	1.16 (0.89 – 1.50) 1.19 (0.91 – 1.54)
Ergonomic Practices Residuals > 3 Removed	0.92 (0.79 – 1.06) 0.93 (0.81 – 1.08)	0.98 (0.87 – 1.09) 0.99 (0.89 – 1.07)	1.09 (0.92 – 1.28) 1.04 (0.89 – 1.21)
Safety and Health Leadership Residuals > 3 Removed	0.74 (0.56 – 0.97) 0.72 (0.56 – 0.95)	0.93 (0.76 – 1.15) 1.00 (0.82 – 1.22)	1.28 (0.97 – 1.70) 1.27 (0.95 – 1.70)
Disability Management Residuals > 3 Removed	0.95 (0.82 – 1.11) 0.94 (0.81 – 1.09)	0.97 (0.88 – 1.07) 0.95 (0.87 – 1.05)	1.04 (0.92 – 1.19) 0.98 (0.86 – 1.10)
Employee Engagement Residuals > 3 Removed	0.71 (0.57 – 0.87) 0.71 (0.59 – 0.86)	1.09 (0.87 – 1.37) 1.09 (0.88 – 1.35)	1.09 (0.81 – 1.49) 1.06 (0.77 – 1.44)
Organizational Performance Residuals > 3 Removed	0.69 (0.51 – 0.93) 0.68 (0.51 – 0.90)	1.04 (0.78 – 1.40) 0.86 (0.64 – 1.15)	1.20 (0.78 – 1.84) 1.13 (0.74 – 1.73)
Safety Culture Assessment Residuals > 3 Removed	0.63 (0.47 – 0.84) 0.61 (0.46 – 0.80)	1.00 (0.74 – 1.35) 1.03 (0.78 – 1.37)	1.27 (0.81 – 1.98) 1.14 (0.74 – 1.77)
Workplace Safety and Health Committee/Representative ¹ Residuals > 3 Removed	0.84 (0.67 – 1.06) 0.87 (0.70 – 1.08)	1.04 (0.86 – 1.25) 1.01 (0.84 – 1.22)	1.14 (0.84 – 1.57) 1.23 (0.89 – 1.71)

*All models are adjusted for Industry, Region, Total Number of Workers, Jobsite Type, Respondent Type, Number of Types of Training Received, COR™/SECOR™ certification.

The COR™/SECOR™ covariate (yes/no) is highly significant for large/medium size firms (typically, $p < .0001$), very significant for small firms (typically, $p < .005$), and not significant for very small firms (typically, $p < .20$). But all have positive relative risk estimates for COR™/SECOR™ = “Yes”

Table 7. Adjusted* Relative Risk (95% Confidence Interval) Lost-Time Claim Rates for Scales by Firm Size

Scale	Lost-Time Claim Rates		
	Large Firms N=177	Small Firms N=255	Very Small Firms N=380
Safety Practice Residuals > 3 Removed	0.51 (0.36 – 0.72) 0.49 (0.34 – 0.69)	0.86 (0.64 – 1.15) 0.92 (0.70 – 1.22)	1.65 (1.03 – 2.65) 1.13 (0.72 – 1.79)
Hazard Detection and Control Residuals > 3 Removed	0.60 (0.43 – 0.84) 0.61 (0.44 – 0.84)	0.91 (0.71 – 1.20) 1.03 (0.79 – 1.32)	1.21 (0.89 – 1.65) 1.32 (0.93 – 1.88)
Ergonomic Practices Residuals > 3 Removed	0.86 (0.72 – 1.03) 0.90 (0.76 – 1.08)	1.00 (0.88 – 1.26) 1.01 (0.90 – 1.13)	1.19 (0.99 – 1.44) 0.97 (0.80 – 1.17)
Safety and Health Leadership Residuals > 3 Removed	0.68 (0.49 – 0.95) 0.67 (0.48 – 0.93)	0.88 (0.69 – 1.12) 0.96 (0.76 – 1.21)	1.49 (1.05 – 2.12) 1.82 (1.18 – 2.81)
Disability Management Residuals > 3 Removed	0.96 (0.80 – 1.16) 0.97 (0.80 – 1.17)	1.02 (0.91 – 1.14) 1.01 (0.91 – 1.12)	1.07 (0.92 – 1.26) 0.95 (0.82 – 1.10)
Employee Engagement Residuals > 3 Removed	0.69 (0.54 – 0.88) 0.70 (0.56 – 0.90)	1.09 (0.84 – 1.42) 1.14 (0.89 – 1.46)	1.29 (0.88 – 1.89) 1.22 (0.80 – 1.85)
Organizational Performance Residuals > 3 Removed	0.62 (0.44 – 0.89) 0.66 (0.47 – 0.93)	1.09 (0.77 – 1.54) 1.05 (0.76 – 1.45)	1.03 (0.62 – 1.71) 0.98 (0.58 – 1.65)
Safety Culture Assessment Residuals > 3 Removed	0.57 (0.40 – 0.81) 0.55 (0.39 – 0.78)	1.02 (0.72 – 1.45) 1.05 (0.75 – 1.46)	1.29 (0.75 – 2.23) 1.42 (0.77 – 2.62)
Workplace Safety and Health Committee/Representative ¹ Residuals > 3 Removed	0.82 (0.62 – 1.08) 0.82 (0.63 – 1.08)	1.15 (0.92 – 1.44) 1.07 (0.86 – 1.34)	1.19 (0.78 – 1.81) 1.20 (0.81 – 1.78)

*All models are adjusted for Industry, Region, Total Number of Workers, Jobsite Type, Respondent Type, Number of Types of Training Received, COR™/SECOR™ certification.

Table 8. Adjusted* Relative Risk (95% Confidence Interval) No-Lost Time Claim Rates for Scales by Firm Size

Scale	No-Lost-Time Claim Rates		
	Large Firms N=177	Small Firms N=255	Very Small Firms N=380
Safety Practice Residuals > 3 Removed	0.68 (0.49 – 0.93) 0.54 (0.40 – 0.72)	1.06 (0.80 – 1.40) 1.04 (0.77 – 1.41)	1.13 (0.81 – 1.58) 1.57 (0.97 – 2.56)
Hazard Detection and Control Residuals > 3 Removed	0.72 (0.54 – 0.96) 0.62 (0.47 – 0.82)	0.96 (0.70 – 1.29) 1.02 (0.77 – 1.34)	1.14 (0.79 – 1.65) 1.23 (0.85 – 1.77)
Ergonomic Practices Residuals > 3 Removed	0.97 (0.83 – 1.34) 0.99 (0.85 – 1.15)	0.96 (0.85 – 1.09) 0.98 (0.87 – 1.10)	0.99 (0.80 – 1.22) 0.94 (0.77 – 1.15)
Safety and Health Leadership Residuals > 3 Removed	0.79 (0.59 – 1.05) 0.78 (0.57 – 1.00)	1.03 (0.81 – 1.32) 1.05 (0.83 – 1.32)	1.12 (0.79 – 1.57) 1.18 (0.81 – 1.71)
Disability Management Residuals > 3 Removed	0.97 (0.83 – 1.14) 0.95 (0.82 – 1.11)	0.94 (0.84 – 1.05) 0.92 (0.83 – 1.03)	0.99 (0.85 – 1.17) 0.97 (0.83 – 1.14)
Employee Engagement Residuals > 3 Removed	0.69 (0.55 – 0.87) 0.68 (0.56 – 0.84)	1.10 (0.86 – 1.41) 1.04 (0.82 – 1.33)	1.04 (0.71 – 1.53) 1.20 (0.80 – 1.59)
Organizational Performance Residuals > 3 Removed	0.75 (0.56 – 1.02) 0.73 (0.55 – 0.98)	1.05 (0.75 – 1.46) 1.07 (0.77 – 1.47)	1.49 (0.85 – 2.61) 1.46 (0.83 – 2.56)
Safety Culture Assessment Residuals > 3 Removed	0.67 (0.50 – 0.92) 0.64 (0.49 – 0.87)	1.03 (0.74 – 1.45) 1.03 (0.74 – 1.42)	1.36 (0.76 – 2.43) 1.36 (0.74 – 2.51)
Workplace Safety and Health Committee/Representative ¹ Residuals > 3 Removed	0.82 (0.64 – 1.05) 0.84 (0.67 – 1.07)	0.96 (0.77 – 1.19) 0.92 (0.75 – 1.14)	1.01 (0.64 – 1.58) 1.18 (0.75 – 1.88)

*All models are adjusted for Industry, Region, Total Number of Workers, Jobsite Type, Respondent Type, Number of Types of Training Received, COR™/SECOR™ certification.

Table 9. Adjusted* Relative Risk (95% Confidence Interval) Musculoskeletal Injury Claim Rates for Scales by Firm Size

Scale	Musculoskeletal Injury Claim Rates		
	Large Firms N=177	Small Firms N=255	Very Small Firms N=380
Safety Practice Residuals > 3 Removed	0.48 (0.33 – 0.70) 0.41 (0.28 – 0.59)	0.85 (0.60 – 1.19) 0.94 (0.67 – 1.31)	1.33 (0.70 – 2.52) 1.19 (0.64 – 2.23)
Hazard Detection and Control Residuals > 3 Removed	0.65 (0.45 – 0.93) 0.64 (0.46 – 0.89)	0.95 (0.69 – 1.31) 1.00 (0.72 – 1.38)	0.98 (0.66 – 1.44) 0.99 (0.67 – 1.46)
Ergonomic Practices Residuals > 3 Removed	0.84 (0.69 – 1.02) 0.82 (0.67 – 1.00)	1.01 (0.87 – 1.17) 1.01 (0.88 – 1.17)	0.99 (0.79 – 1.24) 1.04 (0.80 – 1.35)
Safety and Health Leadership Residuals > 3 Removed	0.72 (0.50 – 1.04) 0.63 (0.45 – 0.90)	0.88 (0.67 – 1.16) 0.89 (0.68 – 1.17)	1.11 (0.73 – 1.71) 1.03 (0.67 – 1.59)
Disability Management Residuals > 3 Removed	1.03 (0.82 – 1.28) 1.05 (0.84 – 1.30)	1.00 (0.88 – 1.14) 0.98 (0.87 – 1.11)	1.02 (0.83 – 1.25) 1.05 (0.84 – 1.32)
Employee Engagement Residuals > 3 Removed	0.63 (0.48 – 0.83) 0.62 (0.48 – 0.81)	1.10 (0.82 – 1.48) 1.13 (0.84 – 1.51)	1.28 (0.79 – 2.07) 1.11 (0.71 – 1.73)
Organizational Performance Residuals > 3 Removed	0.58 (0.40 – 0.85) 0.53 (0.38 – 0.76)	1.01 (0.68 – 1.49) 0.84 (0.58 – 1.23)	1.04 (0.54 – 2.02) 0.95 (0.49 – 1.87)
Safety Culture Assessment Residuals > 3 Removed	0.54 (0.36 – 0.79) 0.55 (0.38 – 0.79)	0.94 (0.64 – 1.39) 0.97 (0.66 – 1.42)	1.07 (0.54 – 2.13) 1.12 (0.55 – 2.29)
Workplace Safety and Health Committee/Representative ¹ Residuals > 3 Removed	0.79 (0.59 – 1.08) 0.79 (0.59 – 1.05)	1.07 (0.82 – 1.38) 1.03 (0.80 – 1.33)	1.12 (0.64 – 1.94) 1.15 (0.64 – 2.07)

*All models are adjusted for Industry, Region, Total Number of Workers, Jobsite Type, Respondent Type, Number of Types of Training Received, COR™/SECOR™ certification.

