SAFETY AND HEALTH INVESTMENT PROJECTS
FINAL REPORT

Developing Effective Health and Safety Committees for High Risk Small Business
2011ZH00172
1/30/2012 – 12-31/2013

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April 10, 2014

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Funding and support for this project has been provided by the State of Washington, Department of Labor & Industries, Safety & Health Investment Projects.

PART I

Narrative Report

Organization Profile: For awarded organizations, to include partners and collaborators, provide a brief description of each organization. Mission, vision, and purpose for each of the organizations who applied (this includes partners and collaborators) for the grant.
University of Washington Department of Environmental and Occupational Health Sciences includes several programs including Occupational Medicine, Environmental Health, Toxicology, and the Exposure Sciences Program. Our department has a history of providing health and safety training, consultations, laboratory testing and clinical services to business and labor organizations. The Exposure Sciences program includes programs of study and research in Occupational Hygiene, Ergonomics, and Health and Safety Management. The departments Continuing Education Program provides occupational health training in Washington to business, labor and the public. The department's official mission is to identify agents in the environment and the workplace that affect human health, elucidate their mechanisms to develop strategies for confronting their effects, and to share the knowledge obtained. We prepare students, workers, and managers by training them to identify and reduce hazards in industry as well as in the environment. Preventing occupational injuries and illnesses is central to our mission.

Abstract: Present a short overview of the nature and scope of the project and major findings (less than half a page).
See attached report

Purpose of Project: Describe what the project was intended to accomplish.
See attached report

Statement and Evidence of the Results: Provide a clear statement of the results of the project include major findings and outcomes and provide evidence of how well the results met or fulfilled the intended objectives of the project.
See attached report

Measures to Judge Success: If relevant, state what measures or procedures were taken to judge whether/ how well the objectives were met and whether the project or some other qualified outside specialist conducted an evaluation.
See attached report

Relevant Processes and Lessons Learned: Specify all relevant processes, impact or other evaluation information which would be useful to others seeking to replicate, implement, or build on previous work AND Provide information on lessons learned through the implementation of your project. Include both positive and negative lessons. This may be helpful to other organizations interested in implementing a similar project.
See attached report

Product Dissemination: Outline of how the products of the project have been shared or made transferrable.
The project has been summarized into a final report and will distributed to participating companies and can be made available to other interested companies.

Feedback: Provide feedback from relevant professionals, stakeholder groups, participants, and/ or independent evaluator on the project.
Participating companies reported appreciating support and resources for their committees.

Project's Promotion of Prevention: Explain how the results or outcomes of this project promote the prevention of workplace injuries, illnesses, and fatalities?
The purpose of health and safety committees is to prevent workplace incidents through hazard recognition and control by fostering employee involvement. By improving committee effectiveness, hazard regonition and control should follow, ultimately leading to reduced rates of incidents.

Uses: How might the products of your project be used within the target industry at the end of your project? Is there potential for the product of the project to be used in other industries or with different target audiences?
The final report and results can be used by participating companies to further identify strengths and weakenesses in committee function that can be addressed to continue to improve effectiveness. Training materials may be useful for other worksites to assess and improve health and safety committee functioning.

Additional Information

Project Type

- ☐ Best Practice
- ☐ Technical Innovation
- ☐ Training and Education Development
- ☐ Event
- ☐ Intervention
- ☒ Research
- ☐ Other (Explain):

Target Audience: Companies with health and safety committees (and companies wanting/needing to establish health and safety committees), research community, policymakers

Languages: English

Industry Classification (check industry(s) this project reached directly)

- ☐ 11 Agriculture, Forestry, Fishing and Hunting
- ☐ 21 Mining
- ☐ 22 Utilities
- ☐ 23 Construction
- ☒ 31-33 Manufacturing
- ☐ 42 Wholesale Trade
- ☐ 44-45 Retail Trade
- ☐ 48-49 Transportation and Warehousing
- ☐ 51 Information
- ☐ 52 Finance and Insurance
- ☐ 53 Real Estate and Rental and Leasing
- ☐ 54 Professional, Scientific, and Technical Services
- ☐ 55 Management of Companies and Enterprises
- ☐ 56 Administrative and Support and Waste Management and Remediation Services
- ☐ 61 Educational Services
- ☐ 62 Health Care and Social Assistance
- ☐ 71 Arts, Entertainment, and Recreation
- ☐ 72 Accommodation and Food Services
- ☐ 81 Other Services (except Public Administration)
- ☐ 92 Public Administration

Please provide the following information - *- (information may not apply to all projects)*

# classes/events:	14
# hours trained	20
# companies participating in project	6
# students under 18	NA
# workers	680
# companies represented	6
# reached (if awareness activities)	NA
Total reached	680

List, by number above, industries that project products could potentially be applied to.
All

Potential impact (in number of persons or companies) after life of project?
Unknown

Have there been requests for project products from external sources? No
If Yes, please indicate sources of requests:

PART II

Financial Information
Budget Summary

Project Title:	Developing Effective Health and Safety Committees for High Risk Small Business		
Project #:	**2011ZH00172 K-1854**	**Report Date:**	April 28, 2014
Contact Person:	Allison Crollard	**Contact #:**	206-221-5445
Start Date:	1/30/2012	**Completion Date:**	12/31/2013

1.	**Total original budget for the project**	$ 250,000
2.	**Total original SHIP Grant Award**	$ 250,000
3.	**Total of SHIP Funds Used**	$ 253,524.33
4.	**Budget Modifications (= or - if applicable)**	$ -
5.	**Total In-kind contributions**	$ 26,344.80
6.	**Total Expenditures (lines 2+4+5)**	$ 276,344.80

Instructions:

- Complete the Supplemental Schedule (Budget) form first (on the next page).
- The final report must include all expenditures from date of completion of interim report through termination date of grant.
- Indicate period covered by report by specifying the inclusive dates.
- Report and itemize all expenditures during specified reporting period per the attached supplemental schedule.
- Forms must be signed by authorized person (see last page).
- Forward one copy of the report to **Project Manager Name, SHIP Project Manager** at **PO Box 44612, Olympia, WA 98504-4612**

PART II
(Continued)

Financial Information
Supplemental Schedules (Budget)

Project Title:	Developing Effective Health and Safety Committees for High Risk Small Business		
Project #:	**2011ZH00172 K-1854**	**Report Date:**	April 28, 2014
Contact Person:	Allison Crollard	**Contact #:**	206-221-5445
Total Awarded:	$250,000		

ITEMIZED BUDGET: How were SHIP award funds used to achieve the purpose of your project?

	Budgeted for Project	Amount Paid Out	Difference
A. PERSONNEL	$207,063	$223,381.44	$-16,318.44
Explanation for Difference and other relevant information: Personnel changes/adjustments in effort occurred mid-project.			

	Budgeted for Project	Amount Paid Out	Difference
B. SUBCONTRACTOR	$0	$0	-
Explanation for Difference and other relevant information: N/A			

	Budgeted for Project	Amount Paid Out	Difference
C. TRAVEL	$3,060	$2,725.86	$334.14
Explanation for Difference and other relevant information: Includes all travel plus vehicle maintenance charge ($22.24)			

	Budgeted for Project	Amount Paid Out	Difference
D. SUPPLIES	$500	$186.08	$313.92
Explanation for Difference and other relevant information: Much of the data collection and presentation to sites was conducted electronically, reducing need for office supplies.			

	Budgeted for Project	Amount Paid Out	Difference
E. PUBLICATIONS	$650	$0	$650
Explanation for Difference and other relevant information: Training manual materials were presented to the committees electronically.			

	Budgeted for Project	Amount Paid Out	Difference
F. OTHER	$16,000	$5,675	$10,325
Explanation for Difference and other relevant information: Partner organizations did not request offsets so funds for these and HSC honoraria have been rebudgeted to personnel (approved). The graphic designer was ultimately not needed as training manual content was presented electronically.			

	Budgeted for Project	Amount Paid Out	Difference
TOTAL DIRECT COSTS	$227,273	$ 231,968.38	$-4,695.38
	Budgeted for Project	Amount Paid Out	Difference
TOTAL INDIRECT COSTS	$22,727	$21,555.95	$1,171.05
	Budgeted for Project	Amount Paid Out	Difference
TOTAL SHIP BUDGET	$250,000	$253,524.33	$3,524.33

	Budgeted for Project	Amount Paid Out	Difference
G. IN-KIND	$19,975	$26,334.80	$6,359.80
Explanation for Difference and other relevant information: Third-party cost sharing was slightly higher than anticipated and Dr. Seixas received a raise. The budget was slightly overspent and this deficit was absorbed by the PI's indirect cost return budget, which is why it is included in the in-kind total.			

I hereby certify that the expenditures listed on this report were made with my approval:

04/28/2014

Date

Signature of Project Manager

PART III
Attachments:

Provide resources such as written material, training packages, or video/ audio tapes, curriculum information, etc. produced under the grant.

Also include copies of publications, papers given at conferences, etc.

This information should also be provided on a **CD** or **DVD** for inclusion in the file.

REMINDER!!: All products produced, whether by the grantee or a subcontractor to the grantee, as a result of a SHIP grant are in the public domain and can not be copyrighted, patented, claimed as trade secrets, or otherwise restricted in any way.

Methods of Intervention with Health and Safety Committees to Improve Effectiveness

Final Report

Noah Seixas, PhD
Bert Stover, PhD
Allison Crollard, MS
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April 10, 2014

Funding by Washington State Department of Labor and Industries,
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Executive Summary

Health and safety committees (HSCs) are one of the key organizational forms which companies may use to effectively control safety and health risks by fostering communication and worker engagement, developing and overseeing programs and monitoring site conditions and concerns. Although required by Washington State regulations, HSCs may not be implemented effectively in many small businesses.

Six companies from high hazard metal processing industries were recruited to participate in project to characterize and develop more effective HSCs. Each site was characterized at baseline for HSC structure and function, risk (exposures, controls and injury experience) and safety climate. The HSC was provided with training on effective function and supported in assessing barriers to implementation of effective programs. Subsequently, the sites were reassessed, and any change in conditions, or perceptions of HSC effectiveness was observed.

Among the six sites participating, there was a wide range of HSC effectiveness at baseline. The two smallest sites had no HSC, while the larger sites, with support from a corporate safety program, had well established programs with relatively effective committees engaged in multiple activities.

The two small sites with no committee at baseline were able to establish committees and begin new programs designed to engage workers in safety and health activity. The largest site with a strong program at baseline was able to use the training to enhance its own internal processes. Two sites which were undergoing significant restructuring at the upper management level, were largely unable to respond to the HSC training, and thus continued with relatively ineffective programs.

A limited training on HSC functions was useful to small companies which had little previous experience with worker involvement in HSC activities. Larger companies, especially those with well-formed programs continued to perform very well or poorly, depending on upper management commitment and stability, and the safety climate at the site.

Introduction

Health and safety committees (HSCs) are important organizational elements for insuring sustainable and comprehensive prevention of work injury and illness. Washington State requires joint labor management HSCs in all companies with greater than 10 employees on a shift at one location, with specific requirements for membership, meetings, recordkeeping, etc. (Washington Administrative Code 296-800-130). Effective HSC performance involves management commitment, labor involvement, communication at all levels of the organization, effective training and information, well-defined committee processes, and the involvement of professional expertise (Boden et al., 1984; Bryce & Manga, 1985; Eaton & Nocerino, 2000; Geldhart et al., 2005; Kochan et al., 1977; Milgate et al., 2002; Morse & Bracker, 2010; Morse et al., 2008; Shannon et al., 1996; Yassi et al., 2013). However, the effectiveness of these committees in preventing occupational injury and illness is uncertain and little information is available about what type of information or support that would assist an existing committee in becoming more effective.

The Department of Environmental and Occupational Health Sciences (DEOHS) at the University of Washington developed a project to assess how health and safety committees can make the workplace safer. Our goal was to determine the degree to which training intervention can be effective in supporting improved safety and health performance in small, hazardous industries. In particular, we provide training intervention at six companies focusing on development of the health and safety committee. The project components included development of guidelines to developing an effective health and safety committee, delivering that training to the existing (or newly formed) HSC at each site, including assisting the committee in developing a work plan, and supporting labor and management communication and cooperation toward effective committee work. Health and safety conditions and management support for committee goals were measured before and after the training, through characterization and observation of the committee function at baseline, questionnaires delivered to a representative sample of the workforce, and work observations to assess exposures, use of safety and health protections. Lessons learned about effective committee work, and components of an effective training for HSC development are provided as our results here.

The original project design called for ten sites to be included in the project and delivery of two different levels of training and support intervention. However, recruitment of appropriate sites into the study proved very challenging, and as a result, only six sites, with a similar intervention model delivered to each, were included. However, the heterogeneity of the sites at baseline provides the basis for an assessment of a simple intervention with very different organizational capacities.

Methods

We partnered with six small businesses in the primary metals and metal products manufacturing industries and provided HSCs with effective methods to prevent workplace exposures, and reduce illness and injury. We identified small companies (<200 workers) within this industrial sector who had had fatalities or significant injuries that resulted in a hospitalization in the last 3 years in Western Washington. A total of 26 companies fitting this description were identified and invited to participate. We were only able to identify six sites that were willing to participate, and available. At least one identified site was shut down by strikes and other interruptions and was unable to commit to participation in the project.

An initial characterization of each site and their HSC status was conducted through onsite visits and discussions with lead health and safety staff. Baseline data was collected between June 2012 and March 2013 with follow-up data collected between May 2013 and October 2013, with the intent that there would be at least 4 months between the training and follow-up evaluation. Data were collected onsite by study staff using Android-based tablets running Open Data Kit (ODK) loaded with the study instruments. Data were uploaded to a web-based server for compiling and made available for downloading and analysis.

A questionnaire was delivered to all workers on each site, if there were fewer than 50 employees. If more than fifty, we took a random sample of 40 workers, stratified by department and shift. In either case, we also sampled the members of the HSC, including representatives of management. The same questionnaire was used for both pre- and post-intervention and included sections addressing exposures (chemical, physical, ergonomic, safety) and use of protective equipment, musculoskeletal disability (QuickDASH, Institute for Work and Health, 2006), injury experience, perceptions and interactions with the HSC, safety climate (Nordic Safety Climate Assessment Questionnaire, Nordic Council of Ministers, 2011), and demographic characteristics. Additional questions were asked about experiences within the HSC for current members. Appendix 1 contains the questionnaire.

We also collected data on exposures and use of protective equipment (personal and engineering controls) at each site using an observation approach. Members of the study team determined a comprehensive walk-through route covering all major areas of the site with pre-determined observation locations. At each location, each visible worker was rated for the presence of a potential exposure (None, Low, High), and if present, the use of related PPE. The target number of observations was at least 15 circuits through the site before and after the training, and included all working shifts. The hazards (controls) observed were: Work at Height (harness/railings), Noise (HPDs), Eye hazards (safety glasses, etc.), Dust/fume (Dust mask or respirator), Struck by objects (hardhat, barriers), Traffic/vehicle hazards (Hi-Vis vest, etc.), Machine hazards (machine guards), Maintenance/Energy control (Lock/Tag-out), Lacerations/Abrasions (gloves), Trip hazards (none). The form and the definitions for each category are presented in Appendix 2.

We have restricted the analysis of the questionnaire to data for individuals on whom we had data both before and after the intervention. For most sections of the questionnaire, we present means and standard deviations of the results at baseline, and for selected outcomes. In addition, for selected results, tables present the change in questionnaire results from pre- to post-intervention, and matched sample t-tests were conducted to test the statistical significance of any change observed. Due to the small number of companies in this study and the large number of t-tests conducted, the significance levels provided need to be interpreted with caution as some results may be significant ($p<0.05$) due to chance.

Hazard observations are reported as the frequency (percent of observations made) in which a particular worker was exposed to the hazard. Linked to each of these exposures is the percent of exposures in which a protective barrier or PPE was effectively in use. In other words, the presence of an exposure would only be a risky situation if the protective system were also absent. In addition to the baseline observations, the change in the percent of exposure and use of protective systems is presented.

In addition, we provide descriptive information about each site's and HSC's activities and accomplishments during the post-intervention period. These notes provide a more complete story of the circumstances and events affecting the HSC and its possible effect on the worksite. These notes were summarized from numerous site visits, attendance at HSC meetings and discussions with site personnel.

Intervention Description

We built on our previous experience of HSC training to develop a streamlined training package that would be practical for delivery at the partnering companies. Our original model involved a two-part training session, with each session of four hours. However, the partner companies in this case were not willing to commit this much time, and we settled on three to six hours of total training split over two or three sessions to accomplish our goals.

The primary goal for the sessions was to enhance the committee's ability to function as a team, identify the means to gather information about risks and controls at their worksite, and to develop the capacity to affect positive change within their organizational context. Thus, rather than dictating to them how to accomplish specific goals, we facilitated a process of discovery within the committee of the organizational assumptions regarding risk causation, the role of the HSC within the organization, and avenues to affect change. In order to best help the committees through this process and achieve the goals of the intervention, a skilled facilitator was employed to help plan and implement the training sessions, and training activities were designed to limit traditional lecture style delivery, instead emphasizing participatory exercises and discussions.

One of the initial activities of the first training session was to provide all committee members with a baseline understanding of HSC requirements and best practices, and for the group to examine how their own functioning compared. In large and small groups, participants were prompted to discuss current

HSC roles and activities, or in the case of sites with newly created HSCs, to establish activities, roles and responsibilities of the committee and its members. The group was also presented with a model of incident causation, intended to familiarize the group with potential hazards and contributing factors to health and safety incidents. The session concluded with the compilation of current health and safety issues specific to the site, and subsequent prioritization of a few selected topics. Members were then tasked with consulting their constituent coworkers before the next training session to gather information about these and other issues in their respective work areas. The "homework" activity served to not only encourage site-wide awareness and discussion of health and safety issues, but to also give members practice in communication with their coworkers, a fundamental component to HSC success.

The goal for subsequent sessions was to highlight internal and external HSC function through analysis of some of the health and safety issues raised in the first session and in the "homework" discussions in members' work areas. In small groups, HSC members discussed the problem(s) at hand, potential consequences, possible solutions, and what role the HSC could or should play in addressing the issue. In addition to prompting discussions of ways to address hazards, the exercise also encouraged consideration of the broader organizational structure of the company, and how the HSC functions (or could function) within that structure to affect change in health and safety. Ultimately, the goal for the second session was to lay the groundwork for issues which the committee could address effectively after the training was completed. Materials used in the training are provided in the Appendix 3.

Results

Site and Site-specific Training Descriptions

Site 1

Site 1 is a privately owned forge and machining company with a workforce of 150 employees. A variety of components are produced here, many for aerospace contracts. Processes include melting and casting billets, forging the billets into desired shapes, and then further machining and inspecting parts to customer specifications.

The workforce is nonunionized and works over three shifts. The workforce is diverse, with workers speaking a variety of languages. Reportedly, almost all workers have adequate English abilities. The site is divided into a variety of work areas, each with their own leads and supervisors for each shift, and a manager. There is a safety director employed at the forge; however his time is divided, as he also manages maintenance and engineering. The safety director conducts site walkthroughs, safety audits, and safety trainings. An operations staff person also assists with some safety recordkeeping duties. Each department is supposed to hold daily toolbox talks and weekly safety meetings with pre-determined topics, although these appear to happen irregularly in some work areas. Typical safety concerns include hazards leading to musculoskeletal disorders, cuts and scrapes, and burns.

HSC Pre-Training

Site 1's health and safety committee met weekly, and was chaired by a worker representative. The committee consisted of 8 worker members, although there were typically only 4 or 5 in attendance for each meeting. The health and safety director also attended the meetings as the only management representative. Meetings lasted about an hour and were semi-structured with an agenda. Worker members seemed to be generally quiet during meetings, with the chair and safety director doing most of the talking. Most of the committee activities seemed to be centered on safety "PR," such as developing a new safety board and planning for a safety incentive program. Very few safety concerns were brought from the floor. Detailed planning for these initiatives was carefully laid out and tracked using a variety of software programs. Similar tracking was in place for health and safety incidents and concerns. However, it seemed that very few safety issues were relayed by worker representatives from their constituents. Committee members as well as the safety director indicated that they have minimal credibility with the workforce, and were often chastised for interrupting production. Interest in participating on the HSC seemed somewhat limited among workers, and some were asked to volunteer for work on the committee. Formal elections were held annually.

During the data collection period and the time before the intervention, Site 1 experienced significant organizational changes. This included a series of layoffs, and the departures of the safety director, VP of Operations, the CEO, and CFO. These major changes resulted in considerable uncertainty among employees and the interruption of some safety efforts. The worker representative, who is also the chair of the HSC, was named safety coordinator during the interim period before finding a new safety manager. A new safety director was hired a few months before the training intervention.

After substantial negotiations for participation and the signing of a non-disclosure agreement, the site was very helpful and open to having us do observations and surveys. The major changes in management at the site posed challenges in conducting study activities. Having lost some of the workers due to layoffs that originally participated in the interview process, there was a need to replace them with new workers. Without the safety manager, this effort became more cumbersome and time consuming.

Training

Training was scheduled shortly after the site's regularly planned elections for the HSC. Therefore, the majority of members at the training were new to the HSC. Attendance at the trainings was inconsistent, with three managers and five workers at the first session, but only two workers at the second training due to scheduling conflicts around current production demands. The safety director attended part of the first session only. Some managers expressed their frustration at having to spend time away from the plant to attend the training.

Most of the safety issues raised during the training required capital investment, such as lighting, potholes, uneven surfaces, and crane function and operation. Also mentioned was the need to periodically offer refresher safety courses to all workers. It was noted that some of these issues had been raised from workers in the past, but remained on the HSC docket for as long as three years. During

the second session, worker members expressed their frustration at having to relay the same complaints from their co-workers repeatedly, and the resulting negative reflection on the HSC. In addition, the general consensus of the group was that production demands were sometimes in conflict with general safety practices.

The group dynamics during the training highlighted a division that existed between workers and supervisors. We observed that worker representatives worked better as a team, whereas management remained distant and appeared skeptical of the training as a whole. One important issue raised during the sessions is that there was a lack of clarity as to the individual roles of committee members. Although the HSC recently adopted a charter for the group, it was unclear how this was interpreted by new members and how management and supervisors would accept it. .

After the initial HSC training, 14 of the workers included in the first set of interviews were laid off and are no longer working at Site 1. The coordination of the data collection was challenging due to limited staff availability and production demands. The safety manager not only oversees safety he is also is now responsible for the management and supervision of the maintenance, electrical and environmental staff. Since our last visit in August, work schedules have been changed in order to accommodate production. On numerous attempts to complete the interviews, we faced changes in schedule and were offered limited access to staff time to complete some of the interviews, and we were only able to complete less than half of these interviews over a period of two months.

Overall perception of HSC function and recommended post-training actions

At the study onset, the HSC at Site 1 was well-organized, met regularly and very frequently, and was the only participating site with a worker-representative as chairperson. However, communication seemed to be limited between members and the workforce, and relatively few worker-generated concerns were raised or addressed during meetings. Lack of credibility of the HSC was also a reported barrier to HSC success, along with variable support for safety at the supervisor level. These issues were further augmented with the management turnover and layoffs.

During the training, it became very clear that understanding of individual member roles and responsibilities differed among the newly elected committee. While efforts were made to find common ground and agreement on this within the group during the training sessions, it was recommended that the HSC work together to define roles and responsibilities of its members and of the committee itself in a more formal charter-type document. Subsequent implementation of agreed upon roles and responsibilities would require significant collaboration and communication efforts at all levels of the organizational structure.

Site 2:

Site 2 is a large foundry with approximately 260 workers. The foundry was acquired by their current parent company in 2007, a global corporation. The site makes steel castings for United States military, nuclear, and other applications. Work areas include a full wood-working pattern shop; core making and

molding; ladle preparation and repair; melting and pouring; and finishing operations including arcing, grinding, welding, and inspection processes.

The workforce is nonunionized and works over three shifts. The workforce is diverse, with workers speaking a variety of languages. Reportedly, almost all workers have adequate English abilities, and many supervisors are bilingual. The site is divided into a variety of work areas, each with their own leads and supervisors for each shift, and a manager. The foundry employs a full time safety director, as well as a safety assistant. The safety director conducts site walkthroughs, safety audits, and safety trainings, manages recordkeeping, and coordinates workers' compensation claim management. Typical safety concerns include risks for cuts, scrapes and burns, eye hazards, musculoskeletal hazards, crane and suspended load safety, and housekeeping.

HSC Pre-Training

Each work area had a safety representative for each shift, who also served as a health and safety committee member. Safety representatives were responsible for conducting monthly safety meetings in their work areas; holding daily "pre-shift huddles" which address safety topics; maintaining safety bulletin boards; doing weekly walkthrough inspections of their area; assisting supervisors with behavior based safety observations; and implementing the safety incentive program which awards safe acts with credit for vending machines. Safety representatives were compensated $0.25 an hour in addition to their normal wage. Elections for representatives were held annually, and there seemed to be significant interest among employees in these positions. Orientation of new members would take place during their first committee meeting, and through informal mentoring by the previous safety representative from that work area.

The committee was chaired by the safety director, with recordkeeping done by the safety assistant. Meetings were held monthly, and lasted about an hour. Meetings were attended by the 20 or so safety representatives/worker members. Supervisors were also encouraged to attend meetings and four or five were typically present, along with four management representatives including the site's VP of Operations. The meeting format was very structured, with a closely followed agenda, and a formal atmosphere. Worker and management members seemed to collaborate well, and worker members were often solicited for ideas on solutions for safety concerns raised. Committee members also seemed to have good visibility and credibility among the workforce, in part due to their range of responsibilities as safety representatives.

The site was eager to participate and was cooperative in providing us access to their facilities and scheduling surveys with study staff. At times it was a bit difficult to schedule visits the site, due to production pressures. In the midst of pre-intervention data collection, the safety director left the company, making it more difficult to coordinate study activities at the site. Although we were able to coordinate with the safety assistant to complete most of the baseline assessment (surveys of night shift employees remained), she was quite busy managing additional responsibilities. Despite the absence of the safety director who chairs the committee, the site held regular elections for safety

representatives/HSC members and continued with their regular meetings. A new safety director was hired shortly after HSC elections, and the training was scheduled for soon after.

Training

To coordinate the training to meet the facility's schedule, both the first and second training were delivered to two separate groups on the same day, one in the morning to include third and first shifts, and the one in the afternoon to accommodate the second shift. A total of 18 workers and three management members completed the trainings.

A variety of health and safety issues were raised during the training sessions, including inhalation and dermal exposures; housekeeping; safety training and awareness; concerns about working while sick and communicable illness; communication challenges with the multi-lingual workforce and three shift structure. Throughout the training, the research team highlighted the need for the HSC to identify the differences between "fixing problems" such as maintenance and replacement of ventilation systems, versus what the HSC is able to do as part of its function in the organization such as reinforcing safety work practices requiring training for workers, such as the implementation of the suspended loads safety policy.

During the training management representatives actively participated during the group exercises. In addition, workers benefited from the training not only from the information presented but by the opportunity to work in groups to address safety issues and collectively identifying possible solutions.

Overall perception of HSC function and recommended post-training actions

The HSC at Site 2 was well-organized, productive, had clear roles and responsibilities, and maintained worker engagement in health and safety processes. Upper management supported HSC efforts and safety in general. Because the committee was so large, working as a cohesive group was somewhat challenging at times. The committee was encouraged to apply their skills and commitment to safety as individuals to the larger group process in order to address broader health and safety issues (particularly those that apply site-wide or which have potential long-term health impacts).

Site 3

Site 3 is a unionized and self-insured scrap metal recycling business with about 100 production employees at the beginning of the project. The site primarily processes ferrous materials from commercial customers. There is a large shredder and downstream separation system for processing auto bodies and other large items; mobile shearing and torch cutting for breaking down large or awkward items; and a large maintenance facility. Metals, once separated and broken down, are loaded onto ships, trains, or trucks by Site 3's workforce or by an onsite contractor to be shipped and sold.

Employees at this site are represented by various unions, depending on job title. Work was initially organized into three shifts at the project start, but was changed to two shifts after collection of pre-intervention data. Organizational structure includes a site general manager, managers for work

areas/departments, and supervisors for each work area and shift. Most employees are native English speakers, with several Spanish-speaking workers with varying English abilities.

Site 3 has a health and safety engineer on staff, who splits his time between this and another company site. The health and safety engineer conducts site walkthroughs, safety audits, safety trainings, and manages recordkeeping. The site holds monthly safety meetings for all employees, which includes a company-produced video addressing various safety topics pertaining to their metal recycling sites. In addition, the various departments hold their own safety meetings on a weekly basis. Typical safety concerns as reported by the employees include traffic safety, potential for cuts and scrapes, minor burns, and ergonomic risks.

HSC Pre-Training

The site's existing health and safety committee met monthly, with the health and safety engineer chairing the committee and performing recordkeeping duties. Meetings lasted between 60 and 90 minutes, and were semi-structured. The general manager was part of the committee, and department managers attended as they were able, which seemed to be irregularly. There were worker representatives from most departments and from first and second shifts, with some vacant positions. One representative was bilingual in Spanish and English. Worker members tended to be "junior" employees, and many had not been at the company for more than a year or two. Elections for new members were roughly held annually, only some representatives were selected in true elections. As interest in serving on the committee varied throughout the site, many members were approached and asked to volunteer to be on the committee.