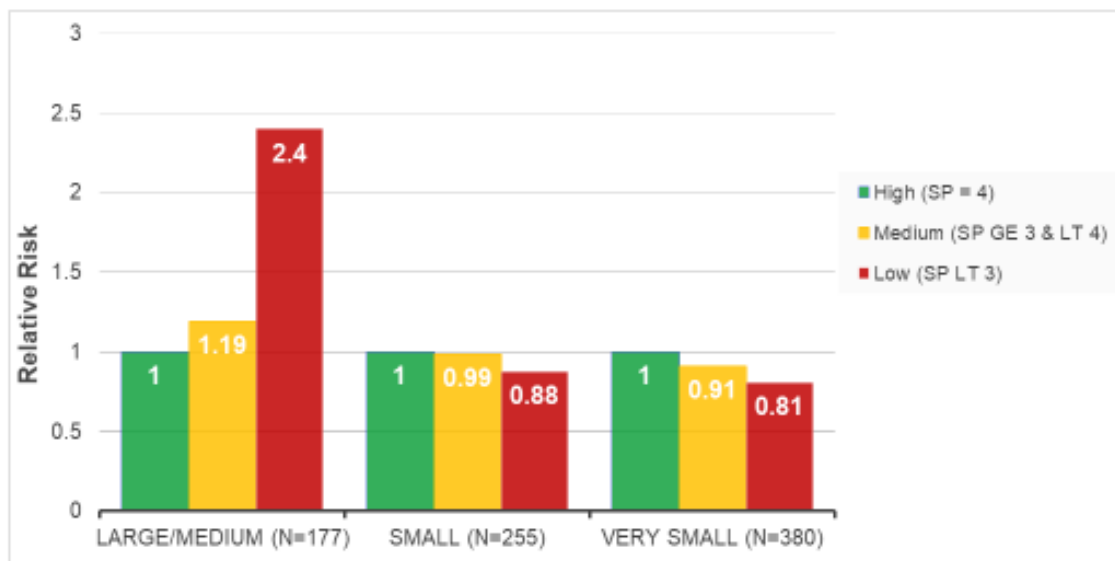
To take a closer look at the relationship between the leading indicator measures and historical injury/illness claims, the response range for each scale score was partitioned into three categories: “High” (best performers – scale score = 4), “Medium” (good performers – scale score 3.0-3.99), and “Low” (poorest performers – scale score below 3). “High” (the best performers) was used as the reference group (i.e., relative risk set to 1).

Figures 1-9 present the relative risk for each leading indicator by high, medium, and low score categories for adjusted all claims rates. The figures illustrate a statistically significant gradient effect among large/medium organizations, indicating that the best performers, i.e., organizations with more OHS policies and practices in place (higher leading indicator scores) tend to have lower injury/illness claims. More specifically, as the leading indicator scores get higher, the injury/illness claims get lower.

Figures 1-9. Relative Risk for Categories of Each Leading Indicator by All Claim Rates

Figure 1. Safety Practices

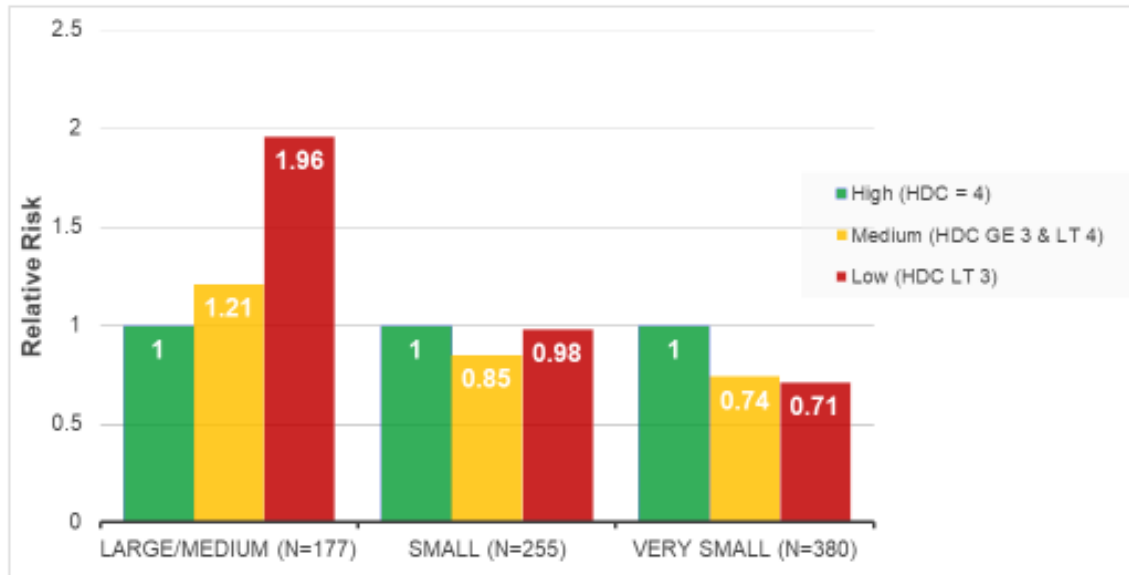
Relative Risk for High-Medium-Low Categories of Safety Practices (SP) Score for Adjusted All Claim Rates



**High is the reference with Relative Risk= 1. Note: the estimate for Large/Medium (Low category) is statistically significant.

Figure 2. Hazard Detection and Control

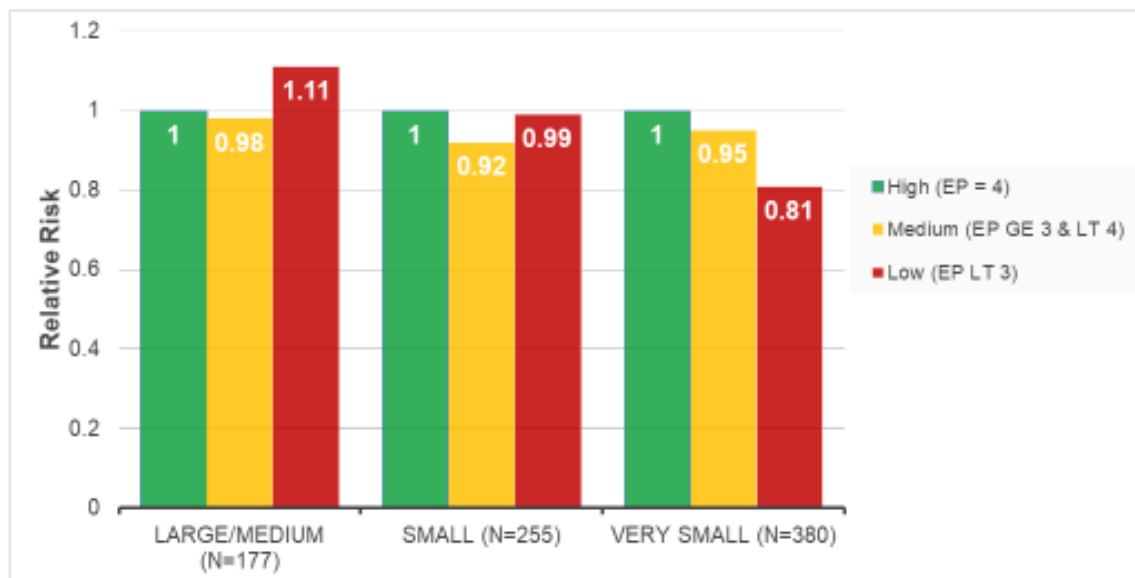
Relative Risk for Categories of High-Medium-Low Hazard Detection & Control (HDC) Score for Adjusted All Claim Rates



*High is the reference with Relative Risk= 1. Note: the estimate for Large/Medium (Low category) is statistically significant.

Figure 3. Ergonomic Practices

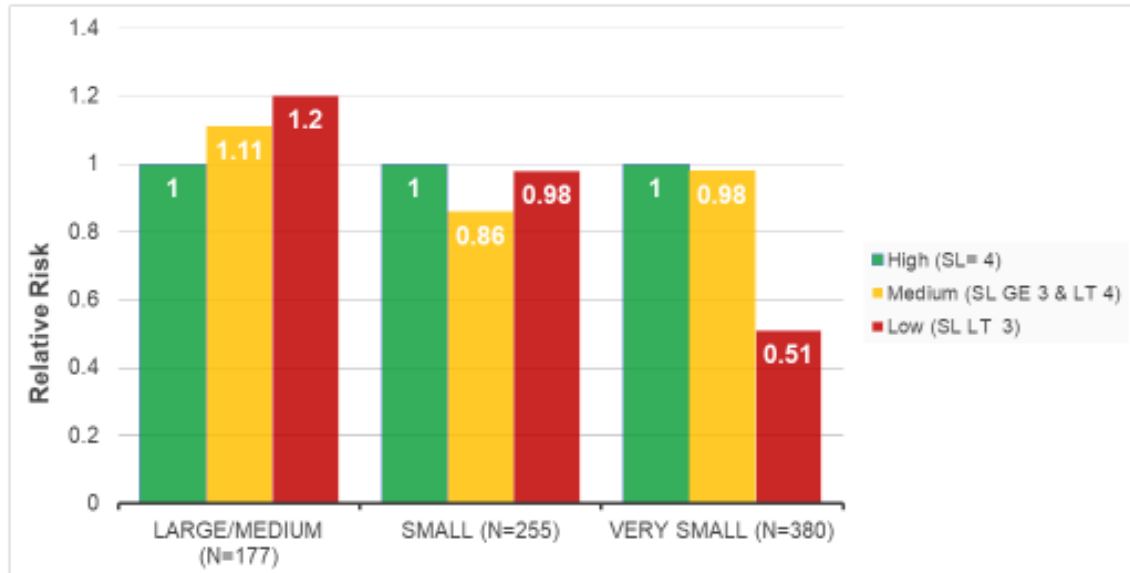
Relative Risk for High-Medium-Low Categories of Ergonomic Practices (EP) Score for All Claim Rates



*High is the reference with Relative Risk= 1

Figure 4. Safety Leadership

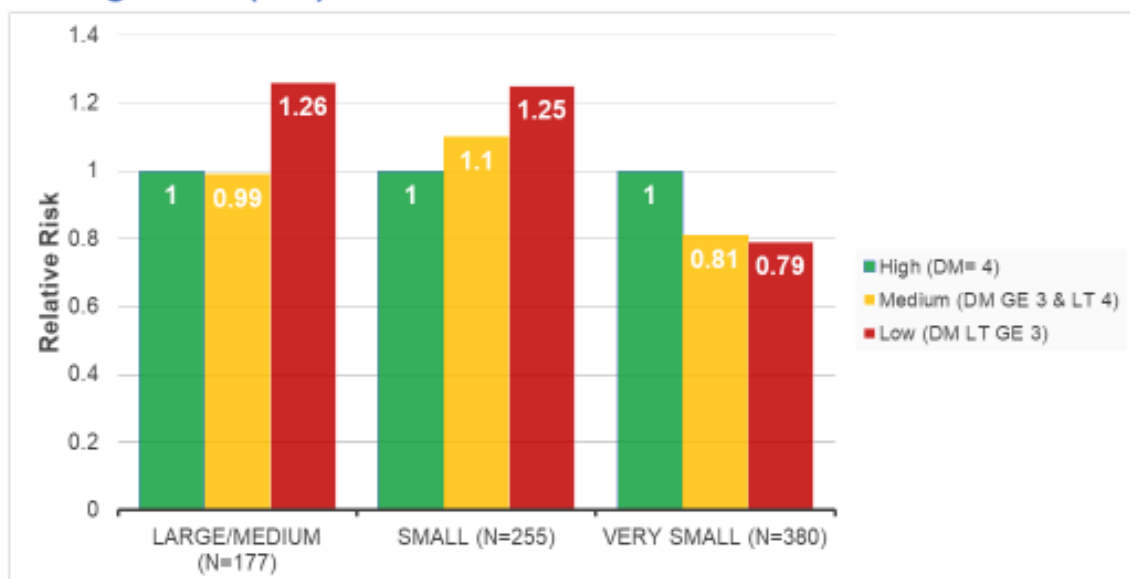
Relative Risk for High-Medium-Low Categories of Safety & Health Leadership (SL) Score for All Claim Rates



**High* is the reference with Relative Risk= 1. Note: the estimate for Very Small (Low category) is statistically significant.