Observation of early committee meetings revealed that there was good rapport between management and worker representatives. Members seemed comfortable around one another, and the atmosphere was informal with frequent joking and laughter. Worker representatives seemed to relay health and safety concerns of their coworkers raised at their department meetings. At the meeting, health and safety concerns were readily identified and ideas for potential solutions were offered by all members. Management members frequently asked employees for input on solutions or priorities, and received considerable feedback. At the same time, the overall perception among members was that their role as a committee member was limited. Safety issues that required planning and investment were left to management to decide, often without any feedback regarding the status and progress made. Identified safety-related issues that were raised at the worker level and documented remained on the to-do list for long periods of time. The lack of resolution impacts workers' perception that safety is a priority, which negatively impacts the role of individual members in their work area as a safety representative.

The site was at first cooperative in providing us access to their facilities and was open to further developing their HSC. However, it was at times difficult to get time to survey employees, reportedly due to production pressures. Near the end of our baseline assessment, it was announced that there would be significant layoffs. The majorities of employees laid off were junior employees, and unfortunately happened to include more than half of the current HSC members. For this reason, the training was

delayed several months until elections could be held and the committee could be reestablished. By the time this occurred, the site and the committee had a substantially less positive climate.

Training

A total of 6 workers and two management members completed training. The safety manager attended only one training session. A manager-in training was the only other management representative at both training sessions. Committee members seemed hesitant at the first, but were more engaged during the second session. This appeared to be in part due to the lack of management presence, and feeling more comfortable in speaking up. Furthermore, labor-management relations during the trainings seemed to be much more strained, and the mood was more negative and pessimistic than in observations of the HSC early in the study. This was likely attributable to recent layoffs, and widespread worry about job security.

A range of issues was raised during the sessions, including equipment maintenance, electrical safety, traffic hazards, dust exposures, communication challenges, and sick leave policies. Committee members particularly expressed concern that production demands tended to override safety practices. For example, equipment scheduled for maintenance that is not fully operational was often in continued use. HSC members also discussed the need for the HSC to improve communication with managers and supervisors about the HSC activities and their role of the HSC. In addition, there was criticism of the process by which safety issues are tracked and resolved, as issues would remain on the docket for long periods of time without any reporting on the status. Committee members also believed that lack of resolution for safety issues identified by co-workers diminished the overall HSC credibility.

Overall perception of HSC function and recommended post-training actions

At baseline, the HSC at Site 3 was relatively well-organized, discussed a variety of worker-generated health and safety issues and solutions, and had decent worker-member participation and engagement during meetings. However, after the significant layoffs, the committee atmosphere shifted, and worker-members began expressing frustration with perceived lack of management support for safety (i.e. production pressures overriding safety concerns/procedures), feelings of powerlessness in effecting health and safety changes, and lack of credibility among the workforce. These strained labor-management relations were highlighted in heated discussion regarding the sick-leave policy, in which workers reported working while sick (a health and safety issue), for fear of being formally disciplined, even with written medical justification.

In an effort for the committee to achieve a sense of ownership of their process and real engagement in health and safety efforts, we recommended the use of formal recommendations to management. At the end of the training, the committee requested our help to help facilitate this process. The general manager present at the meeting approved the recommendation and agreed that the junior manager/HSC member should bring the HSC requests back to the managers' monthly meetings.

Site 4

Site 4 is a small, non-unionized, scrap-metal recycling site with approximately 25 production employees. It belongs in the same corporation as Site 3. This site was acquired by the parent company in late 2008, having previously been a family-owned company. The site accepts both ferrous and nonferrous materials from commercial customers as well as individuals. Nonferrous processing takes place in a warehouse setting and consists of shake-out, baling, and torch-cutting operations. The ferrous processing area is outdoors and is relatively small, involving the use of mobile cranes to unload appliances and other materials into a large baler. Sorted materials are then usually sent to the company's larger Tacoma site to be sold.

Site 4 runs one shift per day. Workers receive annual bonuses based on incident record and net profits. The majority of workers are native English speakers, with a handful of Spanish-speaking workers with varying English abilities. The site has a general manager, but most production issues are handled by the ferrous supervisor.

Formal safety activities are largely handled by a regional safety engineer who visits the site once or twice a month, and is responsible for conducting site walk-throughs, safety audits and managing recordkeeping. Workers receive safety training using computer-based videos. The site holds monthly safety meetings for all employees, which includes a company-produced video addressing various safety topics pertaining to their metal recycling sites. In addition, the ferrous and non-ferrous work areas hold their own more informal safety meetings on a weekly basis. Typical safety concerns as reported by the employees include mobile equipment/traffic safety, general housekeeping, potential for cuts and scrapes, and ergonomic risks, radio communication protocol, and use of personal phones and texting. The site has not had a recordable injury in several years.

HSC Pre-Training

This site did not have a committee established prior to participating in the study. The parent company's regional safety engineer decided that Site 4 should participate in the project and develop an HSC to comply with state regulation. The site's general manager seemed eager to develop a committee, although the production supervisors seemed hesitant. Although willing, the ferrous supervisor was not convinced that it would have an impact on their already "excellent" safety record. Despite this sentiment, site staff were very accommodating, allowing us access to their site, readily providing their employees' time to complete baseline surveys with study staff, and promptly scheduling the training intervention. Prior to the training, committee members were elected, with representatives for all work areas, including a bilingual speaker that could convey information to fellow workers in Spanish.

HSC Training

A total of 6 workers and two management members completed the training. At both sessions, due to production demands, only a portion of committee members attended. In addition, the production supervisor was frequently interrupted or distracted during the trainings to manage production issues. Committee members seemed hesitant during the sessions. During the training we confronted some

disagreement between the regional safety manager and the production supervisor, expressed in the reluctance from the supervisor to adopt new safety responsibilities perceived as detractors from production schedules.

Safety concerns raised during the trainings included traffic safety, site communication strategies, and musculoskeletal hazards. While most of these issues could be resolved internally, such as forklift operator training, others needed corporate approval and funding (new radios). Participants spent significant training time discussing and formalizing processes, procedures, roles and responsibilities for their new committee. The production supervisor was elected as committee chair, and a record keeper was also appointed. There was also much discussion on differentiating HSC activities and responsibilities from those of the regional safety manager.

Overall perception of HSC function and recommended post-training actions

As Site 4 did not have an HSC at initiation of the study, many of the recommendations resulting from the training were centered on establishing policies, procedures, roles and responsibilities for the committee. We encouraged the committee to consider how current safety initiatives could support HSC efforts and vice versa. In addition, we attempted to highlight how the committee might be a useful tool for the site to have a sense of ownership of health and safety, rather than it being something imposed upon them from the regional office.

Site 5

Site 5 is a small foundry employing 25 production workers. It makes small castings in aluminum, bronze, iron and other metals for a variety of customers. Their processes include molding, melting and pouring, heat treating, and finishing.

The workforce is nonunionized and works two overlapping shifts. The workforce is diverse, with several workers speaking Spanish or Somali with extremely limited English abilities. Many are hired via a service for refugees. One of the site's owners handles many production issues, along with the site's two foremen. There is no designated safety staff person on site, and the owner's wife does most of the recordkeeping. External consultants are called in for health and safety concerns as needed. Common health and safety issues at the site include musculoskeletal hazards, risks for cuts, scrapes and burns, and housekeeping concerns.

Pre-training

Site 5 did not have a committee established prior to participating in the study. Instead, monthly safety meetings were held with the entire staff. The owner seemed eager to participate, although he was uncertain about employees' willingness to participate and form a committee. The owner was also concerned about language barriers. Nonetheless, the site was very accommodating, allowing us access to their site, and readily providing their employees time to complete baseline surveys with study staff.

Training

HSC members participating in the training included 8 workers and 2 management representatives. For 3 of the members English was a second language, with one fully Spanish-English bilingual worker serving as an interpreter. Many of the worker members were hesitant at the start of the training and seemed unaccustomed to contributing to decision-making processes. However, engagement and participation improved throughout the training with prompting from the facilitator and management representatives.

Safety concerns raised during the trainings included PPE use and storage, use of raised work platforms, first aid supplies and training, and lighting throughout the plant. Participants spent significant training time discussing and formalizing processes, procedures, roles, and responsibilities for their new committee. The group elected the owner and the bilingual worker representative as co-chairs for the committee, and designated a record keeper. It was also decided that members would start conducting more formal walkthrough inspections of their work areas to identify health and safety issues in addition to consulting their coworkers.

Overall perception of HSC function and recommended post-training actions

As Site 5 did not have an HSC at initiation of the study, many of the recommendations resulting from the training were centered on establishing policies, procedures, roles and responsibilities for the committee. In particular, much time was spent planning logistics of committee processes such as meeting structure, recordkeeping tools, and leadership of the committee. In addition, there was also discussion on ways to better engage workers in health and safety processes and decisions, and how to manage the significant language and cultural barriers.

Site 6

Site 6 is a family-owned company that operates an investment casting foundry. It currently employs approximately 120 workers. The company serves a wide variety of industries and makes a variety of products including aerospace components, industrial pumps, industrial gas turbines, medical products, transportation products, and computer hardware. Work areas include a waxing/molding area, melting and pouring, heat treat, and finishing operations including grinding, blasting, welding, and inspection processes.

The workforce is culturally diverse. Most workers are native English-speakers, though several speak Spanish and Vietnamese as their first language. Language and cultural diversity were reportedly challenging for accurately and consistently communicating among non-English speaking workers. The workforce is nonunionized and works two shifts. The site is divided into work areas that are supervised by one manager and lead workers in each area. Site 6 employs a full-time safety manager. The safety manager conducts safety audits, safety orientations, safety training, and manages recordkeeping. The site holds monthly meetings for all employees, which includes a message from the owners and a safety message from the safety manager. Typical safety concerns as reported by the employees include

housekeeping, forklift safety, language barriers, musculoskeletal hazards, cuts, burns, ventilation and noise.

Pre-Training

The site's safety committee met monthly for an hour. The HSC was chaired by the safety manager, who led the semi-structured meetings by reviewing pending items from previous meetings, and soliciting members for new health and safety issues. Some of these items remained on the list for several months, as time was needed for management to allocate resources for addressing issues requiring significant investments in machinery and equipment. Elections for members were held approximately annually, with elected workers often being new to the company. HSC members were oriented in their role by the safety manager during their regularly scheduled meeting. New members received copies of the Washington Employers Inc. "Safety Committees: Safety Committee Member Guide."

Communication to and from the HSC took place by word of mouth and through the posting of meeting minutes, although postings typically contained limited information. The safety director would occasionally email upper management with committee recommendations for addressing health and safety issues. HSC members were not formally meeting with coworkers in their work areas, and rarely participated in safety activities outside of meetings. Most of the workers seemed aware of the existence of the HSC, but for the most part lacked knowledge of their actual role in making the workplace safer. HSC members and employees expressed that safety issues such as airborne exposures, equipment maintenance and safety training had been ongoing, which contributed to a reported lack of trust in the effectiveness of the HSC.

The site was cooperative in providing us access to their facilities and was open to further developing their HSC. The safety manager facilitated the process by which we were able to complete the data collection phase with limited obstacles.

Training

The training was attended by the 10 worker members and the safety manager. All members attended both sessions. Participants were engaged and actively participated through the training, and seemed to be open to sharing concerns and discussing solutions. HSC members shared personal experiences dealing with safety, and also listed examples of safety concerns shared by their co-workers.

Safety concerns discussed at the trainings included forklift safety, housekeeping, ventilation concerns, PPE use, emergency planning, and safety training. In addition, although the company had not experienced a recordable time loss injury for six months, just prior to the training several workers reported experiencing musculoskeletal disorders related to lifting (e.g., hernia, shoulder injury). Many of these were related to concerns previously raised by workers and HSC members. Participants at the training appeared eager to address health and safety issues, but were lacking established policies and procedures to act effectively.

Overall perception of HSC function and recommended post-training actions

Site 6's HSC met regularly and was composed of interested and engaged members. Workers and management seemed open to new ideas for improving function and addressing health and safety concerns. However, there was little structure in place, and HSC roles, responsibilities, policies, and procedures were not well defined or implemented. We recommended formalizing these elements, particularly recordkeeping and establishing methods for regularly engaging workers in health and safety communication and processes.

Summary of Site and HSC Characteristics

A summary of the site characteristics and the structure and function of each companies' HSC at baseline is provided in Table 1, below.

Table 1. Summary of Site Characteristics

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Site "demographics"						
Number of employees	150	260	100	25	25	120
Industry	Forge	Foundry	Scrapyard	Scrapyard	Foundry	Foundry
Corporate safety program	No	Yes	Yes	Yes	No	No
Safety personnel on site	Yes	Yes	Yes	No	No	Yes
HSC established	Yes	Yes	Yes	No	No	Yes
Union	No	No	Yes	No	No	No
HSC characteristics						
Committee size	10	25	12			11
Worker/mgmt member ratio	5:1	2:1	2:1			8:1
All shifts/depts represented	No	Yes	Yes			No
Incentives for HSC service	No	Yes	No			No
Formal elections held	Yes	Yes	No			No
Formal orientation for members	No	Yes	No			No
Extra training for members	No	Yes	No			No
Mgmt support for activities outside meetings	Always/almost always	More than half the time	About half the time			Always/almost always
Meetings and recordkeeping						
Meeting frequency	Monthly	Weekly	Monthly			Monthly
Recordkeeping	Agendas, minutes, action item tracking	Agendas, minutes, action item tracking	Agendas, minutes, action item tracking			Agendas, minutes,
Sharing of minutes with workers	Online, verbal	Bulletin board	Verbal			Bulletin board
External HSC activities						
Communicating with workers about HSC work	Weekly safety meetings	Weekly safety meetings	Weekly safety meetings			Informal word of mouth
Other member responsibilities	Weekly inspections, safety incentive program	Weekly inspections, safety incentive program, behavior based observations	Monthly inspections			None
Recommendations to mgmt	Occasionally, in writing	Frequently, during meetings	Occasionally, via safety director			Occasionally, via safety director

*As reported by safety personnel/committee chairperson

Questionnaire Results

Worker and site characteristics

Two hundred and forty eight workers provided questionnaires, with 164 workers providing both baseline and follow-up responses, and these 164 form the basis of this analysis. An additional 24 managers completed questionnaires and their responses are included in the HSC results section only.