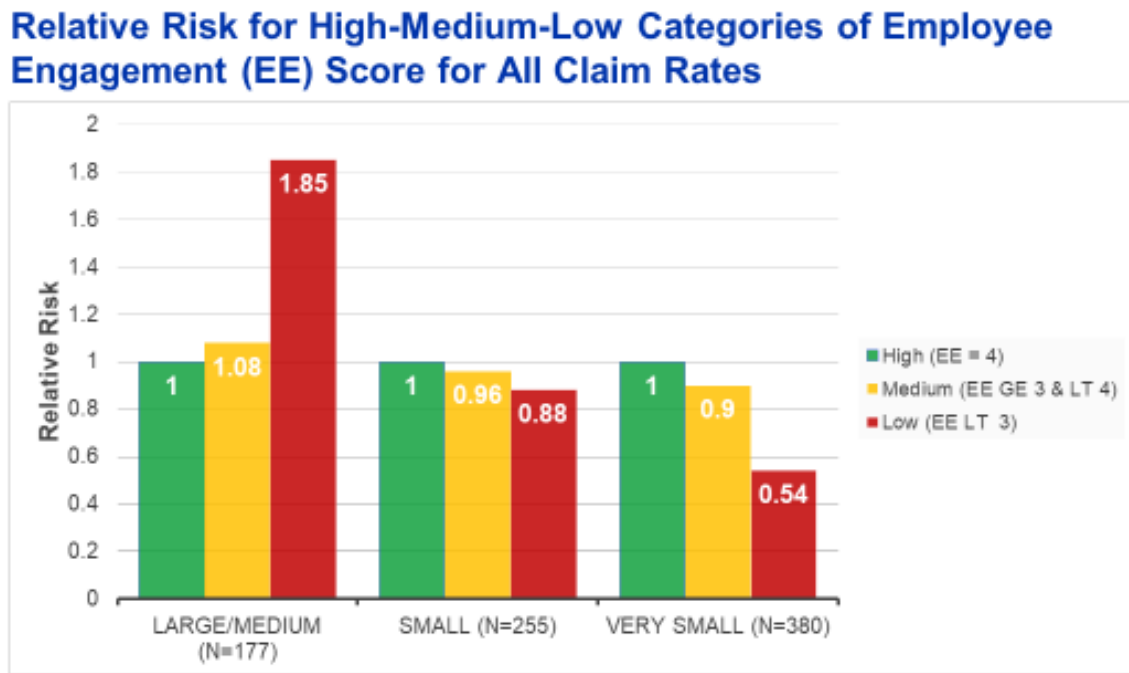
Figure 5. Disability Management

Relative Risk for High-Medium-Low Categories of Disability Management (DM) Score for All Claim Rates



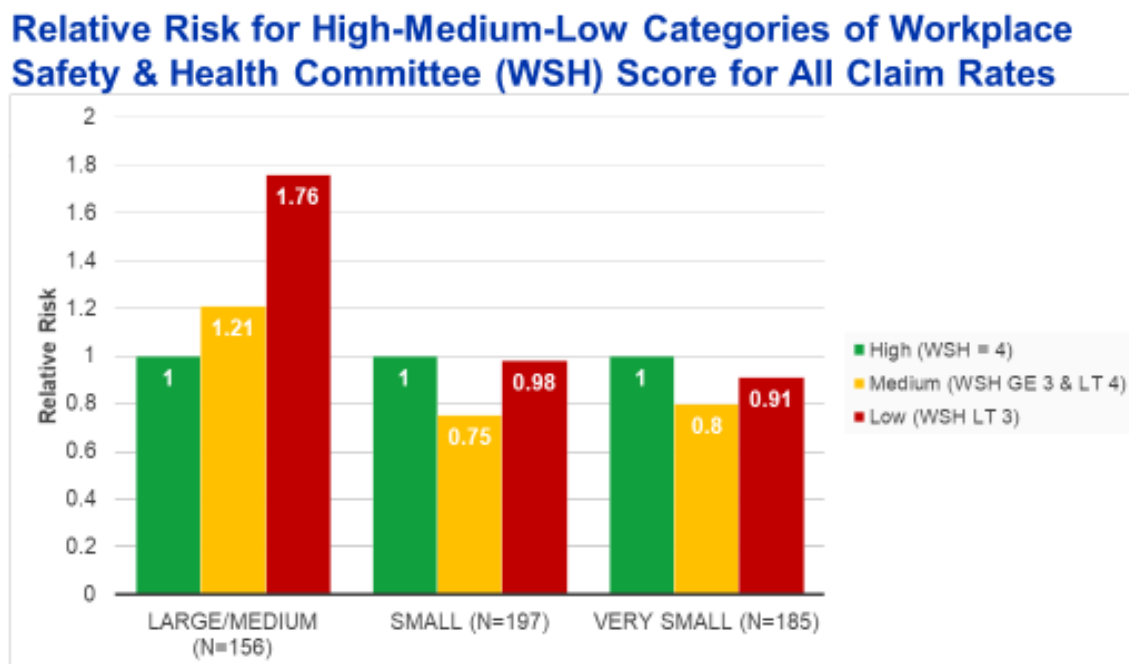
**High* is the reference with Relative Risk= 1

Figure 6. Employee Engagement



**High* is the reference with Relative Risk= 1. Note: the estimate for Large/Medium (Low category) is statistically significant.

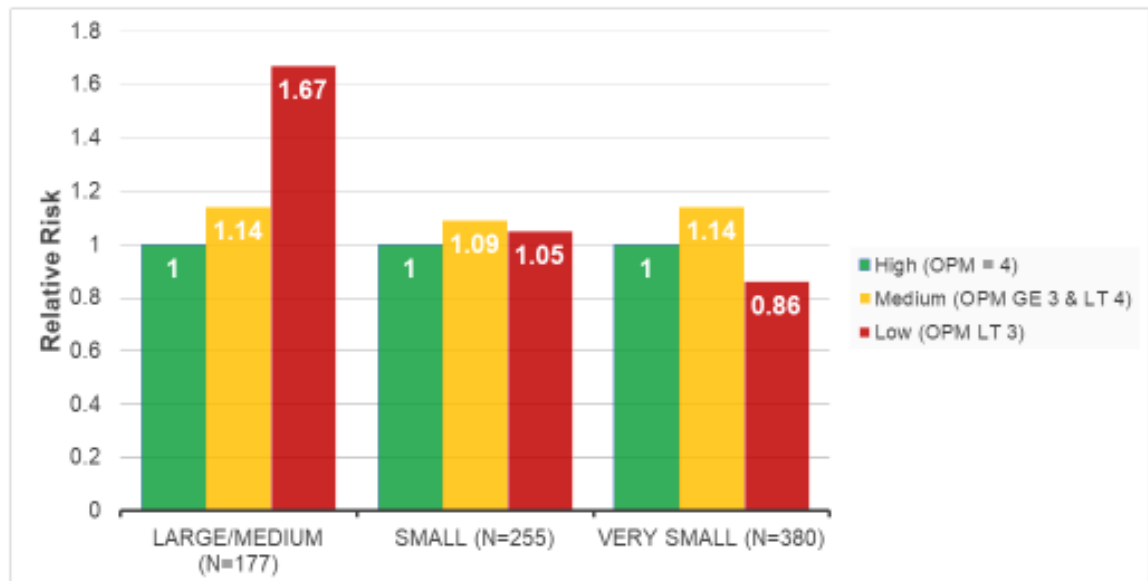
Figure 7. Workplace Safety and Health Committee



**High* is the reference with Relative Risk= 1. Note: the estimates for Large/Medium (Low category) and Small (Medium category) are statistically significant.

Figure 8. IWH-OPM

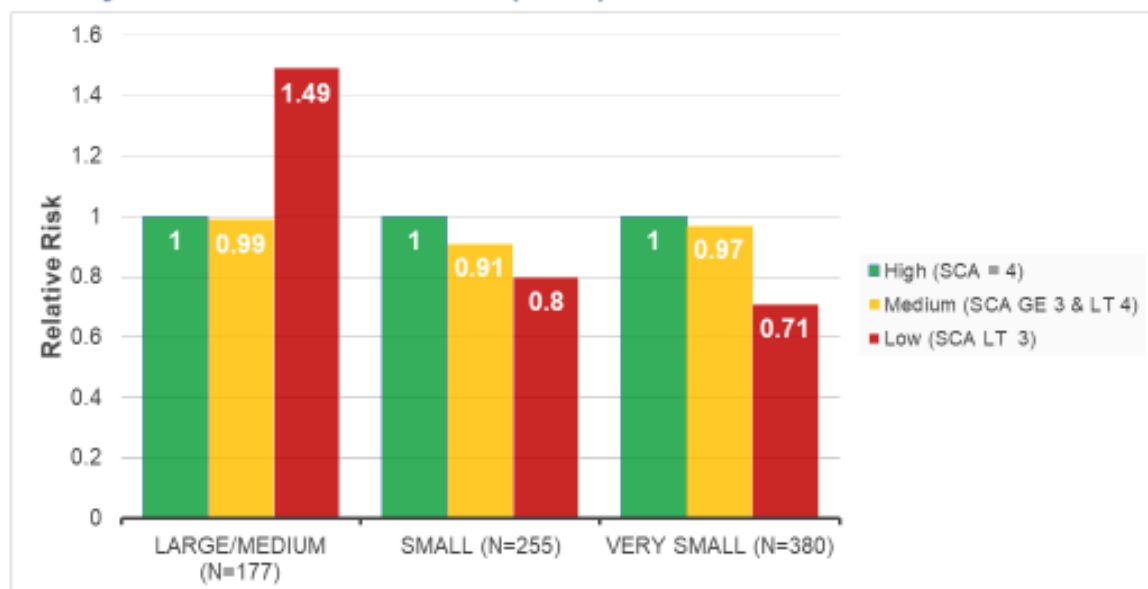
Relative Risk for High-Medium-Low Categories of IWH-OPM Score for All Claim Rates



**High* is the reference with Relative Risk= 1

Figure 9. Safety Culture Assessment

Relative Risk for High-Medium-Low Categories of Manitoba Safety Culture Assessment (SCA) Score for All Claim Rates



**High* is the reference with Relative Risk= 1

For the large/medium firms, there is a clear linear relationship between leading indicator scores and injuries. However, there is no consistency and little meaningful relationships for the small and very small firms. Therefore, we concluded that the simple continuous scale is better. Overall, we find a consistent and clear relationship between leading indicators and a firm's injury rate over the past five years.

Cost per Claim

A Negative Binomial distribution for the rates was used in Proc GlimMix to calculate the regressions for costs per claim. Since rate and cost variables were supplied in the sampling frame provided by WCB Manitoba, only 877 observations out of the total 910 observations could be used. There were 812 valid observations for rates' calculations and all 877 observations for the costs were used.

Overall, for claim costs, we found no statistically significant effects, only a trend among large/medium organizations, showing organizations with better leading indicator scores have lower costs. This is presented in Tables 10-12 below.

Since we were calculating regressions with a small number of observations, we could not afford to lose any observations in the adjustment regressions, therefore we included only the covariates with small numbers of missing values: Industry, Region, Total Number of Workers, Jobsite Type, Respondent Type, Number of Types of Training Received, CORTM/SECORTM certification.

Cost Per Claim (Adjusted Regressions)

The dataset containing non-zero costs/claim contained N=516 observations, which were broken-down into Large/Medium (n=173), Small firms (n=218) and Very Small firms (n=125).