The demographics of the worker's with both baseline and follow-up questionnaires are provided by site in Table 2. The average age across sites was 41 years with a site average range of 37 to 47. Among all workers, the youngest was 22 and the oldest was 70 years. Workers had lived in the U.S. for an average of 20 years, but this varied considerably across sites from the shortest average of 13 years in Site 4, to the longest in Site 1 with 26 years. A minimum of high school education was obtained by 89% of workers across all sites. However, only 50% of workers obtained this level of education in Site 5, with 21% obtaining high school education and 29% receiving college or technical school training.

We asked three questions concerning language, language usually spoken at home, comfort speaking English, and comfort level reading English. Over all sites, 73% of workers reported usually speaking English at home. Across sites, Site 4 had the lowest rate of usually speaking English at home, 50%, while Site 2 had the highest proportion with 86%. After English, Russian was used at home by 32% in Site 1, and Spanish was used by 31% at Site 6. In Sites 5 and 6, fewer than 80% of workers speak English comfortably, while 86% of workers overall speak English at least comfortably. A similar proportion of workers read English at least comfortably overall 85%, with workers in Sites 5 and 6 reporting lower proportions of 64% and 71% respectively.

Table 2, Baseline Worker Education and English proficiency

Site	1	2	3	4	5	6	Overall
Age, mean (SD)	47 (12)	42 (13)	45 (12)	38 (9)	42 (10)	37 (11)	41 (12)
Years in US	26 (12)	18 (10)	27 (10)	13 (5)	15 (11)	18 (8)	20 (10)
Years with company	12 (11)	11 (9)	9 (9)	7 (7)	14 (10)	5 (5)	9 (9)
Education							
≤High School	32%	52%	35%	56%	21%	69%	47%
>High School	63%	46%	53%	45%	29%	17%	42%
Speak English Comfortable/ Very Comfortable	89%	100%	88%	83%	64%	74%	86%
Read English Comfortable/ Very Comfortable	95%	100%	82%	89%	64%	71%	85%

Exposures and protective equipment use

Workplace exposures were measured for 12 common hazards using a 5 point response scale from 1 (Never), 3 (About half the time), to 5 (Always) and the mean response to this scale, by site, is reported in Table 3. Table 3 also includes the change in reported exposures from baseline to follow-up for each worker. The change over time was tested for statistical significance using a paired t-test. Because many comparisons were made, some significant findings are expected by chance.

The three most commonly reported workplace exposures were high levels of noise (4.2), working with materials that could cut or scrape (3.8), and working with or near dust or welding fumes (3.6). Site 6 had the lowest exposure score for 6 of the 12 hazards, and Site 1 had the highest exposure score on 4 of the hazards. The levels of exposures varied greatly between hazards as well as between companies.

Table 3, Exposures at Baseline, and Change (Post-Pre) by Site

Site	1 n=19 Baseline Mean (SD)	1 n=19 Change Mean (SD)	2 n=44 Baseline Mean (SD)	2 n=44 Change Mean (SD)	3 n=34 Baseline Mean (SD)	3 n=34 Change Mean (SD)	4 n=18 Baseline Mean (SD)	4 n=18 Change Mean (SD)	5 n=14 Baseline Mean (SD)	5 n=14 Change Mean (SD)	6 n=35 Baseline Mean (SD)	6 n=35 Change Mean (SD)	Overall n=164 Baseline Mean (SD)	Overall n=164 Change Mean (SD)
Dust	2.79 (1.62)	-0.37 (1.83)	4.41 (1.06)	-0.09 (0.96)	4.21 (1.12)	-0.15 (1.33)	2.67 (1.57)	0.78 (1.80)	3.64 (1.45)	0.43* (1.40)	2.79 (1.67)	-0.85† (1.67)	3.58 (1.55)	-0.15 (1.51)
Chemicals	3.05 (1.65)	-1.00* (1.63)	2.45 (1.52)	0.14 (1.39)	2.26 (1.64)	-0.62† (1.18)	1.61 (1.20)	-0.39 (1.04)	2.64 (1.55)	0.00 (1.62)	2.49 (1.62)	-0.49 (1.79)	2.41 (1.57)	-0.35† (1.49)
Noise	4.58 (0.77)	0.11 (0.74)	4.50 (0.90)	0.09 (0.60)	4.35 (0.98)	-0.12 (1.09)	3.33 (1.46)	0.44 (1.98)	4.77 (0.60)	0.23 (0.60)	3.83 (1.42)	-0.54* (1.60)	4.23 (1.16)	-0.04 (1.21)
Eye	4.05 (1.47)	0.05 (1.90)	4.33 (1.13)	-0.16 (1.17)	3.62 (1.52)	-0.29 (1.98)	2.72 (1.56)	0.39 (1.54)	4.07 (1.14)	0.86 (1.23)	3.11 (1.60)	-0.20 (1.78)	3.69 (1.50)	-0.02 (1.51)
Cut	4.63 (0.90)	-0.16 (0.60)	4.16 (1.27)	-0.21 (1.26)	3.76 (1.56)	-0.27 (2.04)	3.39 (1.58)	0.22 (2.26)	3.00 (1.71)	0.86* (1.51)	3.34 (1.61)	-0.77* (1.82)	3.77 (1.51)	-0.20 (1.70)
Burn	2.53 (1.43)	0.32 (1.80)	3.14 (1.55)	0.20 (1.56)	2.29 (1.34)	0.06 (1.50)	1.50 (0.86)	0.00 (0.77)	2.86 (1.41)	-0.29 (1.90)	2.40 (1.63)	-0.11 (0.23)	2.53 (1.50)	0.05 (1.49)
Struck	3.95 (1.31)	-0.16 (1.64)	4.09 (1.27)	-0.61* (1.56)	3.35 (1.59)	-0.38 (1.81)	2.78 (1.44)	0.72 (2.16)	2.69 (1.32)	-1.08* (1.44)	1.97 (1.22)	-0.54* (1.27)	3.21 (1.57)	-0.39† (1.67)
Housekeeping	3.95 (1.22)	-0.68 (1.89)	3.34 (1.48)	0.25 (1.33)	3.50 (1.62)	-0.21 (1.98)	2.56 (1.58)	-0.11 (1.94)	2.50 (1.51)	1.14* (1.66)	1.83 (1.27)	0.14 (1.19)	2.96 (1.60)	0.06 (1.66)
Traffic	2.79 (1.23)	-0.05 (1.35)	2.57 (1.39)	0.09 (0.09)	3.61 (1.54)	-0.39 (1.84)	3.94 (1.43)	-0.11 (1.64)	2.43 (0.94)	-0.93* (1.64)	2.29 (1.49)	-0.40 (1.58)	2.88 (1.50)	-0.24 (1.64)
Fall	1.79 (1.03)	-0.42 (0.90)	2.23 (1.41)	-0.09 (1.18)	2.62 (1.37)	-0.06 (1.39)	2.06 (1.66)	0.11 (1.68)	1.43 (0.85)	-0.21 (0.97)	1.06 (0.34)	0.09 (0.45)	1.92 (1.31)	-0.07 (1.13)
Machinery	4.32 (1.20)	-0.74 (1.66)	2.84 (1.78)	-0.02 (2.06)	3.06 (1.80)	0.03 (1.51)	2.61 (1.75)	0.06 (1.95)	2.79 (1.72)	-1.79† (1.72)	2.09 (1.48)	-0.40 (1.48)	2.87 (1.75)	-0.32* (1.80)
Electrical	1.89 (1.49)	0.47 (1.58)	2.00 (1.60)	-0.02 (1.47)	2.41 (1.73)	-0.24 (0.89)	2.17 (1.47)	-0.61* (1.14)	1.57 (1.09)	-0.07 (0.27)	1.37 (1.03)	-0.06 (1.11)	1.92 (1.48)	-0.09 (1.22)

* P < .05, † P < .01

The use of controls and personal protective equipment use (PPE) among exposed workers was addressed for all but one of the hazards; Housekeeping. The same 5 point response set used for hazard exposures is used for PPE use (1=Never, 5=Always) and the mean reported use is reported in Table 4. At Baseline, a dust mask or respirator was used about half the time when exposed to dust or fume (2.7 on the 5 point scale). Gloves, eye protection, and machine guards were used most of the time when exposed, while the use of hearing protection and fall protection was highly variable between sites.

Table 4. PPE Use at Baseline, and Change (Post-Pre) by Site

Site	**1**		**2**		**3**		**4**		**5**		**6**		**Overall**	
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
	Change		Change		Change		Change		Change		Change		Change	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
Dust	8	3.00 (1.69)	41	3.39 (1.50)	32	2.06 (1.44)	14	1.64 (1.45)	12	3.25 (1.86)	11	2.45 (1.37)	118	2.69 (1.63)
(RPE)		-0.25 (1.98)		0.20 (1.52)		0.72* (1.97)		0 (1.62)		-0.17 (1.27)		1.09 (1.70)		0.33* (1.70)
Chemical	9	3.22 (1.92)	25	4.68 (0.85)	10	4.40 (1.35)	3	4.33 (1.15)	6	4.67 (0.82)	11	4.82 (0.40)	64	4.44 (1.18)
(gloves, etc)		1.00 (2.78)		-0.04 (0.45)		0.60 (1.35)		-0.67 (1.15)		-0.17 (0.41)		-0.09 (0.70)		0.16 (0.13)
Noise	19	5.00 (0)	43	4.88 (0.63)	31	4.77 (0.76)	13	3.38 (1.76)	13	4.46 (0.88)	27	3.26 (1.61)	146	4.40 (1.22)
(HPDs)		0 (0)		0.12 (0.63)		-0.10 (1.04)		0.08 (1.38)		-0.15 (1.28)		-0.07 (1.33)		-0.01 (0.98)
Eye	15	5.00 (0)	41	5.00 (0)	24	4.71 (1.00)	11	4.55 (1.04)	14	4.64 (0.84)	21	4.90 (0.44)	126	4.85 (0.63)
(glasses)		-0.13 (0.52)		-0.05 (0.31)		0.17 (1.20)		-0.18 (0.75)		0.29 (0.83)		-0.10 (0.83)		0 (0.76)
Cut	19	4.63 (0.76)	37	4.38 (1.23)	24	4.83 (0.48)	11	4.64 (0.92)	10	4.70 (0.95)	19	4.63 (0.83)	120	4.60 (0.93)
(gloves)		0.11 (0.94)		-0.05 (0.74)		0.04 (0.62)		0 (0.45)		-0.40 (0.70)		-0.21 (1.13)		-0.06 (0.80)
Burn	10	5.00 (0)	30	4.67 (0.80)	15	4.53 (0.99)	4	4.75 (0.50)	6	4.67 (0.82)	15	4.80 (0.77)	80	4.71 (.77)
(gloves)		0 (0)		-0.03 (0.76)		0.33 (1.18)		-0.25 (0.50)		0 (1.27)		0.07 (0.96)		0.05 (0.87)
Struck	18	5.00 (0)	33	4.82 (0.73)	21	4.76 (0.89)	12	4.92 (0.29)	4	1.25 (0.50)	4	1.00 (0)	92	4.53 (1.23)
(hardhat)		0 (0)		-0.09 (0.38)		0.24 (0.89)		0.08 (0.29)		0.25 (0.50)		0 (0)		0.02 (0.51)
Traffic	14	1.29 (1.07)	26	2.92 (1.87)	26	4.81 (0.80)	13	5.00 (0)	3	1.00 (0)	7	1.57 (1.51)	89	3.35 (1.93)
(HiVis Vest)		-0.29 (1.07)		0.62* (1.50)		0.19 (0.80)		0 (0)		0 (0)		-0.57 (1.51)		0.15 (1.13)
Fall	4	5.00 (0)	20	3.55 (1.73)	24	4.25 (1.26)	5	2.60 (2.19)	1	5.00 (na)	0	na ()	54	3.91 (1.58)
(harness)		0 (0)		0 (1.12)		0.63* (1.41)		0.20 (2.49)		-4.00 (na)		()		0.22 (1.49)
Machinery	14	4.86 (0.36)	21	4.62 (1.20)	17	4.59 (0.62)	7	5.00 (0)	0	na ()	8	4.63 (0.74)	67	4.70 (0.80)
(Guarding)		-0.07 (0.27)		0.33 (1.24)		0.24 (0.75)		-0.29 (0.49)		()		-0.13 (1.36)		0.10 (0.94)

* P < .05, † P < .01. Counts of responses vary by exposure and site.

Exposures related to musculoskeletal disorders

We asked 8 questions concerning workplace risk factors associated with musculoskeletal disorders. These include 4 questions concerning posture, 1 question about repetitive motion, and 3 questions concerning lifting. These questions also use a 5 point response scale (1=Never, 3=About half the time, 5=Always). The individual's responses were averaged over the questions referring to Posture, Repetitiveness and Lifting and are provided in Table 5.

Over all sites at baseline, repetitive motion was reported to occur most frequently with a score of 3.6, compared to lifting with a score of 2.3, and posture with a score of 1.9. Site 1 had the lowest ratings for repetitive motion exposures reporting a score of 2.6, and the lowest score for lifting exposures at 1.8. The highest exposure for posture was reported for Site 3 with a score of 2.3, the highest exposure for repetitive motion was in Site 6 with a score of 3.9, the highest lifting exposures were reported in Site 5 with a score of 3.1.

Table 5, Ergonomic exposure scores by site

Site	1 n=19 Baseline Change Mean (SD)	2 n=44 Baseline Change Mean (SD)	3 n=34 Baseline Change Mean (SD)	4 n=18 Baseline Change Mean (SD)	5 n=14 Baseline Change Mean (SD)	6 n=35 Baseline Change Mean (SD)	Overall n=164 Baseline Change Mean (SD)
Posture	1.75 (0.83) 0.03 (0.84)	2.23 (1.02) -0.27* (0.13)	2.30 (0.90) 0.04 (0.97)	1.53 (0.61) 0.17 (0.74)	1.71 (0.94) -0.27 (1.22)	1.61 (0.57) 0.09 (0.65)	1.94 (0.89) -0.05 (0.87)
Repetitive	2.58 (1.68) 0.42 (2.29)	3.82 (1.26) -0.05 (1.24)	3.56 (1.58) 0.35 (1.74)	3.78 (1.63) 0.33 (1.53)	3.86 (1.51) 0.36 (1.08)	3.88 (1.57) 0.06 (1.61)	3.63 (1.54) 0.19 (1.59)
Lifting	1.81 (0.94) -0.19 (0.86)	2.35 (1.13) -0.17 (0.82)	1.94 (1.08) -0.16 (0.76)	1.83 (1.02) 0.30 (1.22)	3.07 (1.20) -0.19 (1.01)	2.80 (1.23) -0.26 (1.20)	2.30 (1.18) -0.14 (0.97)

Upper extremity disability

We used a measure of upper extremity disability, the QuickDASH, that measures disabilities of the arm, shoulder, and hand. QuickDASH standardized scores can range from 0-100 with a population normative mean of 10 and SD of 15. A higher score indicates more disability. Results of the average scores are reported in Table 6. The average disability score across all companies is 5.7, ranging from 3.4 in Site 1 to a high of 6.7 in Site 5. While these disability scores are low, indicating few workers have upper extremity disability, each site has at least one worker with a disability score above 30 which indicates a relatively high level of disability.