Table 10. Adjusted* Non-Zero Total Cost per Claim for Leading Indicator Scales by Firm Size

Leading Indicator Scale	Relative Risk (95% Confidence Limits) By Firm Size		
	Large/Medium N=173	Small N=218	Very Small N=125
Safety Practices (Residuals > 3 Deleted)	0.81 (0.58 – 1.13) 0.90 (0.65 – 1.24)	1.09 (0.72 – 1.65) 1.32 (0.90 – 1.93)	0.98 (0.56 – 1.75) 0.88 (0.53 – 1.46)
Hazard Detection and Control (Residuals > 3 Deleted)	0.96 (0.72 – 1.27) 0.92 (0.71 – 1.20)	1.34 (0.95 – 1.89) 1.30 (0.94 – 1.80)	1.13 (0.75 – 1.71) 1.02 (0.71 – 1.47)
Ergonomic Practices (Residuals > 3 Deleted)	1.01 (0.86 – 1.18) 0.99 (0.86 – 1.15)	1.16 (0.99 – 1.38) 1.13 (0.97 – 1.34)	1.27 (1.00 – 1.62) 1.24 (1.00 – 1.55)
Safety and Health Leadership (Residuals > 3 Deleted)	1.10 (0.82 – 1.49) 1.32 (0.98 – 1.80)	1.12 (0.84 – 1.48) 1.06 (0.80 – 1.40)	1.04 (0.70 – 1.57) 0.96 (0.66 – 1.40)
Disability Management (Residuals > 3 Deleted)	1.07 (0.92 – 1.26) 1.03 (0.88 – 1.20)	1.16 (1.00 – 1.35) 1.10 (0.96 – 1.27)	1.27 (1.02 – 1.57) 1.18 (0.98 – 1.42)
Employee Engagement (Residuals > 3 Deleted)	0.98 (0.76 – 1.25) 1.03 (0.82 – 1.32)	1.45 1.03 – 2.05 1.32 (0.96 – 1.83)	1.20 (0.80 – 1.79) 1.10 (0.76 – 1.59)
Organizational Performance (Residuals > 3 Deleted)	0.95 (0.67 – 1.33) 0.92 (0.67 – 1.26)	1.16 (0.76 – 1.75) 1.23 (0.82 – 1.82)	1.21 (0.67 – 2.18) 0.87 (0.51 – 1.50)
Safety Culture Assessment (Residuals > 3 Deleted)	0.97 (0.69 – 1.37) 1.04 (0.75 – 1.45)	1.24 (0.83 – 1.86) 1.27 (0.86 – 1.87)	1.11 (0.60 – 2.07) 0.82 (0.47 – 1.45)
Workplace Safety and Health Committee/Representative ¹ (Residuals > 3 Deleted)	0.90 (0.74 – 1.11) 0.90 (0.74 – 1.09)	1.23 (0.92 – 1.65) 1.07 (0.81 – 1.43)	1.28 (0.69 – 2.37) 1.32 (0.72 – 2.44)

*All models adjusted for Industry, Region, Total Number of Workers, Jobsite Type, Respondent Type, Number of Types of Training Received, COR™/SECOR™ certification

COR™/SECOR™ is not significant for all the firm size classifications

Table 11. Adjusted* Non-Zero Lost-Time Cost per Claim for Leading Scales by Firm Size

Leading Indicator Scale	Relative Risk (95% Confidence Limits) By Firm Size		
	Large/Medium (N=173)	Small (N=218)	Very Small (N=125)
Safety Practices (Residuals > 3 Deleted)	0.81 (0.47 – 1.42) 0.82 (0.48 – 1.40)	1.19 (0.61 – 2.31) 1.51 (0.80 – 2.84)	1.75 (0.46 – 6.61) 2.03 (0.52 – 7.94)
Hazard Detection and Control (Residuals > 3 Deleted)	0.98 (0.62 – 1.55) 0.94 (0.62 – 1.44)	1.45 (0.84 – 2.48) 1.47 (0.86 – 2.46)	2.47 (0.84 – 7.25) 2.47 (0.84 – 7.25)
Ergonomic Practices (Residuals > 3 Deleted)	1.02 (0.77 – 1.34) 1.06 (0.83 – 1.35)	1.22 (0.93 – 1.60) 1.23 (0.94 – 1.59)	1.88 (1.05 – 3.34) 1.85 (1.03 – 3.30)
Safety and Health Leadership (Residuals > 3 Deleted)	1.11 (0.65 – 1.90) 0.93 (0.55 – 1.57)	1.17 (0.74 – 1.86) 1.16 (0.73 – 1.82)	2.43 (0.86 – 6.85) 2.46 (0.88 – 6.91)
Disability Management (Residuals > 3 Deleted)	1.11 (0.84 – 1.45) 1.08 (0.83 – 1.39)	1.20 (0.94 – 1.54) 1.18 (0.92 – 1.50)	1.83 (1.07 – 3.13) 1.78 (1.03 – 3.09)
Employee Engagement (Residuals > 3 Deleted)	0.85 (0.56 – 1.30) 0.83 (0.55 – 1.26)	1.67 (0.94 – 2.98) 1.63 (0.93 – 2.87)	3.54 (1.06 – 11.86) 3.61 (1.08 – 12.07)
Organizational Performance (Residuals > 3 Deleted)	0.91 (0.50 – 1.66) 0.87 (0.50 – 1.53)	1.25 (0.63 – 2.49) 1.33 (0.69 – 2.57)	2.36 (0.57 – 9.65) 2.36 (0.57 – 9.65)
Safety Culture Assessment (Residuals > 3 Deleted)	0.91 (0.49 – 1.67) 0.90 (0.51 – 1.60)	1.33 (0.67 – 2.65) 1.40 (0.72 – 2.71)	3.84 (0.79 – 18.54) 3.72 (0.77 – 17.86)
Workplace Safety and Health Committee/Representative ¹ (Residuals > 3 Deleted)	0.91 (0.65 – 1.28) 0.87 (0.63 – 1.21)	1.61 (0.94 – 2.77) 1.44 (0.84 – 2.48)	13.96 (1.88 – 103.56) 15.09 (2.28 – 99.97)

*All models adjusted for Industry, Region, Total Number of Workers, Jobsite Type, Respondent Type, Number of Types of Training Received, COR™/SECOR™ certification

¹ WSH (N = 152 for Large/Medium, N=169 for Small, and N=73 for Very Small). WSH estimates probably unstable for Very Small firms.

Table 12. Adjusted* Non-Zero No-Lost-Time Cost per Claim for Leading Scales by Firm Size

Leading Indicator Scale	Relative Risk (95% Confidence Limits) By Firm Size		
	Large/Medium (N=173)	Small (N=218)	Very Small (N=125)
Safety Practices (Residuals > 3 Deleted)	0.84 (0.62 – 1.14) 0.92 (0.72 – 1.17)	1.11 (0.62 – 1.97) 1.42 (0.80 – 2.54)	0.61 (0.16 – 2.41) 0.62 (0.16 – 2.33)
Hazard Detection and Control (Residuals > 3 Deleted)	1.05 (0.82 – 1.36) 0.97 (0.79 – 1.20)	1.06 (0.65 – 1.72) 1.08 (0.67 – 1.75)	0.83 (0.31 – 2.21) 0.83 (0.31 – 2.21)
Ergonomic Practices (Residuals > 3 Deleted)	1.01 (0.88 – 1.16) 0.93 (0.83 – 1.04)	1.09 (0.88 – 1.36) 1.12 (0.91 – 1.39)	0.94 (0.53 – 1.66) 0.88 (0.50 – 1.56)
Safety and Health Leadership (Residuals > 3 Deleted)	1.04 (0.80 – 1.34) 0.95 (0.76 – 1.18)	1.21 (0.80 – 1.82) 1.39 (0.93 – 2.07)	0.55 (0.22 – 1.39) 0.57 (0.23 – 1.41)
Disability Management (Residuals > 3 Deleted)	1.01 (0.89 – 1.14) 1.00 (0.90 – 1.11)	1.08 (0.90 – 1.31) 1.07 (0.89 – 1.28)	0.96 (0.65 – 1.43) 0.97 (0.66 – 1.44)
Employee Engagement (Residuals > 3 Deleted)	0.97 (0.79 – 1.20) 0.88 (0.73 – 1.05)	1.30 (0.84 – 2.01) 1.25 (0.80 – 1.93)	1.19 (0.54 – 2.61) 1.18 (0.53 – 2.60)
Organizational Performance (Residuals > 3 Deleted)	0.91 (0.69 – 1.20) 0.97 (0.76 – 1.24)	1.42 (0.81 – 2.49) 1.49 (0.85 – 2.61)	1.32 (0.29 – 6.04) 1.40 (0.32 – 6.17)
Safety Culture Assessment (Residuals > 3 Deleted)	0.91 (0.68 – 1.22) 0.96 (0.74 – 1.24)	1.46 (0.83 – 2.56) 1.52 (0.88 – 2.65)	1.00 (0.22 – 4.46) 0.96 (0.22 – 4.20)
Workplace Safety and Health Committee/Representative ¹ (Residuals > 3 Deleted)	0.98 (0.79 – 1.21) 0.93 (0.77 – 1.12)	0.84 (0.58 – 1.21) 0.88 (0.61 – 1.26)	0.32 (0.09 – 1.22) 0.29 (0.06 – 1.28)

*All models adjusted for Industry, Region, Total Number of Workers, Jobsite Type, Respondent Type, Number of Types of Training Received, COR™/SECOR™ certification

¹ WSH (N = 152 for Large/Medium, N=169 for Small, and N=73 for Very Small)

Development of evidence-based benchmarks for the Manitoba construction sector

The Institute for Work & Health (IWH) took advantage of the administrative data provided in the WCB sample to develop propensity scores. The propensity scores allow for reweighting the data so information on the non-participants and participants can be used to make the benchmarks representative of firms in the Manitoba construction sector. A range of factors including firm size and historical claims rates were used to examine what predicted whether a firm participated or did not participate. The propensity scores also took into consideration the region and industry group/rate code. These scores were used to ensure the benchmarks were as representative as possible of all firms in the participating industry groups.

Table 13 provides the benchmarking scores for the 18 CSAM industry rate codes by each leading indicator measure. The score range is 0 (lowest) to 4 (highest) for all measures. The cells in the table are colour-coded green, yellow or red based on the score level, i.e., 'Green' indicates a score of 75 per cent or greater; 'Yellow' indicates a score of 50 to less than 75 per cent; and 'Red' indicates a score less than 50 per cent. These cut-points were defined by stakeholders. Overall, the propensity-weighted scores were consistently lower for 'ergonomic practices' and 'disability management' across industry groups.

Table 13. Benchmarking Results by 18 CSAM Rate Codes

Leading Indicator Measures		Building Construction (40102)	Concrete Work (40110)	Constructing Dams/Wharves Bridges & Steel (40502)	Drywall & Stucco Contracting (40108)	Electrical Contracting (40203)	Flooring & Tiling (40103)
Organizational Policies and Practices (OPP)							
	Safety practices (SP)	3.57	3.35	3.66	3.67	3.59	3.44
	Hazard identification and control (HIC)	3.15	2.94	3.58	2.87	3.26	3.25
	Ergonomic practices (EP)	2.76	2.63	3.16	2.61	2.80	2.67
	Safety leadership (SL)	3.23	3.22	3.56	2.84	3.28	3.21
	Disability management (DM)	2.73	2.96	3.44	2.44	2.65	3.09
	Employee engagement (EE)	3.45	3.00	3.55	3.54	3.63	3.53
Safety Culture Assessment (SCA)		3.51	3.27	3.62	3.43	3.64	3.58
Workplace Safety & Health Committee (WSHC) or Representative (WSHR)		3.32	3.60	3.31	3.49	3.24	3.20

Table 13. Benchmarking Results by 18 CSAM Rate Codes Cont'd

Leading Indicator Measures		Installing Case Goods & Fixtures (40112)	Installing Doors & Windows (40109)	Installing Elevators (40602)	Installing Heavy Machinery (40603)	Installing Metal Products (40104)	Landscaping (40115)
Organizational Policies and Practices (OPP)							
	Safety practices (SP)	3.04	3.65	3.79	3.35	3.80	3.39
	Hazard identification and control (HIC)	2.47	2.87	3.76	3.11	3.31	3.00
	Ergonomic practices (EP)	2.09	2.62	3.72	1.96	2.94	3.00
	Safety leadership (SL)	2.88	3.41	2.57	2.87	3.19	3.29
	Disability management (DM)	2.25	2.02	4.00	3.27	2.82	2.24
	Employee engagement (EE)	3.65	3.27	3.39	3.47	3.84	3.77
Safety Culture Assessment (SCA)		3.47	3.55	3.40	3.64	3.64	3.63
Workplace Safety & Health Committee (WSHC) or Representative (WSHR)		2.88	3.77	3.33	3.41	3.46	3.40
Leading Indicator Measures		Painting & Decorating (40105)	Plumbing, Insulating & Mechanical (40204)	Railway Construction (40904)	Roofing & Eaves-troughing (40403)	Tower & Energy Construction (40903)	Wrecking & Moving Buildings (40106)
Organizational Policies and Practices (OPP)							
	Safety practices (SP)	3.76	3.61	3.84	3.78	3.93	3.80
	Hazard identification and control (HIC)	3.31	3.15	3.83	3.29	3.88	3.37
	Ergonomic practices (EP)	2.66	2.35	3.29	2.49	3.44	2.71
	Safety leadership (SL)	3.29	3.37	3.73	3.31	3.89	3.54
	Disability management (DM)	2.66	3.01	3.82	2.58	3.82	3.17
	Employee engagement (EE)	3.66	3.67	3.66	3.60	3.82	3.43
Safety Culture Assessment (SCA)		3.75	3.61	3.72	3.70	3.85	3.72
Workplace Safety & Health Committee (WSHC) or Representative (WSHR)		3.43	3.56	3.63	3.32	3.77	3.28

The score range is 0 (lowest) to 4 (highest) for all measures. All scores are propensity weighted to ensure the benchmark is representative of all firms from all regions of Manitoba in the construction sector. Colour coding ['Green' indicates a score of 75 per cent or greater. 'Yellow' indicates a score of 50 to less than 75 per cent. 'Red' indicates a score less than 50 per cent].