Table 6, Upper extremity disability, QuickDASH by site

Site	1 n=19 Baseline Change Mean (SD)	2 n=44 Baseline Change Mean (SD)	3 n=34 Baseline Change Mean (SD)	4 n=18 Baseline Change Mean (SD)	5 n=14 Baseline Change Mean (SD)	6 n=35 Baseline Change Mean (SD)	Overall n=164 Baseline Change Mean (SD)
QuickDash	3.35 (5.38) -0.84 (9.85)	6.56 (10.85) -0.26 (9.94)	5.69 (1.24) 1.46 (10.75)	5.18 (11.71) -0.25 (7.79)	6.66 (16.13) 0.49 (19.98)	5.39 (10.09) 1.43 (9.72)	5.71 (10.36) 0.56 (10.90)

Injuries, almost injured, lost time, and light duty

The fraction of workers reporting an injury, near miss, number of days missed or light duty days due to injury at work is reported in Table 7. Among the 164 workers at baseline 35 reported at least 1 injury with an average of 1 injury for every 4 workers (mean injuries per worker, 0.25) in the past year. The rate of injury ranged from 0.18, or 18 injuries per 100 workers, in Site 3 to 0.43 in Site 5.

Workers also reported an average of 1.9 times they were almost injured (near miss) at work in the past year with considerable difference between sites ranging from 0.43 in Site 5 to 2.7 in Site 3. Among workers with injuries in the past year, the worst injuries were associated with an average of 2 work days missed and 5.9 days of light duty. Site 5 had the highest average of lost days (4.8), and Site 1 had the highest average of light duty days (11.3). Among the worst injuries, 54% were caused by parts or materials and 14% were caused by tools. These worst injuries occurred largely through contact with objects or equipment (25 of 35), while bodily reaction or exertion accounted for 7 injuries, and falls the remaining 3.

Table 7, Injuries, almost injured, lost time, and light duty

Site	1		2		3		4		5		6		Overall n=164	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
Injuries	19	0.21(0.42)	44	0.32 (0.71)	34	0.18 (0.39)	18	0.22 (0.55)	14	0.43 (0.65)	35	0.20 (0.47)	164	0.25 (0.55)
Near miss	19	0.84 (2.29)	43	2.44 (5.66)	34	2.68 (8.54)	18	1.11 (2.91)	14	0.43 (0.36)	35	2.09 (4.43)	163	1.91 (5.43)
Missed days	4	3.00 (6.00)	11	1.09 (2.12)	6	0.50 (0.84)	3	0 (0)	5	4.80 (8.58)	6	3.33 (5.92)	35	2.03 (4.59)
Light days	4	11.25 (22.50)	11	4.26 (9.17)	6	7.33 (13.82)	3	0 (0)	5	9.00 (13.42)	6	4.00 (3.74)	35	5.89 (11.42)

Safety climate

Safety climate represents workers' shared perception of management and coworker support for safe work practices. We used the Nordic Safety Climate Questionnaire (NOSACQ-50) to measure the organizational safety climate in each workplace before and after the interventions. This questionnaire includes seven safety climate dimensions consisting of a total of 50 questions. Each safety climate dimension is scored separately with scores from 1 strongly disagree to 4 strongly agree, with higher scores indicating a stronger (more positive) climate. Average scores at baseline are provided, by site, in Table 8, and in Figure 1.

Across all dimensions, scores range between 2.58 and 3.33. Scores across dimensions tended to correlate more strongly within sites than between sites. Site 4 ranked highest on 6 of the 7 dimensions, while Site 3 ranked lowest on three dimensions and near the lowest score on the other dimensions. The lowest ranking safety climate dimension at baseline across all sites is worker safety priority and risk non-acceptance, and the highest ranking is worker trust in the efficacy of safety systems.

Table 8. Safety climate scales at baseline and change (post-pre) by site

Site	1 n=19		2 n=44		3 n=34		4 n=18		5 n=14		6 n=34		Overall N=163	
	Baseline Mean	(SD)	Baseline Mean	(SD)	Baseline Mean	(SD)	Baseline Mean	(SD)	Baseline Mean	(SD)	Baseline Mean	(SD)	Baseline Mean	(SD)
	Change Mean	(SD)	Change Mean	(SD)	Change Mean	(SD)	Change Mean	(SD)	Change Mean	(SD)	Change Mean	(SD)	Change Mean	(SD)
Management Priority	3.11	(0.35)	3.15	(0.38)	2.89	(0.35)	3.30	(0.43)	3.07	(0.20)	2.86	(0.40)	3.04	(0.39)
	-0.11	(0.24)	0.01	(0.39)	-0.21	(0.31)	-0.04	(0.30)	-0.10	(0.32)	-0.07	(0.37)	-0.08†	(0.35)
Management empower	3.05	(0.31)	3.07	(0.39)	2.87	(0.35)	3.12	(0.39)	2.98	(0.25)	2.85	(0.33)	2.98	(0.36)
	-0.05	(0.21)	0.00	(0.37)	-0.18	(0.34)	0.04	(0.23)	-0.06	(0.30)	-0.11	(0.30)	-0.07†	(0.32)
Management justice	2.95	(0.36)	2.98	(0.44)	2.65	(0.43)	3.05	(0.34)	2.99	(0.34)	2.97	(0.31)	2.91	(0.41)
	-0.06	(0.30)	0.09	(0.40)	-0.12	(0.39)	0.08	(0.26)	-0.04	(0.50)	-0.10	(0.30)	-0.02	(0.37)
Workers commitment	3.01	(0.33)	3.12	(0.34)	2.93	(0.31)	3.22	(0.41)	2.99	(0.35)	3.00	(0.22)	3.04	(0.33)
	0.02	(0.21)	-0.01	(0.30)	-0.02	(0.32)	0.05	(0.31)	-0.06	(0.38)	-0.09	(0.30)	-0.02	(0.30)
Workers priority	2.93	(0.25)	2.87	(0.40)	2.58	(0.36)	2.79	(0.44)	2.67	(0.32)	2.70	(0.35)	2.76	(0.38)
	-0.08	(0.28)	0.00	(0.34)	0.06	(0.28)	0.16	(0.44)	0.17	(0.22)	0.03	(0.32)	0.04	(0.32)
Workers comm learning	3.09	(0.31)	3.17	(0.36)	2.96	(0.22)	3.33	(0.43)	3.04	(0.40)	2.98	(0.32)	3.08	(0.35)
	-0.05	(0.22)	0.00	(0.37)	-0.00	(0.20)	-0.01	(0.34)	-0.02	(0.46)	-0.05	(0.33)	-0.02	(0.32)
Workers trust	3.14	(0.32)	3.22	(0.39)	3.02	(0.26)	3.29	(0.36)	2.97	(0.23)	3.08	(0.27)	3.13	(0.33)
	-0.08	(0.24)	-0.03	(0.39)	0.06	(0.29)	-0.06	(0.22)	0.07	(0.33)	-0.05	(0.31)	-0.02	(0.32)

* P < .05, † P < .01

Figure 1. Nordic Safety Climate dimensions at baseline for each site

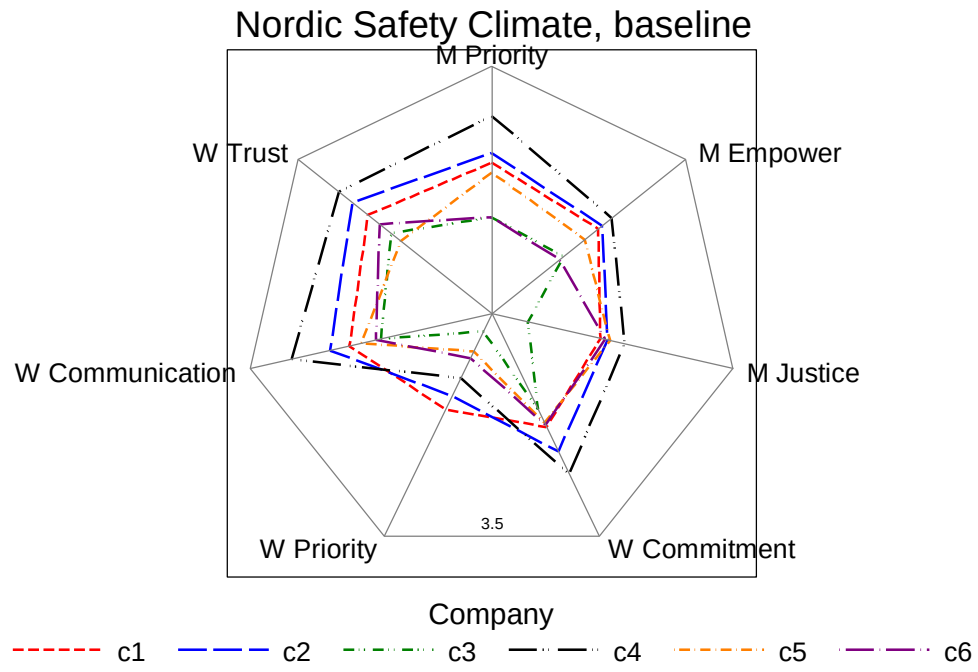
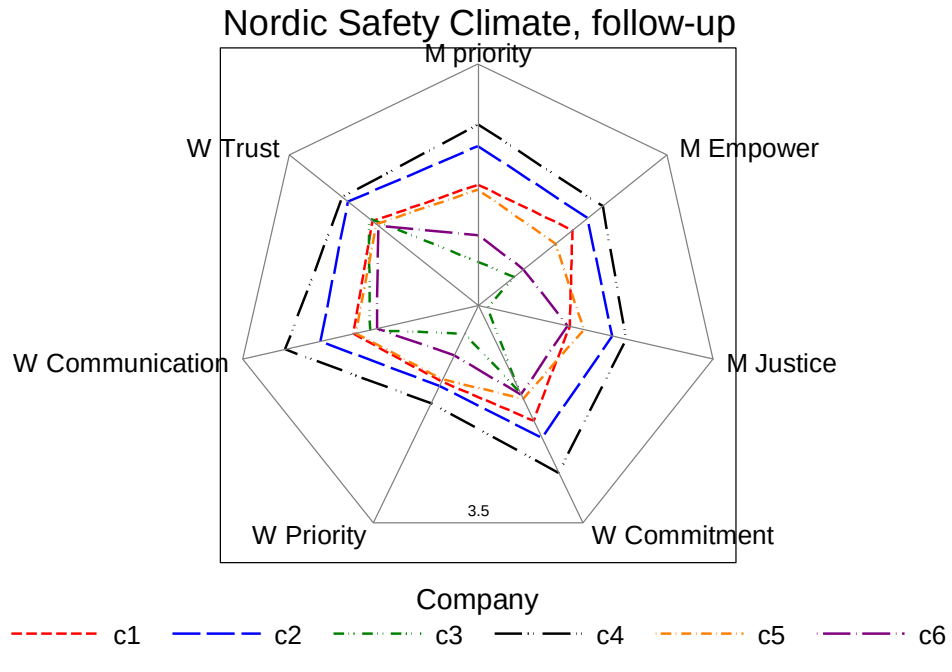


Figure 2. Nordic Safety Climate dimensions at follow-up for each site



Health and safety committee performance

We asked workers 11 questions concerning HSC performance. The first five questions we called "HSC reporting" which address workers' awareness of the committee's reporting and feedback processes. The other six questions we called "HSC function" which address workers' impression of the quality of the committee's responses, trustworthiness, and communication. Individual questions followed the same pattern as the combined results presented here. Results for Sites 4 and 5, which didn't have a HSC at baseline, are provided at follow-up instead. The average responses to these two aspects of HSC function are reported in Table 9. Workers indicate the HSC reporting activities average performance of 3.5 ranging between 2.8 and 4.4 of a possible best performance of 5. However, Sites 4 and 6 had a lower rating of HSC Reporting while Site 5 had a somewhat higher rating. Workers also reported the HSC was trustworthy and responsive to safety issues, rating HSC functioning at 3.8 overall.

Table 9. Workers' impression of HSC performance

Site	1		2		3		4		5		6		Overall	
	Baseline		Baseline		Baseline		Followup only*		Followup only*		Baseline		Baseline	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
	Change		Change		Change		Change		Change		Change		Change	
	Mean (SD)		Mean (SD)		Mean (SD)		Mean (SD)		Mean (SD)		Mean (SD)		Mean (SD)	
HSC Reporting	19	3.26 (1.63)	44	3.73 (1.47)	34	3.88 (1.57)	18	2.94 (1.43)	14	4.36 (1.08)	35	2.83 (1.42)	132	3.46 (1.55)
		0.00 (1.33)		-0.21 (1.45)		-0.41 (1.84)		NA		NA		0.17 (1.42)		-0.12 (1.54)
HSC Effectiveness	18	3.98 (0.67)	43	3.90 (0.63)	33	3.68 (0.58)	18	4.05 (0.44)	14	3.90 (0.32)	33	3.75 (0.59)	127	3.82 (.62)
		-0.21 (0.44)		0.20 (0.78)		-0.39 (0.80)		NA		NA		-0.21 (0.56)		-0.12 (0.73)

* Sites 4 and 5 did not have a HSC at baseline.

The questionnaire also included 10 questions regarding HSC characteristics and function that were administered only to HSC members (Table 10). Because of annual turnover in committee positions, only 18 subjects have matched pre and post responses. Therefore, all HSC member responses were analyzed (baseline n=46, follow-up n=46). Again, the series of questions for the members were collapsed into scales reflecting, generally, HSC Function (taken seriously, good use of time, timely resolution of issues, etc.) and Worker Perception (workers' awareness and respect for the committee).

Table 10. HSC Members' rating of Committee performance

	1		2		3		4		5		6		Overall	
	Baseline		Baseline		Baseline		Followup only*		Followup only*		Baseline		Baseline	
	Change		Change		Change		Change		Change		Change		Change	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
HSC Function	10	3.88 (.42)	15	3.99 (.52)	12	3.77 (.73)	7	4.14 (.35)	6	4.10 (.47)	9	3.38 (.64)	46	3.79 (.61)
		0.02		0.08		-0.48		NA		NA		-0.01		-0.02
HSC Worker Perception	10	3.50 (0.86)	15	3.62 (0.49)	12	3.44 (.56)	7	4.00 (0.00)	6	3.94 (0.53)	9	3.37 (0.47)	46	3.50 (.58)
		0.32		0.22		-0.29		NA		NA		-0.10		0.10

* Company 4 and 5 did not have a HSC at baseline.