Benchmarking report distribution

Individual benchmarking reports were generated at IWH as PDF files in December 2018 using MS Access. Then reports were password-protected by means of an encryption method in Adobe Acrobat. From January to May 2019, the benchmarking reports were distributed to participating firms. An initial email was sent to firms who provided their email address to receive a benchmarking report. Upon response from participants who consented to receiving a 2 MB size file, the password-protected report was sent, along with a password to open their report in a separate email. Two additional reminder email blasts were also sent out to non-responding firms. Hard copies of the benchmarking reports were mailed to participating firms upon request (eight firms requested hard copies of the benchmarking report). See Appendix A for a sample benchmarking report.

Development and testing the usability of a benchmarking dashboard

Designing the Indicator Dashboard

Bit Space Development (BSD), a Manitoba-based technology company, led the development of the INDICATOR dashboard for CSAM.

At the initial stage, the design team took several actions:

- The design was created and sent to CSAM before development began to ensure that the tools being developed were both considered usable and on brand for CSAM.
- The design was created using industry best practices for accessibility to allow for readability of text and tab order.
- Responsive design was taken into consideration to handle users on multiple screen resolutions & device types.

Once development began, meetings with the project advisory committee were held to allow for input on the tool. The members provided input to ensure that the tool was considered useful throughout the course of its development.

CSAM Safety Conference 2018

The IWH team partnered with CSAM and Bit Space Development to conduct a workshop at the Annual CSAM conference about leading indicators, the benchmarking report and dashboard development. During the workshop, attendees were asked several questions:

- 1) What is the most important information you want to learn from a benchmarking report?
- 2) Does the red/yellow/green colour-coding scheme make sense to signify your safety performance?
- 3) Should the report be one page or more than one?
- 4) Does company size matter in the benchmarks?
- 5) When does benchmarking data get old?

6) What information is not valuable in a benchmarking report?

Workshop participants were shown preliminary design items for the planned dashboard. Then they were included in a discussion about features and functions they would like to see in a dashboard tool to be used by their organization. Participants were also invited to be involved in the feedback and usability testing portion of the project.

The feedback was quite positive and led to the alpha development phase of the dashboard.

Usability Findings

Question #1: What is the most important information you want to learn from a benchmarking report?

- *Identify strengths and weaknesses*

Most participants would like a benchmarking report to help them identify their strengths and weaknesses. They specified that the report should show them what they are doing well and where they need to improve or focus their attention. It was also important for the report to be used to check if their safety policies are being followed/adhered to.

- *How they compare to similar companies*

Participants want a report to show them how they are doing compared to a suitable benchmark. Participants often stressed the importance of being compared to similar companies by size, sector, industry rate code, and geographic region. Participants want to get a snapshot of where they are compared to the industry in one click; they want to know what they need to improve “right now”.

A few participants wished to compare themselves to leaders in the field (i.e., high performers), focusing on best practices. Other suggestions were to be benchmarked on the 14 sections of COR™, to compare COR™ versus non-COR™ companies, and to compare prime contractors to non-prime and sub-contractors. The value of looking at market segments was also suggested, as well as doing internal comparisons (e.g., comparing themselves to different divisions within their own company).

- *Track performance over time*

Several participants expressed interest in being able to track their performance over time to assess trends; they felt that seeing historical data/trends would be useful. An idea proposed was to look at the time spent on OSH activities daily/weekly/monthly.

- *Relationship between Leading and Lagging Indicators*

A few participants mentioned the value in aligning their leading indicators with their lagging indicators, to examine if an improvement in their leading indicators is associated with a decline in their injuries/illnesses.

Question #2: Do red, yellow and green colours make sense to signify your performance?

- *Red/yellow/green makes sense*

Most participants agreed that the red/yellow/green colour-coding scheme used on the sample benchmarking report is a simple and effective way to signify their performance. Although, some participants recommended that having a wider spectrum of colours would help to provide a clearer sense of where you fall (i.e., if your score falls in yellow, are you on the lower end of 'yellow' closer to 'red', or on the higher end closer to 'green'?). It was advised that there should not be more than 5 groups of colours on the chart.

- *More visual representation of the data*

Several respondents suggested to include more graphs (i.e., line and bar graphs) to make the report more visual. It was observed that the numbers on the benchmarking report table/chart were difficult to see, so they felt that using graphs and other images in place of numbers could provide a clearer representation of the data. Participants also thought that a graph could better help them view trends over time. Some participants were interested in a graph for reporting their near misses.

Question #3: Should the report be one page or more than one page?

- *One-page report preferred*

Most participants preferred a one-page report that is simple and concise, or a report that is no more than three pages in length. Few suggested having a longer report with the main details and key issues they need to focus on included in a one-page executive summary, with supporting documentation available to review for further information.

Question #4: Does company size matter in the benchmarks?

- *Company size matters*

All participants agreed that company size matters in their benchmarks and stressed the importance of being compared to firms of a similar size. They expressed interest in including different size comparisons (e.g., a column for large, medium, small) in their report.

Question #5: When does benchmarking data get old? One year, two years, three years or never?

- *Update benchmarking data between one to three years*

Most participants felt that benchmarking data should get updated annually, suggesting that the shorter time frame would give companies more incentive/push to work on the areas they need to improve on quicker. Others thought that every three years or a maximum of three years was reasonable, as it aligns with certain OHS policies that need to be reviewed every three years; while few participants felt that benchmarking data never gets old. Another suggestion was to use the first year to make improvements and

then relook/review every three years. It was also noted that the frequency data updates are required may depend on the industry.

Question #6: What information is not valuable to you in a benchmarking report?

- Participants felt that unrelated industry information and anything that is not about safety would not be valuable in a benchmarking report. Also mentioned was the type of jobsite, type of tools being used on a job, cost-related information, information already included in COR™, information that is too general/not specific for action, and things they do not have control over. There were a few comments to indicate that nothing would be totally useless, as all information in the survey they completed was relevant.

Workers Compensation Board

Several meetings were held with the RWIP funder, the WCB of Manitoba. These meetings were to discuss the potential to incorporate lagging indicators (injury and illness claims) with leading indicators into the dashboard. In these meetings, various executives from the WCB provided feedback and insights into the tool.

Industry Meetings

Various industry consultation meetings were held to specifically demonstrate and gather usability and functionality feedback from the industry. This included the meeting on October 11, 2018, which identified numerous usability items where were addressed in the final development phase of the dashboard.

Functionality Findings

A key functionality mentioned repeatedly was the ability to make comparisons, by viewing the data in a variety of ways.

Internal comparisons within site

The group discussed how the perspectives of personnel may impact the survey; they questioned how a different perspective from another “person most knowledgeable” could change the survey results. It was voiced that people have different perspectives, e.g., what managers believe is not the same as the frontline workers. As such, the dashboard should have the ability for different employees on site to complete the survey and make comparisons (i.e., to compare management, supervisors, employees). Questions raised were: How do we show survey data from different types of employees in a company or on a site? Can everyone in the company fill it out? Can we compare [two] surveys done by [two] different people?

Subset survey for employees

It was suggested to have a subset of questions for employees, as there are items in the

main survey that employees would not know the answer to. In this way, companies can make more meaningful internal comparisons.

Ability to set access permissions

Having the ability to set administrative and company rep permissions (with varying levels of access) to perform specific functions was also mentioned.

Internal comparisons by site

Large companies with multiple sites across the country would like to conduct comparisons by sites, i.e., How can companies take surveys and access data from internal groups across the country?

Size comparisons

The group felt that it is important to have the ability to break down the data by size to ensure that we are comparing apples to apples, i.e., the comparator should be as accurate as possible. Can we sort by size for the benchmarking?

Comparisons to other industry groups

There was some interest in comparing industry groups. Can we show the ranking of industry groups? Can employers compare themselves to another industry, other than their own?

Regional comparisons

Can employers export data from the dashboard by region, i.e., can the data be narrowed down to a region?

Time trends/historical comparisons

The ability for INDICATOR to track improvements over time was mentioned, i.e., producing graphs to enable employers to compare past survey scores to scores from a new survey. It was suggested to add a 4th column to the benchmarking report to show a recent survey score against the last submitted (or selected) survey score. Can we do month-by-month comparisons?

Comparisons to top performers

There was interest in seeing how you rank compared to the competition, e.g., how far are you from the best score (i.e., high performers)?

Comparisons to lagging indicators

What are the next steps for including WCB data in the dashboard? Can we match WCB data categories with what we include?

CSAM Safety Conference 2019

At the CSAM conference in 2019, the BSD team hosted a booth demonstrating the INDICATOR dashboard, to collect initial feedback and interest in the tool. IWH partnered with CSAM to conduct a presentation where the tool was demonstrated for industry and organizations were invited to sign up and enter their data.

Functionality for entering existing benchmarking data for participants that completed the survey in the current project was added. Shortly after, the tool was launched to the public.

Usability Assessment Survey

After the launch of INDICATOR, CSAM invited its members to access the dashboard and complete a short usability assessment survey about their experience using INDICATOR. In addition, at the final meeting with the advisory committee (June 2019), attendees were asked to complete the usability survey. The results are summarized in the Figures 10-17 below.

A few dashboard users completed the usability assessment. Overall, we had two groups: A small group (always one person) that was not happy with INDICATOR, and a larger group that was generally satisfied and found the tool easy-to-use and valuable.

Figures 10-17. Usability Assessment Survey Results

Figure 10

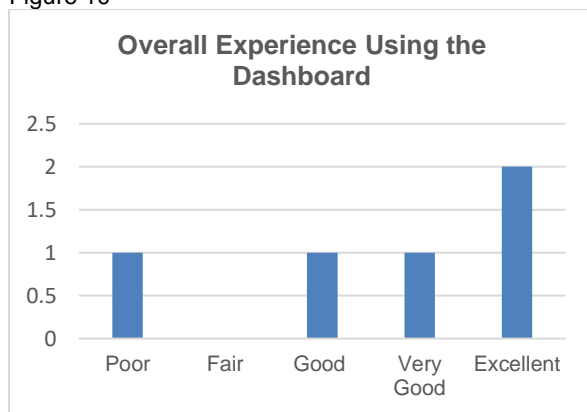


Figure 11

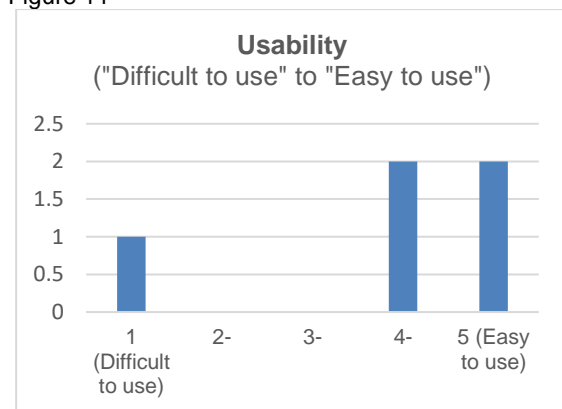


Figure 12

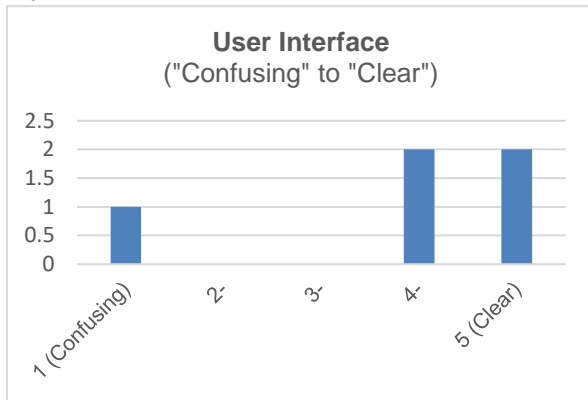


Figure 13

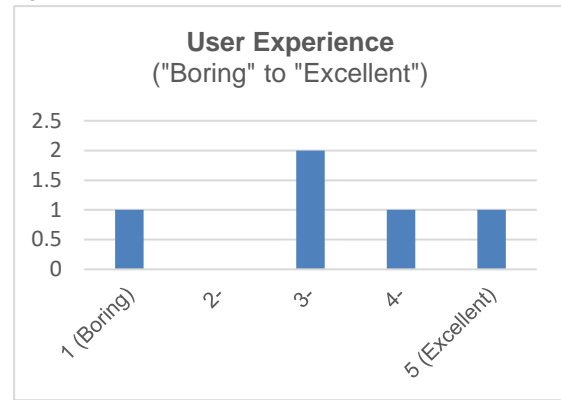


Figure 14

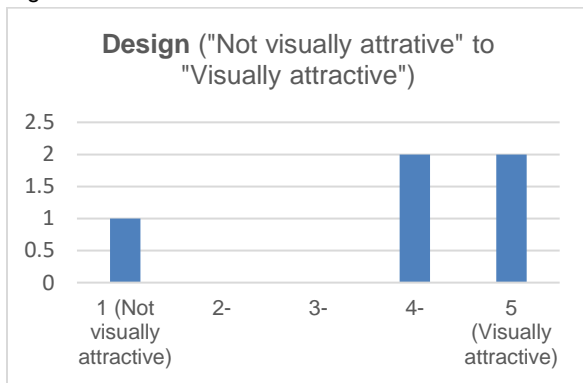


Figure 15

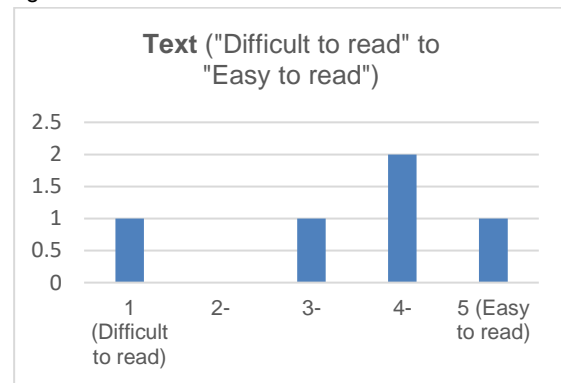


Figure 16

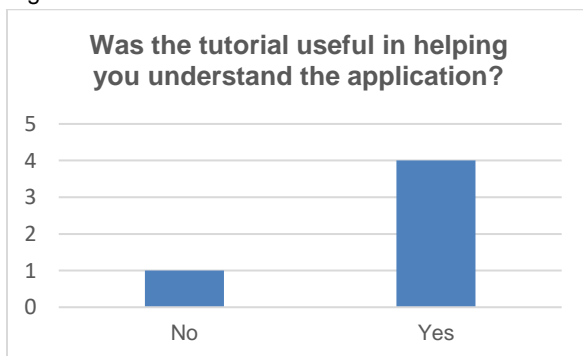
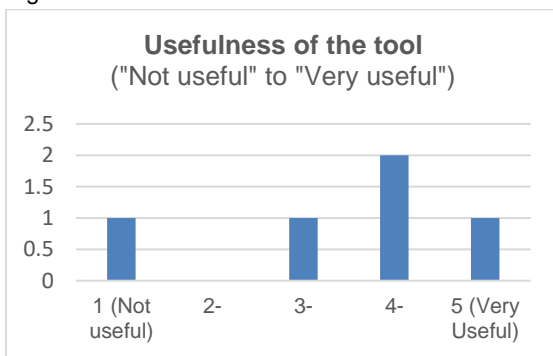


Figure 17



Discussion

We examined nine OHS leading indicator scales with a set of pre-established criteria related to measurement properties, using the data collected from organizations across 18 CSAM rate codes. We found that all scales met our primary priority criterion for internal consistency and showed acceptable structural validity. Moreover, the secondary priority criteria were achieved for all measures. In the planning phase of the project, there was some concern that only the high performing organizations would participate in the survey, but that was not the case. All response options for all items had at least some endorsement, although we observed a positive skew in the distribution of scores.

Strengths

The main strength of this study is the adequate sample size of 910 organizations, distributed across 18 industry rate codes, eight geographical regions, and three firm size groups. These participants were from a known population, organizations registered with the workers compensation board of Manitoba. We used a stratified sampling strategy to obtain more precise estimates of population quantities and to obtain reasonably precise estimates within subgroups. Minimal required criteria for measurement properties were established a priori.

Limitations

A limitation of the study is the cross-sectional design; we do not have an assessment of predictive validity for the measures – especially for predicting injuries. In addition, over 90% of the sample consisted of very small- and small-sized organizations, of which many did not have any incurred costs or injuries. This may have contributed to the null findings in our costs analyses. This is, however, the first study to have collected safety performance data from a significant number of very small firms, which could also be considered a strength. Another limitation is the use of self-report data; however, in the Ontario Leading Indicators Project (OLIP) we did not find any evidence to suggest that the key informant was responding in a socially desirable manner. Nevertheless, social desirability was not assessed in this study. Finally, as the recruitment effort targeted the one respondent in the organization who is most knowledgeable about health and safety, it is important to consider if the position of the person in the organization that completed the survey affected the content of the information provided.

Cost data

We did not find statistically or substantively significant effects in the cost data analyses, as many of the companies were small or very small and had no incurred cost. In addition, the sample of companies may have been too small and therefore the variation was large. If the Manitoba construction industry wishes to use cost as a tool to evaluate best practices in managing leading indicators, CSAM will need more organizations participating in the future, or the WCB cost data will need to be provided at the individual claimant-level, rather than at the firm-level.

Dashboard next steps (improvements and uptake)

One of the key features of the INDICATOR dashboard is its ability to link people to available resources to help them improve their health and safety programs. However, encouraging more organizations to access the dashboard to complete the survey is a challenge now that the dashboard is live and available for use. CSAM will need to consider creative approaches to promote its use, e.g., make the survey mandatory for COR™/SECOR™ companies by including it as part of the audit. Reducing the length of the survey so it can be completed in “less than 10 minutes” is a strategy to help persuade the non-COR™ companies to also get on board to maximize the value and utility of the tool. IWH has provided CSAM with a recommended shorter version of the survey. In the future, it may prove beneficial to incorporate lagging indicators (injury illness claims data) with the leading indicators in the dashboard.

Recruitment and Data Collection Challenges

There were some issues and challenges that were faced during the recruitment phase and administration of the survey due to the high proportion of very small construction firms in the target sample. These firms had generally less than five employees, and often were self-employed individuals, or “one-person operations”, which made reaching a live contact difficult. Once a contact was reached, it was further a challenge to persuade the very small firms to participate. Challenges within the questionnaire were also apparent, as some respondents struggled to answer questions that they felt were not applicable to them due to their firm size.

Recruitment challenges: Challenges with non-responders

Getting a hold of firms, no answers and voicemails

Getting a hold of firms proved to be very difficult for the small and very small firms. The number of attempts made to reach a respondent that completed the survey ranged from 1 to 9+ contact attempts (by telephone, email, or hardcopy mail-out). Voicemail messages were left, or survey links were emailed to the firm.

Challenges recruiting very small firms

It was difficult to reach many companies in the daytime during their working hours. Research assistants achieved more success calling after 5PM EST when participants had completed their work shifts and/or were at home. It was a challenge to achieve contact with the key informant most knowledgeable about health and safety in a large proportion of firms. Many of the key informants were the owners, who frequently travelled between jobsites and followed a sporadic schedule. Oftentimes, the call to their telephone number would go to an automated answering service. This made it considerably difficult to achieve contact with them. Moreover, due to the nature of construction work, individuals moved a lot and had little time available. In some instances, research assistants were asked to call back repeatedly by the key informant who was willing to participate, however, was unable to do so due to time constraints.

Bookkeeper listed as company contact

In some cases, a bookkeeper was the only listed contact for a construction company. Many of these bookkeeping companies declined to provide contact information for the construction firm. Although, some bookkeeping companies forwarded information about IWH and the study (sent by the research assistants) to the construction firm and notified research assistants that the firm would contact IWH if they were interested in participating.

Recruitment challenges: Most common reasons for declines (and responses)

Once contact was established, research assistants faced a challenge in persuading the very small and self-employed firms to participate in the study. As many contacts were self-employed, their time was very limited. Not having enough time to participate in the survey was the most common reason for a decline.

Statements were prepared on the benefits of a very small or self-employed firm participating in the survey. Described below are some of the common scenarios that were encountered during the recruitment phase and the responses given by the research assistants to encourage participation.

Q: I see no benefit in this for me.

A1: Some respondents have felt that they have learned about safety policies and practices during the survey. They have gained ideas on how and where they can improve on their occupational safety and health practices, procedures and policies for their company, for instance pre-job hazard assessment or conducting regular safety audits. You will benefit from participating in the survey by possibly learning new ideas and strategies that reinforce safety which are important to protecting yourself at the worksite. The survey can be an educational/learning experience. You might learn new ideas on prevention of incidents at the worksite.

A2: To thank you for your participation, you will receive a benchmarking report comparing your safety and health performance to that of others in the industry. CSAM will use the benchmarking information to produce a leading indicators dashboard that you can use to track your success. The study is trying to understand how construction firms manage safety and health at the worksite in an effort to help identify management and organizational indicators that support recovery and prevent workplace injuries and illnesses. The highest rates of workplace injuries are in the construction sector. Our mission is to build organizational safety and health performance benchmarks to help define best practices to advance the protection of construction workers in Manitoba and to take care of you and your safety so that you can go home safe and take care of your family.

Q: I'm just a one-person operation, I won't be much help and this survey won't apply to me.

A: We value the voice of small firms and are happy to have your input. We are speaking to companies of all sizes in Manitoba. We want to obtain a complete picture of construction firms in Manitoba and very small companies represent an important part of the construction industry in Manitoba. Your voice is important. We understand that small companies have unique needs and risks that may be mitigated in larger corporations. We want to hear what your issues are to help other small business. We also want to learn how and where small companies are doing better. You can answer the questions as they apply to you at your company. Your input and feedback will help other small and very small construction firms in Manitoba to improve their safety and health practices and develop programs tailored to the unique needs of very small firms.

Q: I don't have time for a survey.

A: You are listed as the person most knowledgeable about health and safety at your organization, so we would really appreciate your input. Your voice and knowledge on health and safety is important to us. The survey is multiple choice, so it is straightforward and quick. You can also complete it online on your phone if that is easier.

Q: Health and safety is being pushed down our throats. It is hard for us "little guys" to keep up with all the new legislation.

A: Our study is looking to understand your experiences as well as challenges in managing health and safety. Your experiences as a small organization are especially helpful so that we can better understand how it can be made easier for small firms like yours to be safe in Manitoba.

Other Reasons for Decline:

A very small number of firms initially agreed to participate, but declined after the consent form was read out to them. Reasons for decline provided included "I'm not in construction", "This is not something I want to get into", and "There is too much jargon". However, most often reasons for decline were not provided beyond "I no longer wish to participate."