There is no SD of difference because these are not matched on subject for pre- and post-intervention.

Change from baseline

Each of the questionnaire sections were also graded in terms of the change in scores from baseline to follow-up, and these changes are also presented in Tables 3 (Exposures), 4 (PPE Use), 5 (Ergonomic exposures), 6 (Upper extremity disability), and 8 (Safety Climate). Many of these elements are not expected to substantially change, and for the most part, there was no meaningful change observed – small fluctuations are observed both up and down, suggesting random variability for the most part. The elements we would have expected to see change on, PPE usage, safety climate, and especially, HSC performance, also did not show meaningful change. Thus, there is no objective evidence here that our training with the health and safety committees made measureable changes in these elements as reported by the workers at the sites.

Observations

Assessment of workplace hazard exposures, and personal protective equipment use was conducted before and after the HSC intervention. In total 2,880 observations were made for each of 12 hazards, with 1,424 observations taken prior to the HSC interventions. Because the pre and post intervention observations are not matched, all data are used, and the difference in percent of observations is calculated. Exposures were rated as either low (present) or high (likely to present a substantial risk), and the results are presented only for those exposure rated as 'high.' However, because the prevalence of 'high' hazard was low in most circumstances, use of PPE was described for all cases in which the exposure was rated either high or low. This is also appropriate since PPE would be indicated even if the exposure is not particularly high.

Results of the observed exposures at baseline and their change is presented in Table 11. At baseline for all hazards combined, 2.0% of observations were rated as high exposure with a drop to 0.5% at follow-up, which is likely not a significant change. Across all sites at baseline, noise exposure was the most common with 41% high exposure, eye hazards were the second most common with 16% high exposure, and cut or scrape hazards were third with 13% of observations with high exposure. The prevalence of high exposures varied greatly across sites.

Across the six sites for the 12 hazards observed, the change in high exposure prevalence from baseline to follow-up increased or stayed the same in 34 instances while in the other 38 instances observation of high hazards declined. The largest drop in high hazard exposure was noise with a baseline to follow-up drop of 17.8%, cut and scrape hazards decreased by 4.1%. For all other hazards the changes, decrease or increase, were less than 1.5%. Looking at the experience of individual sites, the greatest decrease in high hazard exposure was in Site 4 where 33% of observations indicated high noise exposure at baseline, however, during follow-up a 26% decrease was observed.

Table 11. Percent of Exposure Observations Rated High, At baseline and change

Site	1	2	3	4	5	6
Baseline N=	220	392	224	171	246	171
Change (Follow-up N=)	268	301	282	214	191	200
	%	%	%	%	%	%
Fall	0.45	2.30	6.25	5.26	0.41	0.00
	0.29	3.35	0.49	-0.59	-0.41	0.00
Noise	16.82	42.86	30.36	33.33	86.18	22.81
	-14.95	-20.27	-13.69	-26.32	5.97	-10.81
Dust	1.82	17.35	2.68	0.00	13.82	9.94
	-0.70	7.24	3.35	0.47	-9.11	-5.94
Eye	4.55	19.90	2.23	1.17	26.42	37.43
	0.31	6.02	4.51	-0.70	-8.10	-4.43
Cut	8.18	10.20	21.43	15.79	15.85	11.11
	-1.09	-1.23	-7.24	1.97	-12.19	-9.11
Burn	1.36	11.48	2.23	0.00	16.26	12.28
	0.88	6.79	4.86	0.47	-5.26	-3.28
Chemical	4.55	9.69	0.00	0.58	17.48	6.43
	-2.31	0.94	3.19	-0.12	-0.73	-3.93
Struck by	5.45	2.30	0.00	0.00	0.81	0.00
	-2.47	5.68	0.71	0.47	-0.29	0.00
Traffic	0.45	1.28	4.46	11.70	0.41	0.00
	1.04	-0.28	2.98	-0.95	-0.41	0.00
Machines	17.27	2.30	0.00	2.92	6.10	5.85
	-12.05	3.02	7.80	-2.92	-1.90	-4.58
Machine Maintenance	.91	0.00	0.00	0.00	.41	0.00
	-.91	1.00	1.42	.47	-.41	0.00
House keeping	2.27	1.53	2.68	0.00	4.88	0.00
	-2.27	-.20	-1.61	0.00	-4.88	0.00

Observed use of PPE and Other Protective Systems.

At the time of making hazard exposure observations, use of PPE or other protective systems was also recorded for 11 hazards. The percent of observations with a 'high' or 'low' exposure in which such systems were in use, and the change in this percentage, if given in Table 12.

Overall protection was frequently used, generally over 80% of the time when workers were exposed. However, for dust and fall from elevation, PPE use prevalence was on average below 40% and 25% respectively. While working in environments with dust exposure, PPE was used only 18% of the time in Site 3 while the most frequent use was in Site 2 with 67%. Like the presence of hazards, PPE use varied considerably across sites, for example, fall protection was not used at site 5 for the 3 observations where the hazard was present, but was used in 81% of the 21 observations at site 3.

Baseline to follow-up change in PPE use was positive for 36 of the 58 instances by hazard and site when the hazard was present, but declined in 22 instances.

Table 12. Protection Used When Exposed
(% of low or high hazard in which protective systems/PPE were in place)

Site	1		2		3		4		5		6	
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
	Change		Change		Change		Change		Change		Change	
	%	n	%	n	%	n	%	n	%	n	%	n
Fall	0.50	6	42.31	26	80.95	21	0.80	10	0.00	3	na	0
	0.50	8	7.69	20	14.05	40	0.20	10	na	2	na	3
Noise	95.27	169	91.05	257	79.31	87	60.61	66	82.52	103	69.12	136
	5.67	140	5.68	245	-0.32	119	-7.00	97	9.48	150	5.59	170
Dust	33.33	6	66.96	115	17.65	17	na	1	57.47	87	48.39	31
	16.67	6	2.54	118	4.41	68	na	2	25.61	65	48.84	36
Eye	100.00	57	99.35	155	100.00	5	100.00	4	97.44	156	96.55	87
	0.00	81	0.01	158	-1.18	85	0.00	13	-2.11	107	3.45	110
Cut	81.40	43	98.48	66	100.00	55	97.30	37	93.85	65	100.00	20
	15.97	38	-2.74	47	-4.00	50	.32	42	6.15	9	0.00	4
Burn	92.31	13	95.18	83	100.00	5	na	0	94.44	54	88.89	27
	2.69	20	3.47	74	0.00	28	na	1	-1.59	28	7.66	29
Chemical	88.89	27	93.22	59	100.00	1	100.00	1	69.23	65	92.86	14
	11.11	15	0.11	45	-9.09	11	na	2	4.30	34	7.14	10
Struck by	100.00	42	100.00	60	100.00	6	100.00	8	40.00	10	50.00	2
	-2.35	85	-1.10	91	-2.00	50	na	1	10.00	2	-40.91	11
Traffic	50.00	2	70.00	10	90.48	21	100.00	29	0.00	2	0.00	2
	-40.91	11	7.78	9	7.30	45	-3.44	58	na	0	na	0
Machines	98.77	81	100.00	11	100.00	54	100.00	12	100.00	19	100.00	12
	1.23	67	0.00	23	-2.38	42	0.00	7	0.00	12	na	2
LOTO	96.15	26	100.00	1	88.89	9	100.00	3	na	na	100.00	1
	3.85	12	na	1	11.11	24	0.00	6	na	na	na	na

Site Activities and Post-intervention Changes

Through our ongoing involvement, we were able to observe HSC function and activities at each of the sites to varying degrees following the training intervention. This included initial response to the training, changes within the committee, and any changes the committee was able to influence at the site. With the dynamic nature of workplaces, there were often a variety of other occurrences that may have influenced the outcomes of the study.

Site 1

The significant instability of the upper management during the course of the study resulted in substantial challenges in post-intervention follow-up and support. We were unable to attend any of the subsequent safety committee meetings, despite numerous contacts and requests. It was therefore difficult to assess what elements of the training were incorporated into subsequent meetings. The safety director reportedly distributed a safety committee charter to members of the HSC. The document contained a mission statement, committee composition, as well as a description of roles and responsibilities, and meeting ground rules. We were not aware if the committee had fully adopted or implemented the directives contained in the charter.

As reported by the new safety director, safety efforts were stressed by the uncertainty and lack of resources due to missing key upper management personnel. He also expressed that he sometimes lacked the support of supervisors, and little guidance was available from management. For instance, according to the safety director, after multiple reports of a worker not wearing hearing safety equipment, neither the worker nor the supervisor was willing to concede to the authority of the safety director in regards to the enforcing of the rule. The worker was permitted to go without hearing protection in violation of the rules, despite the worker and the supervisor knowing about the requirements.

Site 2

During the post-intervention phase of the project, we worked closely with the safety personnel at Site 2 to gain access to the facility to perform safety/hazards observations and schedule interviews with the workers. In the time since the baseline assessment six of the original workers interviewed were laid off, and during our scheduled interview period six additional workers lost their jobs. Coordination of the interviews and observations were completed in a relatively short time due to the excellent support provided by the safety manager and staff with the expressed support from upper management.

After the training, the HSC continued to function well as a group and members seemed more able to voice their views and opinions with management. Management was receptive and supportive of the committee functions and listened closely to the members' opinions. Committee activities remained generally the same, with a slight shift in topics to broader site-wide issues.

A variety of other initiatives were observed at Site 2. This included a facility-wide event featuring a safety talk by an injured worker from another of the company's sites; initiation of a "5S" program, to which the company has added "Safety"; and implementation of pre-shift stretching routines in efforts to minimize musculoskeletal injuries. Actions like these illustrate the company's effort to develop a safety culture that involves all workers, with management leading the effort. Programs such as the stretching reinforce the message of the company's interest in having a workforce that practices safety on a routine basis.

This facility demonstrated a variety of attributes of effective committees and management. Minutes were recorded, attendance was consistent, safety issues were discussed and plans are implemented, injuries were reviewed and causes addressed. It was particularly noteworthy that upper management representatives were engaged, attended all meetings and elicited feedback from the members. At the last meeting we attended, the president of the company attended the meeting and shared with the committee that as a request from corporate, he would be actively participating in all accident investigations, providing further evidence of the corporate engagement to safety.

Site 3

We encountered numerous challenges accessing this facility, including scheduling the follow up interviews and observations. We learned that since the initial phase 14 workers had been laid off. The safety manager was promoted and now oversees safety operations at an additional location, and spends half of his time traveling between facilities. Production conflicts, such as the loading of ships from the harbor, prevent access to areas of the yard, making it challenging for coordinating site visits and scheduling interviews with workers.

Following the training, an HSC member began attending managers' meetings to convey formal requests. The committee's first request, which was approved, was to begin posting meeting minutes and progress on resolving issues to help improve workforce awareness of committee efforts. An HR representative was also invited to an HSC meeting to discuss the sick leave policy, though it is unclear if this achieved any resolution to the issue. The safety manager also issued a new set of bylaws for the HSC. These bylaws describe the role and intent of the committee (e.g., facilitate cooperation among workers, assist in the resolution of safety issues, assist in the development of policies, etc.), membership expectations (e.g., voting, quorum, etc.), roles and responsibilities of members (e.g., chairperson, voting members, management, duration of meetings, and personal conduct), and the organization of the HSC. HSC members received a copy of this document signed by the general and plant managers and the safety engineer. According to the HSC members, the document was not reviewed in depth by the committee as a group. Although the document included appropriate guidelines, the fact that it came from management without input or buy-in from committee members demonstrates the limited opportunities for worker participation in safety at this site.

After the training, we attended an all-staff meeting which was intended to address the fact that four separate incidents resulting in injuries had occurred in eight days. At the gathering, managers voiced their safety concerns in reference to the recent series of injuries, and asked the group, "What has

changed during the past few days that have contributed to having all these accidents?" Though many workers were quiet and response was limited, the common theme expressed was related to staff shortages and production pace. As one worker said, "We are doing the same or more work with less workers, while working faster-production demands have not changed and the expectation to complete work on time remains the same." After talking to other workers present, we learned that these workers also shared these feelings. At the end of the gathering, managers and supervisors did not comment on the workers' remarks nor addressed any of the specific details regarding the recently injured workers. The incidents were brought to the following HSC meeting, though there was not enough time set aside to discuss the incidents in detail, and it was unclear if any changes were discussed or made to prevent similar incidents.

There was also mention of the corporate initiative to assess worker's job responsibilities and processes by using external consultants. For several months workers had witnessed the presence of these consultants walking throughout the facility observing and taking notes from all work areas. According to management, the consultants spent a couple of more months observing workers and taking notes with the goal to identify efficiency improvement opportunities. Workers perceived that "they are being watched" and are afraid the result could cause them to "lose their jobs," in addition to feeling pressured to work more quickly, sometimes at the expense of safety.

Site 4

As with the baseline assessment, post-intervention study activities went smoothly. Site staff were extremely accommodating and helpful during the data collection process. With the exception of a couple workers that had been laid off or left the site, we were able to follow-up with all workers.

Following the HSC training, we attended a committee meeting which was now chaired by the production supervisor. We found a functional committee actively addressing safety issues raised by committee members reporting back from other workers, as well as feedback provided from the most recent walkthrough inspection. The committee was well organized, an agenda was available, minutes from the previous meeting were distributed at the meeting, and the group had a note taker.

During meetings, members reviewed the minutes from the prior meeting as well as all pending and completed items with the respective assigned deadlines. Meetings were schedule for one hour, the HSC made good use of the time, issues were discussed as a group, and actions or resolutions were a result of group consensus. The safety audit conducted by the regional safety manager is reviewed during meetings, and the committee requested assistance from the UW and the regional safety manager to develop a safety observation form specifically useful for their facility. The monthly corporate safety/hazard report was also discussed at meetings, along with potential ways to resolve issues applicable to the site. After the monthly meeting, the meeting minutes were posted on the bulletin board. The HSC also used the monthly all-staff safety meeting as a forum for communicating and to address any specific issues listed in the HSC's minutes. Some of the accomplishments included the

incorporation of a “near misses” box along with the forms available to all employees to report incident events.

Site 4’s newly formed HSC benefited from the training because it helped guide the formation of a new committee, and provided them an opportunity to come together as a group with a concrete set of ideas expanding their role as a safety team. In the past they had relied on corporate monthly oversight and reports, but now they feel more empowered to own the internal processes for maintaining and safety at their facility. Site 4 also benefits from the fact that they are a small operation and management plays an active role in supporting safety activities.

Site 5

After the training, the site continued to be very supportive and helpful with study activities. We were able to follow-up with all workers, except for a couple that had left the company.

The newly established HSC decided to hold meetings every two weeks for the first few months or until they felt more in control of the process. We were able to attend several of these meetings. We offered technical support as well as templates to track issues and activities, record minutes and create an agenda. We also provided feedback on the group process during the meetings. The HSC acknowledged the need to be supported as they continued to develop as a team, and requested our help to be present at future meetings in order to provide feedback on their work.

We observed as the HSC at Site 5 continued to improve its functioning, although with some challenges due to the limited safety experience and lack of experience working in groups by its members. The chairs lead the meetings following the previous meeting minutes as a guide. The minutes also contained the list of both safety and infrastructure needs of the company and served as the tracking tool for deadlines and needed resources. Most of the items on the list fell into the responsibility of management (e.g., purchasing equipment, tools, training, and PPE). Minutes were recorded by the owner’s spouse, who also served as the record keeper and managed all the safety program documentation as well as all the compliance requirements. Minutes were made available to employees and posted on a lunchroom bulletin board. Many of the workers actively participated during meetings, although the level of engagement varied widely.

Site 6

Post-training follow-up study activities were conducted with few barriers. Site staff were very cooperative and helpful in coordinating these efforts. Almost all workers were available for follow-up activities.

The committee continued to be chaired by the safety manager; members attended monthly meetings and got updates about the pending items on the committee’s to do list. Committee members were engaged at the meetings, but continued to have a limited role in safety duties outside the monthly

meetings. The group was still developing, although they had not defined their individual responsibilities as members nor collectively planned safety activities outside meetings. For example, it wasn't until after the training at one of the meetings that we suggested the selection of a minute taker as a recommendation to distribute the responsibilities among members.

Following the training, some coordinated efforts were made to address specific health and safety concerns. For instance, signage was created and a drill had been planned for emergency evacuation procedures. However, there were still obstacles to completing tasks. Members were still in the process of learning how to take a larger role in safety efforts, and coordination and communication with floor managers regarding safety activities was often limited.

Conclusions

Summary of HSC Function

We saw a range of HSCs among these companies – from well-formed and active, with worker engagement and power to affect change, to non-existent. Generally, the larger sites, with corporate backing had more effective committees, but this generalization was not entirely consistent. The two smallest sites (Site 4 and 5) did not have HSCs at baseline, they both established HSCs and embarked on significant engagement and activities subsequent to our training. Both sites had significant autonomy and a small 'family business' feel, even though Site 4 was owned and operated by a larger national company, with a regional safety director, and Site 5 was a true family business with the owner and his wife running all aspects of the business, including health and safety. While it could be said that these were special sites because their willingness to participate in the study was an indication that they were ready to engage in increased health and safety activity, for example by establishing a HSC, the fact that they did this with some enthusiasm and results leads us to believe that there may be many small businesses which would benefit by outside "help" in getting started.

Site 4 is particularly interesting because it is part of the same company that operates Site 3, though it is a much smaller site. Site 3, even with the same corporate oversight (they were part of the same corporation), had a much less effective committee, a dissatisfied or even angry workforce, and a lower safety climate scale (Site 3 had the lowest and Site 4 had the highest among the 6 sites studied). Further, we witnessed at Site 3 a degradation of the morale due to lay-offs, increased rates of injuries and a management unwilling to acknowledge the consequences of these structural problems for safety on site.

In contrast, the two largest sites (1 and 2) had well established HSCs and safety programs with staffing at baseline. However, these two sites also present an interesting contrast. Site 2's HSC demonstrated excellent engagement by worker representatives, and significant upper management support for the HSC process. While the site clearly had many significant health and safety issues to grapple with, workers seemed actively engaged in understanding and addressing them, even though not all problems

could be easily solved without massive investment by the company. In contrast, Site 1 had a largely dysfunctional committee, reflecting divisions within the workforce and considerable disarray in top management with multiple high level managers being dismissed during our observation period. Although our perception of the effectiveness of the committee and function were strikingly different at these two sites, the differences in questionnaire and observations were not clearly distinct. Safety climate was only slightly higher at Site 2 compared to Site 1, and the rated HSC performance was quite similar between the two sites.

Site 6 was intermediate in size, with somewhat of a small business feel. Despite their enthusiasm for participation, workers were not effectively engaged in the HSC process, with the safety manager continuing to play the central role, and unable to effectively implement some of the top priorities of the HSC.

Several overall observations are derived from this experience.

Engagement and support of top management is a clear requirement for effective HSCs and programs. This observation is evident both in large (Site 2) and very small family-style business (Site 5), and the lack of stable and supportive management can seriously undermine the ability of the HSC to take itself seriously, or be taken seriously by site workers. This was evident both at Site 1 where managers were being replaced, and Site 3 which was undergoing significant down-sizing and managers did not address the effects of these problems on morale or safety.

Second, worker participation and engagement was a key indicator of a HSC's effectiveness. Sites which clearly supported workers voicing their concerns, reporting problems, and authorizing safety-related activity were more able to address the underlying concerns. This was again evident at Site 2, in contrast to Site 3.

Third, the safety manager can play a key role in facilitating effective committee work, or limiting it. Site 2 had an older, experienced manager at the beginning of the study, who had helped establish the positive culture of worker engagement in the HSC, while the young managers at Site 3 and 6 had limited ability to facilitate worker involvement and respect for the process. The importance of both technical competence and managerial skills in facilitation of group processes was clear from these observations.

With respect to the effectiveness of our training intervention, the primary positive evidence observed were the development of new and re-energized committees, but particularly among the two sites with no existing committee at the beginning of the project. There are both circumstantial and design causes for this limited success. Several of the participating companies went through significant down-sizing or management disruptions during the project, making our participation marginal in the uncertain, and discordant conditions within the company. Although there is nothing that we could have done to over-ride these concerns, this observation underscores the importance, in fact the dependence, of the HSC's effectiveness on stable and supportive organizational context.

The successes achieved were limited by the degree of engagement we were able to offer. The trainings themselves were greatly limited in time and scope, both because of feasibility from our side, and willingness of the companies to dedicate time to the effort. Within the limited few hours of direct training time available, we chose to focus primarily on internal committee function, health and safety concepts and communication issues within the organization, rather than specific safety and health topics and solutions. We continue to believe that these are the main limitations and in most need of development in most committees, and are thus the most important area for committee development. However, much of the real work coming from these limited trainings occurred in the subsequent meetings and activities of the committee. To the degree that the study staff we invited and able to participate in these follow-up activities, this is where the change and effectiveness came about.

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Appendix 1: Worker Questionnaire

SCHOOL OF PUBLIC HEALTH
UNIVERSITY of WASHINGTON

Department of Environmental and Occupational Health Sciences

Please answer the following questions to the best of your ability. Your answers are confidential and will not be shared with your coworkers or supervisor. You can choose not to answer specific questions. For questions about your work activities and behavior, please tell us what you actually do, not what you are supposed to do.

Today's Date: _____/_____/_____

Company:

Job Title:

Shift:

1: EXPOSURES AND CONTROLS

1. How often do you work near dust or welding fumes?	☐ Never or almost never → ***Skip to question 3***
	☐ Less than half of the time
	☐ About half of the time
	☐ More than half of the time
	☐ Always or almost always
2. When you're working near dust/fumes, how often do you use a respirator or dust mask	☐ Never or almost never
	☐ Less than half of the time
	☐ About half of the time
	☐ More than half of the time
	☐ Always or almost always
3. How often do you work with or near chemicals?	☐ Never or almost never → ***Skip to question 5***
	☐ Less than half the time
	☐ About half the time
	☐ More than half the time
	☐ Always or almost always
4. When you're working near chemicals, how often do you use protective equipment (i.e. safety glasses, gloves, apron, etc.)?	☐ Never or almost never
	☐ Less than half the time
	☐ About half the time
	☐ More than half the time
	☐ Always or almost always
5. How often are you exposed to high levels of noise?	☐ Never or almost never→ ***Skip to question 7***
	☐ Less than half the time
	☐ About half the time
	☐ More than half the time
	☐ Always or almost always

6.	**When you are working around high noise levels, how often do you use ear plugs or ear muffs?**	☐ Never or almost never ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
7.	**How often do you work with/near materials that could injure your eyes?**	☐ Never or almost never→ ***Skip to question 9*** ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
8.	**When you are working with/near materials that could injure your eyes, how often do you wear safety glasses (with side shields) or a face shield?**	☐ Never or almost never ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
9.	**How often do you work with/near materials that could cut/scrape you?**	☐ Never or almost never→ ***Skip to question 11*** ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
10.	**When you're working with/near materials that could cut or scrape you, how often do you wear gloves (or other protective equipment)?**	☐ Never or almost never ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always

11.	**How often do you work with/near materials or equipment that could burn you?**	☐ Never or almost never→ ***Skip to question 13*** ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
12.	**When you're working with/near materials or equipment that could burn you, how often do you wear protective equipment (i.e. gloves, leathers, apron, spats etc.)?**	☐ Never or almost never ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
13.	**How often do you work near materials/tools/equipment that could hit or strike you in the head or body?**	☐ Never or almost never→ ***Skip to question 15*** ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
14.	**When you're working near objects that could strike you, how often do you use a hardhat?**	☐ Never or almost never ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
15.	**How often do you work in areas that are cluttered or have uneven or slippery surfaces?**	☐ Never or almost never ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always

16.	**How often do you work near traffic or moving vehicles?**	☐ Never or almost never→ ***Skip to question 18*** ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
17.	**When you're working near traffic or moving vehicles, how often do you use high visibility clothing?**	☐ Never or almost never ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
18.	**How often do you work at heights (at 4 feet or higher)?**	☐ Never or almost never→ ***Skip to question 20*** ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
19.	**When you're working at heights, how often do you use fall protection (i.e. harness, railing)?**	☐ Never or almost never ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
20.	**How often do you work near machinery that could catch/trap/crush/cut you?**	☐ Never or almost never→ ***Skip to question 22*** ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always

21.	**How many machines have protective guards or other mechanisms for injury prevention?**	☐ None/almost none ☐ Less than half ☐ About half ☐ More than half ☐ All/almost all
22.	**How often do you do maintenance or repairs on machinery/equipment?**	☐ Never or almost never→ ***Skip to question 25*** ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
23.	**Does the company have a lock-out tag-out program for machinery repair?**	☐ Yes ☐ No ☐ Don't know
24.	**How often do you follow LOTO procedures when repairing machinery?**	☐ Never or almost never ☐ Less than half the time ☐ About half the time ☐ More than half the time ☐ Always or almost always
25.	**Please indicate the training that you have received from your company (at least 15 minutes) in the last year**	☐ Hazard communication training/PPE use ☐ Noise ☐ General safety hazards (burns, slips/trips, cuts, etc.) ☐ Traffic/vehicle hazards ☐ Working at heights/falls ☐ Machine hazards/maintenance ☐ Ergonomics/lifting/preventing strains/sprains ☐ First aid ☐ Forklift use ☐ Other:_____

2: ERGONOMIC EXPOSURES:

1. How often do you work with your hands above the head or the elbows above the shoulder for more than 2 hours total per day?	☐ Never or almost never ☐ Less than half of work days ☐ About half of work days ☐ More than half of work days ☐ Always or almost always
2. How often do you work with your neck or back bent (without support or ability to vary posture) for more than 2 hours total per day?	☐ Never or almost never ☐ Less than half of work days ☐ About half of work days ☐ More than half of work days ☐ Always or almost always
3. How often do you work squatting or kneeling for more than 2 hours total per day?	☐ Never or almost never ☐ Less than half of work days ☐ About half of work days ☐ More than half of work days ☐ Always or almost always
4. How often do you work holding a fixed position for periods longer than 30 minutes without the opportunity to move around freely (i.e. sitting, standing, welding)?	☐ Never or almost never ☐ Less than half of work days ☐ About half of work days ☐ More than half of work days ☐ Always or almost always
5. How often do you work repeating the same motion with your hands, wrists, arms, or shoulders for more than 2 hours total per day?	☐ Never or almost never ☐ Less than half of work days ☐ About half of work days ☐ More than half of work days ☐ Always or almost always

6.	**How often do you lift or lower objects above the shoulders or below the knees or while twisting for more than 2 hours total per day?**	☐ Never or almost never ☐ Less than half of work days ☐ About half of work days ☐ More than half of work days ☐ Always or almost always
7.	**How often do you lift 10 pounds (4.5 kilos) for more than 2 hours total per day?**	☐ Never or almost never ☐ Less than half of work days ☐ About half of work days ☐ More than half of work days ☐ Always or almost always
8.	**How often do you lift 50 pounds (22.7 kilos) at least once per day?**	☐ Never or almost never ☐ Less than half of work days ☐ About half of work days ☐ More than half of work days ☐ Always or almost always

MUSCULOSKELETAL SYMPTOMS (Quick DASH)

1.	Please rate your ability to do the following activities in the last week by checking the box next to the appropriate response **Opening a tight or new jar?**	☐ No difficulty ☐ Mild difficulty ☐ Moderate difficulty ☐ Severe difficulty ☐ Unable

2.	**Do heavy household chores (e.g., wash walls, floors)**	☐ No difficulty ☐ Mild difficulty ☐ Moderate difficulty ☐ Severe difficulty ☐ Unable
3.	**Carry a shopping bag or briefcase**	☐ No difficulty ☐ Mild difficulty ☐ Moderate difficulty ☐ Severe difficulty ☐ Unable
4.	**Wash your back**	☐ No difficulty ☐ Mild difficulty ☐ Moderate difficulty ☐ Severe difficulty ☐ Unable
5.	**Use knife to cut food**	☐ No difficulty ☐ Mild difficulty ☐ Moderate difficulty ☐ Severe difficulty ☐ Unable
6.	**Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.)**	☐ No difficulty ☐ Mild difficulty ☐ Moderate difficulty ☐ Severe difficulty ☐ Unable

7.	**During the past week, *to what extent* has your arm, shoulder, or hand problem interfered with your normal social activities with family, friends, neighbors or groups?**	☐ Not at all ☐ Slightly ☐ Moderately ☐ Quite a bit ☐ Extremely
8.	**During the past week, were you limited in your work or other regular daily as a result of your arm, shoulder or hand problem?**	☐ Not limited at all ☐ Slightly limited ☐ Moderately limited ☐ Very limited ☐ Unable
9.	Please rate the severity of the following symptoms last week. (circle number) **Arm, shoulder or hand pain**	☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme
10.	**Tingling (pins and needles) in your arm, shoulder or hand**	☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme
11.	**During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? (circle one)**	☐ No difficulty ☐ Mild difficulty ☐ Moderate difficulty ☐ Severe difficulty ☐ So much difficulty that I can't sleep