Some individuals, while willing to participate, informed the research assistants that the company had a strict policy against completing surveys.

Data collection challenges: survey for respondents

There were also challenges that the respondents faced while taking the survey. These challenges included:

- Difficulty understanding the survey questions
- Perceived repetition in the survey with some questions
- Questions within scales that the respondents felt were not applicable. Sometimes online surveys were partially completed, as respondents started it and then felt it was irrelevant

Challenges understanding questions in the “Manitoba Construction Safety Performance Survey”

Safety practices

- i. **Q.11 & 12 (“Supervisors/managers confront and correct unsafe behaviours and hazards (for example, slip, trip and fall hazards) when they occur.” & “Supervisors/managers are trained in job hazards and safe work practices for jobs they supervise.”)**

The wording “supervisors/managers” often confused the respondents that were very small organizations (self-employed or 1-2 employees). As they did not have any managers/supervisors in their organization, it did not apply to them. The research assistants would tell them to think of themselves in this role.

- ii. **Ergonomic practices**

Q.25 (“Ergonomic strategies are used to improve work area design.”)

A few smaller firms or self-employed participants struggled with this item because they had no real “work area” at their organization/jobsite. They usually selected the “Never” response option because they did not think that the question was applicable.

- iii. **Safety leadership**

Q.28 (“The safety manager (or, the person in charge of health & safety) receives support from top management.”)

This was a tricky question for self-employed participants because they play both roles of safety manager and ‘top management’ in their organization. Although most opted for the “Never” response option (i.e., for N/A), the concern is that respondents did not all respond in a similar way – some would respond for how they would do it if they *had* employees, and others would pick “Never” (for N/A).

- iv. **Disability management**

This entire scale was the one that very small/self-employed participants struggled with the most because they had no employees to file claims for.

- v. **Employee engagement**

Similar to the safety leadership items, this scale was also a bit difficult for the self-employed participants because they did not know how to respond. Some opted for “Never” response option (i.e., for N/A), while others responded based on how they would do it if they *had* employees. The concern again was that there

might not be consistency between respondents, and how they answered these questions.

vi. **Organizational performance**

Q.46 & 49 (“Workers and supervisors have the information they need to work safely.” & “Those who act safety receive positive recognition.”)

Again, for self-employed respondents from one-person operations, these questions were tricky to answer.

vii. **Q.60 (“What types of safety training do employees receive?”)**

For self-employed participants, it would be helpful to make this more specific to clarify if we are also referring to the training they received before opening up their own business. As most respondents would talk about training they had previously when they worked for others. So, it was a bit confusing for them.

viii. **Q.62-64 (certified training, OSH awareness training, and training provider)**

Similar to Q.60, re-wording this would be a bit more helpful for self-employed participants – indicating whether or not this can also include the training they received in their past.

ix. **Q.66-69 (“Do workers receive training about the following rights?”)**

Again these questions were confusing for these respondents because most would respond by saying, ‘you know I don’t have workers.’

Perceived repetition in the survey with some questions

Respondents perceived repetition in some of the questions, particularly the questions asked earlier in the survey with questions from the IWH-OPM (Organizational Performance) tool. This sometimes frustrated the respondents, as they felt they had already answered a similar question, and their time was limited.

i. **Q.40 (“Employees are involved in decisions affecting their daily work.”)**

from People-Oriented Culture and **Q47 (“Employees are always involved in decisions affecting their safety and health.”)** from the IWH-OPM.

As these two questions are asked close to each other in the survey, some respondents thought they had already answered the same question.

ii. **Q.44 (“Everyone at this organization values ongoing safety improvement in this organization.”)**

This question could be re-worded as ‘organization’ is mentioned twice.

iii. **Q.30 (“Your company considers safety to be equally important as production and quality in the way work is done.”)** from Safety Leadership and

Q.45 (“This organization considers safety at least as important as production and quality in the way work is done.”) from the IWH-OPM.
Questions **Q30** and **Q45**, also sound repetitive to respondents.

Questions within scales that were not applicable

- Scale Questions (Safety Practices, Safety Leadership, Ergonomic Practices, Disability Management, Employee Engagement, Hazard Detection and Control, and WHSC)
 - A separate response option for “Not applicable” is needed, particularly for the Disability Management scale

Suggestions

One challenge was ensuring that the benchmarking report was delivered to the company. We asked a question in the survey: “In case you are no longer with the company, may we provide the report to someone else at the company?”. Future questionnaires should include a text box for respondents who answered “Yes”, to specify a person’s name, as many respondents that participated in the survey by telephone mentioned a specific name that they wished the report to be provided to, as a back-up recipient of the report. However, for CSAM and their efforts to continue to develop the INDICATOR database this question is not necessary, as benchmarking reports are generated in the dashboard and provided to participants immediately after completing the survey.

A bigger challenge is to try to improve participation. Here are some thoughts.

- Offer the very small firms’ reasons for participating that would be relevant to their business
- Mention that some respondents felt that they learned more about safety by answering questions and got ideas on how to improve their safety practices
- Offer incentives. Providing smaller incentives to each participant, rather than a few large incentives via a lottery may be more effective, e.g., a \$10 gift certificate from Tim Hortons or Canadian Tire

What worked

Multiple methods of questionnaire administration

Although the majority of respondents (74%) completed the questionnaire via online administration, offering participants multiple methods of completing the questionnaire (as was done in this study) increased participation rates. Given the success of online-administered questionnaires in this study, it is imperative that this should remain a key recruitment method in future studies. Mail merges also proved to be particularly successful in online survey recruitment for firms that were difficult to reach via telephone.

Repeated contact

In a number of cases, it required over eight contact attempts by research assistants to get a participant to complete the survey. Some respondents were very busy and often forgot about the survey link; both a telephone and email reminder helped. Some participants who eventually completed the interview by phone, had kept asking to be called back at a more convenient time.

Incentives and Benchmarking Reports

The possibility of an incentive proved to generate greater interest in the research. A number of participants expressed being more inclined to complete the questionnaire due to the lottery incentive (to win one of 10 iPads) and the benchmarking report (comparing their health and safety performance to that of others in the industry).

Conclusions

The current work is a collaboration between the Institute for Work & Health (IWH) and the Construction Safety Association of Manitoba (CSAM). This project sought build evidence-based tools to support changing the dialog in the construction sector to focus on leading, not lagging, indicators of occupational health and safety performance. While CSAM has been successful in getting businesses COR™ or SECOR™ certified, this still only reaches 900 out of 4500 firms. We intended to affect communication through demonstrating the scientific credibility of a series of self-report leading indicator tools which would allow us to build evidence-based benchmarks and, develop a benchmarking report describing firm-level performance. Then CSAM worked with Bit Space Development (BSD), a Manitoba-based technology company, to develop a dashboard, INDICATOR, for member use.

This project comes at a time when SAFE Work Manitoba is seeking to change safety culture both within businesses and within the province. We are the first study to use the newly developed SAFE Work Manitoba Safety Culture Assessment tool. Our work could help the province by demonstrating the importance of building industry-specific performance benchmarks and providing a model program.

We learned that you can develop a series of scientifically credible leading indicators and a set of evidence-based benchmarks for use in a sector. We showed these leading indicators are associated with historical claims. There is an appetite for this information in the construction sector, as people want to use this information to manage occupational safety and health performance. The good and the bad news is that we sought to have a representative sample of large, medium, small and very small construction firms; and the large and medium firms behaved as expected, but the small and very small firms did not. This is very important for the continued development of these evidence-based benchmarks. For small and very small firms some scales and multiple questions were perceived as not relevant. Our approach was one-

size-fits-all, but that is not going to work. We also likely need to include a 'not applicable' response option for some of the measures. The big takeaway is: benchmarks need to be tailored within subsectors by firm size.

We had hoped to have a solid foundation for how leading indicators are related to injury costs, but so many firms had no incurred cost; this made it problematic. We had data at the firm-level and probably needed it at the individual claimant-level, much the same way cost data is currently being used to evaluate COR™ programs across Canada.

We learned that occupational health and safety professionals want an easy-to-use dashboard and would prefer 'one stop' shopping where both leading and lagging indicators are included.

More research is needed on how this information changes the conversation on occupational health and safety in Manitoba construction. It would also be helpful to show how the leading indicators predict injuries and costs in the future. This project will allow for an easy linkage to look at these two important outcomes prospectively.

Recommendations

Further work on leading indicators

- 1) We would encourage a follow-up study to assess the predictive validity of the tools, examining the relationship between leading indicators and future claims.
- 2) Ergonomic practices, disability management, and workplace safety and health (WSH) committee/representative were not related to historical injury/illness claims. We were not surprised by the findings for ergonomic practices and WSH committee/representative, as these measures have not worked well in Ontario. But these are important leading indicators for the construction industry. The results for disability management can be explained by the high number of small- and very small-sized firms in the sample who don't have disability management programs. There is a need to not only work on these three leading indicators, but to determine what is the best way to collect data from small- and very small-sized firms. Perhaps it would be sufficient to only collect the 8-item IWH-OPM and the 12-item SAFE Work Manitoba Safety Culture Assessment Index from small firms.

Further work using cost of injuries data

- 3) Many companies had no incurred costs, especially the very small-sized firms. This may have contributed to the null findings in our costs analyses. Further work is needed with larger samples, i.e., CSAM needs more companies participating if the industry wants to use cost as a tool to evaluate best practices in managing leading indicators. It may also help to examine WCB cost data at the individual (claimant)-level, rather than at the firm-level.

Recruitment/data collection suggestions

- 4) Reducing the final questionnaire to 15 minutes was advantageous in participant recruitment. However, an even shorter survey may prove to generate more interest, given that “not having enough time” to participate in the survey was the most common reason for a decline.
- 5) Include “N/A” as a separate response option in the survey scales, as some of the questions were not applicable to the very small-sized firms.
- 6) Offer multiple methods of questionnaire administration (e.g., online, telephone, mail-out hardcopy survey) to increase survey numbers.
- 7) Due to the nature of construction work, employer contacts move around a lot between jobsites and have very little time available. As such, repeated contact attempts are encouraged to reach participants, especially the very small-sized firms.
- 8) Offer individual incentives, rather than a lottery-type incentive, to compensate all participants for their time.

Further work on the dashboard and uptake

- 9) Strategies to help promote the use the dashboard include shortening the survey, providing a separate survey tailored to the small-/very small-sized firms, or including a “N/A” response option and/or an option to skip sections if not applicable.
- 10) CSAM may also consider making the survey mandatory for CORTM/SECORTM companies to complete annually as part of the audit.
- 11) Including lagging indicators (WCB claims data) to align with the leading indicators would optimize the functionality and utility of the dashboard.

References

- Amick III BC, Habeck RV, Hunt A, Fossel AH, Chapin A, Keller RB, Katz JN. Measuring the impact of organizational behaviors on work disability prevention and management. *J Occup Rehabil* 2000;10(1):21-38.
- Amick B and Saunders R. Developing leading indicators of work injury and illness [Internet] 2013. Available from: <http://www.iwh.on.ca/briefings/developing-leading-indicators-of-work-injury-and-illness>
- Bollen KA. Structural equations with latent variables. New York: John Wiley & Sons, 1989.
- Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrika* 1951;16:297-334.
- Bollen KA, Lennox R. Conventional wisdom on measurement: a structural equation perspective. *Psychol Bull* 1991;110(2):305-314.
- Butler RJ, Johnson WG, Baldwin ML. Managing work disability: Why first return to work is not a measure of success. *Industrial Labour Relations Review* 1995;48:452-469.
- Cullen KL, Williams RM, Shannon HS, Westmorland M, Amick III BC. Workplace organizational policies and practices in Ontario educational facilities. *J Occup Rehabil*. 2005; 15(3):417-433.
- Hu L, Bentler PB. Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling* 1999;6:1-55.
- Occupational Safety and Health Administration, 2008. Consultation Policies and Procedures Manual. Retrieved from https://www.osha.gov/OshDoc/Directive_pdf/CSP_02-00-002.pdf
- SafeWork Manitoba. The Manitoba Workplace Injury Statistics Report: 2008-2017; 2019.
- Streiner DL, Norman GR. Reliability. In: *Health measurement scales: a practical guide to their development and use*. 2nd edition. New York: Oxford University Press, 1995:104-27.
- Tompa E. Productivity and health: empirical evidence and policy implications. In: Sharpe A, St-Hillaire F, Banting K, editors. *The review of economic performance and social progress: towards a social understanding of productivity*. Montreal: The Institute for Research on Public Policy; Ottawa: Centre for the Study of Living Standards; 2002. p. 181-202.
- Ware JE, Harris WJ, Gandek B, Rogers BW, Reese PR. MAP-R: multitrait/multi-item analysis program; revised for Windows. Version 1.0 user's guide. Boston, MA: Health Assessment Lab; 1997.
- Williams RM, Westmorland MG, Shannon H, Rasheed F, Amick III BC. Disability management practices in education, hotel/motel and health care workplaces. *American Journal of Industrial Medicine*. 2005;47:217-226.

Appendix A

Manitoba Construction Safety Performance Project Organizational Benchmarking Report:

[Organization's Name]



Institute
for Work &
Health

Research Excellence
Advancing Employee
Health



Your Benchmarking Report

Your organization took part in the Manitoba Construction Safety Performance Project. This project was conducted by the Institute for Work & Health (IWH) in partnership with the Construction Safety Association of Manitoba (CSAM). As a project participant, we promised to provide you with a benchmarking report comparing your organization's results to others in Manitoba's construction industry. This is your report.

Where do the results come from?

The results come from the Manitoba Construction Safety Performance Survey of leading indicators. Leading indicators allow workplaces and system partners to gauge health and safety performance *before* injuries and illnesses occur.

We benchmarked your organization's leading indicator scores to comparable participating organizations in Manitoba from 18 classifications (rate codes). More detailed information is found in the appendix.

Interpreting your results

We use a colour-coded scheme to help you better understand your results. That is, for each measure included in this report, your organization's score is coded green, yellow, or red to indicate the following.

Green: You are performing well in this area. Keep doing what you are doing and strive for excellence.

Yellow: Your work in this area may need improvement. Consider if this should be a focus area for your organization. Review your safety practices and policies and consult CSAM's website resources for information on how to improve. If you need further guidance, consider contacting CSAM.

Red: Your work in this area likely needs attention and improvement. Consider if this should be a focus area for your organization. Review your safety practices and policies and consult the information available on CSAM's website to help point you in the right direction. Contact CSAM for assistance.

For more information please contact CSAM at: 204-775-3171 or email: mike@constructionsafety.ca

What is new for 2018/19?

Going forward all organizations will be invited to take the Construction Safety Performance Survey directly on CSAM's **INDICATOR** dashboard. You will immediately receive results and be able to compare them to industry benchmarks. **INDICATOR** will enable you to track improvement over time. CSAM plans to expand **INDICATOR**'s capacity beyond a single informant, to allow your organization to have multiple persons across multiple sites complete the survey. This will allow you to examine the consistency of how your programs are performing across operational areas. CSAM is also working with WCB Manitoba to use anonymized claims and cost data from participating companies to enable **INDICATOR** to examine how improving a safety program affects accidents, incidents, and the bottom line.

Training materials developed by CSAM can support you in creating action plans to enhance safety program performance and build a stronger culture. Not only will you benefit by having the opportunity to improve your organization's OSH performance, but strategically CSAM members will help create the best knowledge base in Canada for managing OSH performance. All data collected, including survey responses and organization information, are kept strictly confidential.

For more detailed information on this project, visit: www.constructionsafety.ca/manitoba-construction-safety-performance-survey

Organizational Benchmarking Report for: [Organization's Name]

The results below show your organization's scores for each of the survey measures, based on your answers. Your data was benchmarked against: (1) other organizations in your WCB classification (rate group) and (2) all construction businesses in CSAM.

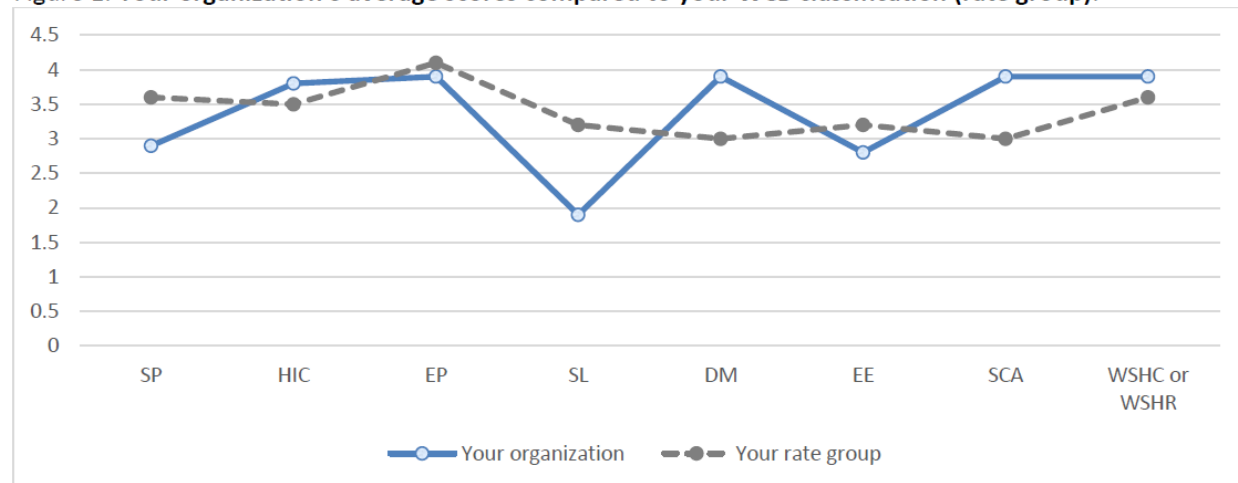
The table presents an average score for each measure. The colour coding (green, yellow or red) indicates your rating as a per cent of the total possible score. Grey cells without a score indicate that the items in the survey were not completed or did not apply to your organization. The same data is shown in a line chart in Figure 1 below. For more information on these measures and how to interpret them, please refer to the glossary and appendix.

Table 1. Your organization's average scores compared to other participating organizations.

The score range is 0 (lowest) to 4 (highest) for all measures.

	Your organization's score	[Rate group name]	All participating organizations
Organizational Policies and Practices (OPP)			
Safety practices (SP)	2.9	3.6	3.8
Hazard identification and control (HIC)	3.8	3.5	3.6
Ergonomic practices (EP)	3.9	4.1	3.9
Safety leadership (SL)	1.9	3.2	2.2
Disability management (DM)	3.9	3.0	3.0
Employee engagement (EE)	2.8	3.2	3.5
Safety Culture Assessment (SCA)	3.9	3.0	3.0
Workplace Safety & Health Committee (WSHC) or Representative (WSHR)	3.9	3.6	3.2

Figure 1. Your organization's average scores compared to your WCB classification (rate group).



Contact CSAM for more information at: 204-775-3171 or email: mike@constructionsafety.ca



**Institute
for Work &
Health**

Research Excellence
Advancing Employee
Health



Appendix

1. How were your scores determined for each leading indicator?

This report provides your organization's results for 8 leading indicators. Each leading indicator included several items, and you were asked to assess how well your organization was doing with respect to each of these items. Your score for each leading indicator is an average of your scores for all the items. For example, "safety practices" comprises six statements and for each you were asked to assess your organization's performance by indicating the percentage of time each practice takes place at your company, from 'never —0%' (score of 0) to 'always —100%' (score of 4). If your scores for the six statements are 3, 4, 2, 4, 4 and 3, respectively, your organization's safety practices score will be $3 + 4 + 2 + 4 + 4 + 3 = 20 / 6 = 3.3$.

2. Interpreting your scores

a. Colour coding

Your organization's average score on each measure was converted to a percentage of the total possible score on that measure. A colour-coding system is used to indicate the percentage range in which each of your average scores falls.

- **Green indicates a score of 75 per cent or greater.** This suggests you are performing well in this area, and that you should keep doing what you are doing while striving for excellence.

- **Yellow indicates a score of 50 to under 75 per cent.** This indicates that your work in this area may need improvement. Consider whether this should be a focus area for your organization. If so, you should review your practices and policies and consult CSAM's website for information about how to improve. If you need further guidance, you should consider contacting CSAM (see the contact information on the previous page).

- **Red indicates a score under 50 per cent.** This suggests that your work in this area likely needs attention and improvement. Consider whether this should be a focus area for your organization. If so, you should review your practices and policies, consult information available on CSAM's website, and contact CSAM (using the information provided on the previous page). Please note that you may have selected 0 for some items because they did not apply to you. This would have resulted in a lower score. To see the survey items, visit the project's webpage at the address listed below.

- You may not have received a score for some measures. This is due to the fact that some measures did not apply to your organization or the items in the survey were not completed.

- You should consider both the colour-coding and your scores benchmarked against others participating in the study to get a more complete picture of your performance.

b. Benchmarking with other organizations

In the table, your average scores on each measure are shown beside comparable organizations from one of the following 18 classifications (rate codes)—building construction (401-02); flooring and tiling (401-03); installing metal products (401-04); painting and decorating (401-05); wrecking and moving buildings (401-06); drywall and stucco contracting (401-08); installing doors and windows (401-09); concrete work (401-10); installing case goods and fixtures (401-12); landscaping (401-15); electrical contracting (402-03); plumbing, insulating and mechanical (402-04); roofing and eavestroughing (404-03); constructing dams, wharves, bridges and steel (405-02); installing elevators (406-02); installing heavy machinery (406-03); tower and energy construction (409-03); and, railway construction (409-04). This will help you know if your organization should improve relative to others, but you should also consider the colour coding to get a more complete picture of your performance.

3. What is the evidence behind the measures used in the survey?

The Manitoba Construction Safety Performance Survey was developed by researchers, with input from OSH practitioners and Manitoba construction stakeholders. The measures have been piloted and analyzed in other studies, and further analyzed in this study.

For more information contact Mike Jones at mike@constructionsafety.ca

Glossary

The following definitions refer only to terms used in this report.

Organizational Policies & Practices (OPP): The OPP tool represents occupational safety & health (OSH) and disability management policies and practices critical for the prevention of injuries and the onset of disabilities in organizations. These OPPs are most effective in high-engagement organizations and, thus, the level of engagement of the organization with its employees needs to be measured.

- **Safety practices:** Practices that an organization engages in to protect employee safety, including maintaining safe work environments and taking corrective and proactive actions to rectify unsafe conditions (6 items).
- **Hazard identification and control:** Practices in support of identifying hazards in the workplace and then reducing hazard risk through engineering controls, personal protective equipment or administrative controls (10 items).
- **Ergonomic practices:** Practices aimed at reducing ergonomic hazards through job design, redesign and procurement policies and practices (4 items).
- **Safety leadership:** Upper management's commitment and participation in safety issues, which is visible in management's involvement, commitment of organizational resources and people's time to promote safety, and active efforts to balance economic and OSH actions (6 items).
- **Disability management:** Policies, procedures and practices to support early intervention post-injury and communication and coordination of care with health-care providers for timely return to work, including education and accommodation in and after return to work to support staying at work (7 items).
- **Employee Engagement:** The extent the organization involves employees in meaningful decision-making, where there is trust between management and employees, and openness to share information in a cooperative work environment (4 items).

Safety Culture Assessment (SCA): This is a measure being used by SAFE Work Manitoba to assess the strength of an organization's safety culture and how it changes in the province over time. Safety culture is defined by SAFE Work Manitoba as a set of shared values and beliefs that influence actions and practices regarding workplace safety and health, shaping how decisions are made, how the organization operates, and how peers and leadership build safe and healthy workplaces (12 items).

Workplace Safety & Health Committee (WSHC) or Representative (WSHR): Practices that examine how well your committee/ representative is performing in supporting to build a safe and healthy workplace (5 items).

For more information on these measures, visit: www.constructionsafety.ca/manitoba-construction-safety-performance-survey