3: INJURIES AND ACCIDENTS

1.	**How many times have you been injured at work <u>in the past year</u>?**	_____times → ***If 0, skip to question 8***

2.	**Did you receive medical care for your worst injury at work in the past year?**	☐ Yes ☐ No
3.	**What type of medical care did you receive for your worst injury at work in the past year?**	☐ First aid at work ☐ Treatment from a doctor or other healthcare professional in a clinic or office ☐ Treatment at emergency room ☐ Other:_____
4.	**How many days of work did you miss due to your worst injury at work in the past year?**	_____days
5.	**How many days were you assigned to light duty or modified work due to your worst injury in the past year?**	_____days
6.	**What <u>type of object or material</u> caused your worst injury at work in the past year?**	☐ Chemicals ☐ Containers ☐ Furniture or fixtures ☐ Machinery ☐ Parts or materials ☐ Persons, plants or animals ☐ Structures or surfaces ☐ Tools ☐ Instruments and equipment ☐ Vehicles ☐ Other:_____

7.	**How did your worst injury at work in the past year <u>occur</u>?**	☐ Contact with objects or equipment ☐ Fall ☐ Bodily reaction or exertion ☐ Exposure to harmful substance or environment ☐ Transportation accident ☐ Fire or explosion ☐ Assault or violent act ☐ Other:_____
8.	**How many times were you <u>almost injured</u> at work in the past year?**	_____times

<u>4: HEALTH AND SAFETY COMMITTEE EXPERIENCES</u>

1.	**Are you aware of the existence of a Health and Safety Committee at your company?**	☐ Yes ☐ No → ***Skip to next section***
2.	**Do you know how to report a problem to the Health and Safety Committee?**	☐ Yes ☐ No
3.	**Have you ever reported a problem or a safety hazard to the Health and Safety Committee?**	☐ Yes ☐ No→ ***Skip to question 6***
4.	**Did you hear back with an answer or solution?**	☐ Yes ☐ No
5.	**Was the problem corrected?**	☐ Yes ☐ No

Please tell us how much you agree or disagree with each statement

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

6.	**You are satisfied with the information you receive from the Health and Safety Committee.**	☐	☐	☐	☐	☐
7.	**The committee gets workers' input on health and safety problems.**	☐	☐	☐	☐	☐
8.	**You trust the committee to deal with a problem that you bring to them**	☐	☐	☐	☐	☐
9.	**You are kept informed of committee progress on dealing with health and safety problems**	☐	☐	☐	☐	☐
10.	**You trust Health and Safety Committee members.**	☐	☐	☐	☐	☐
11.	**The Health and Safety Committee plays an important role in making the worksite safer**	☐	☐	☐	☐	☐

5: SAFETY CLIMATE

In the following section, please describe how you perceive safety at your workplace. Although some questions may appear very similar, please answer each one of them.

		Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**
1.	**Management encourages employees here to work in accordance with safety rules – even when the work schedule is tight**	☐	☐	☐	☐
2.	**Management ensures that everyone receives the necessary information on safety**	☐	☐	☐	☐
3.	**Management looks the other way when someone is careless with safety**	☐	☐	☐	☐
4.	**Management places safety before production**	☐	☐	☐	☐
5.	**Management accepts employees here taking risks when the work schedule is tight**	☐	☐	☐	☐
6.	**We who work here have confidence in the management's ability to deal with safety**	☐	☐	☐	☐

		Strongly Disagree	Disagree	Agree	Strongly Agree
7.	**Management ensures that safety problems discovered during safety rounds/evaluations are corrected immediately**	☐	☐	☐	☐
8.	**When risk is detected, management ignores it without action**	☐	☐	☐	☐
9.	**Management lacks the ability to handle safety properly**	☐	☐	☐	☐
10.	**Management strives to design safety routines that are meaningful and actually work**	☐	☐	☐	☐
11.	**Management makes sure that each and every one can influence safety in their work**	☐	☐	☐	☐
12.	**Management encourages employees here to participate in decisions which affect their safety**	☐	☐	☐	☐
13.	**Management never considers employees' suggestions regarding safety**	☐	☐	☐	☐
14.	**Management strives for everybody at the worksite to have high competence concerning safety and risks**	☐	☐	☐	☐
15.	**Management never asks employees for their opinions before making decisions regarding safety**	☐	☐	☐	☐
16.	**Management involves employees in decisions regarding safety**	☐	☐	☐	☐
17.	**Management collects accurate information in accident investigations**	☐	☐	☐	☐
18.	**Fear of sanctions (negative consequences) from management discourages employees here from reporting near-miss accidents**	☐	☐	☐	☐
19.	**Management listens carefully to all who have been involved in an accident event**	☐	☐	☐	☐
20.	**Management looks for causes, not guilty persons, when an accident occurs**	☐	☐	☐	☐
21.	**Management always blames employees for accidents**	☐	☐	☐	☐
22.	**Management treats employees involved in an accident fairly**	☐	☐	☐	☐

		Strongly Disagree	Disagree	Agree	Strongly Agree
23.	**We who work here try hard together to achieve a high level of safety**	☐	☐	☐	☐
24.	**We who work here take joint responsibility to ensure that the workplace is always kept tidy**	☐	☐	☐	☐
25.	**We who work here do not care about each other's safety**	☐	☐	☐	☐
26.	**We who work here avoid tackling risks that are discovered**	☐	☐	☐	☐
27.	**We who work here help each other to work safely**	☐	☐	☐	☐
28.	**We who work here take no responsibility for each other's safety**	☐	☐	☐	☐
29.	**We who work here regard risks as unavoidable**	☐	☐	☐	☐
30.	**We who work here consider minor accidents as a normal part of our daily work**	☐	☐	☐	☐
31.	**We who work here accept dangerous behavior as long as there are no accidents**	☐	☐	☐	☐
32.	**We who work here break safety rules in order to complete work on time**	☐	☐	☐	☐
33.	**We who work here never accept risk-taking even if the work schedule is tight**	☐	☐	☐	☐
34.	**We who work here consider that our work is unsuitable for cowards**	☐	☐	☐	☐
35.	**We who work here accept risk-taking at work**	☐	☐	☐	☐
36.	**We who work here try to find a solution if someone points out a safety problem**	☐	☐	☐	☐
37.	**We who work here feel safe when working together**	☐	☐	☐	☐
38.	**We who work here have great trust in each other's ability to ensure safety**	☐	☐	☐	☐
39.	**We who work here learn from our experiences to prevent accidents**	☐	☐	☐	☐

		Strongly Disagree	Disagree	Agree	Strongly Agree
40.	**We who work here take each other's opinions and suggestions concerning safety seriously**	☐	☐	☐	☐
41.	**We who work here seldom talk about safety**	☐	☐	☐	☐
42.	**We who work here always discuss safety issues when such issues come up**	☐	☐	☐	☐
43.	**We who work here can talk freely and openly about safety**	☐	☐	☐	☐
44.	**We who work here consider that a good safety representative plays an important role in preventing accidents**	☐	☐	☐	☐
45.	**We who work here consider that safety rounds/evaluations have no effect on safety**	☐	☐	☐	☐
46.	**We who work here consider that safety training is good for preventing accidents**	☐	☐	☐	☐
47.	**We who work here consider early planning for safety meaningless**	☐	☐	☐	☐
48.	**We who work here consider that safety rounds/evaluations help find serious hazards**	☐	☐	☐	☐
49.	**We who work here consider safety training to be meaningless**	☐	☐	☐	☐
50.	**We who work here consider it important to have clear-cut goals for safety**	☐	☐	☐	☐

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
51.	**You are comfortable refusing unsafe work**	☐	☐	☐	☐	☐
52.	**Have you ever refused unsafe work?**	☐ Yes ☐ No				

6: DEMOGRAPHICS

1.	**In what year were you born?**	Year: _____
2.	**In what country were you born?**	_____ → ***If United States, skip to question 4***
3.	**How many years have you lived in the United States?**	_____ years
4.	**Are you Hispanic or Latino**	☐ Yes ☐ No
5.	**Please select the racial category or categories with which you most closely identify. (Check as many as apply)**	☐ American Indian or Alaska Native ☐ Asian ☐ Black or African American ☐ Native Hawaiian or Other Pacific Islander ☐ White
6.	**What is the highest level of formal schooling you have completed?**	☐ Less than high school ☐ Finished high school or GED ☐ Some college ☐ Finished college ☐ Trade/vocational school
7.	**How many years have you worked for the company?**	_____Years

8.	**What language do you usually speak at home?**	☐ English ☐ Spanish ☐ Russian ☐ Vietnamese ☐ Other_____
9.	**How comfortable are you <u>speaking</u> English?**	☐ Not comfortable at all ☐ Somewhat comfortable ☐ Comfortable ☐ Very comfortable
10.	**How comfortable are you <u>reading</u> English?**	☐ Not comfortable at all ☐ Somewhat comfortable ☐ Comfortable ☐ Very comfortable

7: HEALTH AND SAFETY COMMITTEE PARTICIPATION

1.	**Are you currently serving on the health and safety committee?**	☐ No ☐ Yes
2.	**How many years have you served on the committee?**	_____ years

		Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
3.	**You feel comfortable interacting in the committee setting**	☐	☐	☐	☐	☐
4.	**You are taken seriously in the committee setting**	☐	☐	☐	☐	☐
5.	**Worker members and management members cooperate in the committee setting**	☐	☐	☐	☐	☐

6.	**The committee plans together and coordinates efforts**	☐	☐	☐	☐	☐
7.	**Committee meetings are interesting and enjoyable**	☐	☐	☐	☐	☐
8.	**The committee makes good use of time during meetings**	☐	☐	☐	☐	☐
9.	**You are satisfied with the committee's ability to deal with health and safety problems**	☐	☐	☐	☐	☐
10.	**The committee deals with health and safety problems in a timely manner**	☐	☐	☐	☐	☐
11.	**Workers trust the health and safety committee to deal with health and safety problems**	☐	☐	☐	☐	☐
12.	**Workers are aware of committee progress on dealing with health and safety problems**	☐	☐	☐	☐	☐
13.	**Workers respect committee members**	☐	☐	☐	☐	☐

Appendix 2: Hazard observation tool

Researcher: _____ **Company:** _____

Date of observation: _____/_____/_____ **Time of observation:** _____:_____ ☐ **AM** ☐ **PM** **Shift:** ☐ **1** ☐ **2** ☐ **3**

Exposure:		Exposure magnitude		Protective equipment
Fall hazards		☐ Not present ☐ Low ☐ High		*(e.g., fall protection harness, railing, etc)* ☐ Not used ☐ Used ☐ Uncertain
Noise		☐ Not present ☐ Low ☐ High		*(e.g., earplugs or earmuffs)* ☐ Not used ☐ Used ☐ Uncertain
Eye hazard		☐ Not present ☐ Low ☐ High		*(e.g. safety glasses, faceshield, safety goggles)* ☐ Not used ☐ Used ☐ Uncertain
Dust/fume		☐ Not present ☐ Low ☐ High		*(e.g., dust mask or respirator)* ☐ Not used ☐ Used ☐ Uncertain
Struck by objects (not vehicles)		☐ Not present ☐ Low ☐ High		*(e.g.hardhat or helmet)* ☐ Not used ☐ Used ☐ Uncertain
Traffic/vehicle safety		☐ Not present ☐ Low ☐ High		*(e.g. high-visibility vest)* ☐ Not used ☐ Used ☐ Uncertain
Work with machines/equipment		☐ Not present ☐ Low ☐ High		*(e.g., machine guards)* ☐ Not used ☐ Used ☐ Uncertain
Maintenance/energy control		☐ Not present ☐ Low ☐ High		*(e..g., lock or tag)* ☐ Not used ☐ Used ☐ Uncertain
Lacerations/abrasions		☐ Not present ☐ Low ☐ High		*(e..g., gloves, tool not hand)* ☐ Not used ☐ Used ☐ Uncertain
Burns		☐ Not present ☐ Low ☐ High		*(e..g., gloves, apron)* ☐ Not used ☐ Used ☐ Uncertain
Chemicals		☐ Not present ☐ Low ☐ High		*(e..g., gloves, apron, faceshield)* ☐ Not used ☐ Used ☐ Uncertain
Housekeeping		☐ Not present ☐ Low ☐ High		Not applicable

RESEARCHER OBSERVATION FORM HELP NOTES

Hazard	Definition of hazard	Definition of exposure magnitude	Definition of protective equipment
Fall	Fall of 4 vertical feet or more possible from workers' location.	**NP:** -At ground level - At least 1 body length away from edge -In enclosed control cab/booth (windows closed) **Low:** -On a ladder, 3 points of contact -Climbing stairs **High:** -On a ladder, 2 points of contact -On exterior of vehicle or machinery -On scissor or snorkel lift -On a platform/ledge with open edge	**Not used:** -No PPE **Used:** -Fall protection harness -Railing
Noise	Intensity of noise exposure	**NP:** -No high noise sources nearby -In enclosed control cab/booth (windows closed**)** **Low:** -Within 50 feet of high noise source (equipment, machinery, etc) **High:** -Within 10 feet of high noise source (equipment or machinery)	**Not used:** -No PPE **Used:** -Earplugs or earmuffs
Eye	Possibility of eye injury from airborne debris or protruding object	**NP:** -No nearby protruding objects or equipment producing airborne debris -In enclosed control cab/booth (windows closed) **Low:** -Within 10 feet of protruding object or particulate source **High**: -Carrying out a task producing airborne debris -In plume or ejection path of airborne debris	**Not used:** -No PPE **Used:** -Safety goggles/glasses -Faceshield -Debris control or suppression
Dust/fume	Intensity of exposure to particulate or fume	**NP:** -No nearby airborne dust or particulate source -In enclosed control cab/booth (windows closed) **Low:** -Within 10 feet of airborne dust or particulate source **High:** -In plume/ejection path of airborne dust or particulate	**Not used:** -No PPE **Used:** -Dust mask/respirator -Dust control or suppression

Hazard	Definition of hazard	Definition of exposure magnitude	Definition of protective equipment
Struck by objects (not vehicles)	Possibility of being struck by falling or ejected objects	**NP:** -Not working near falling/ejected objects -In enclosed control cab/booth (windows closed) **Low:** -Working within 10 feet of falling/ejected objects or objects that are likely to fall/be ejected **High:** -In pathway of falling/ejected objects	**Not used:** -No PPE **Used:** -Hardhat or helmet
Traffic/vehicle safety (for pedestrians)	Possibility of being struck by a moving or idling vehicle (trucks and cars)	**NP:** - Not near traffic/vehicles **Low:** -Between 10 and 20 ft of moving vehicles -Between 10 and 20 ft of front or back of idling vehicle **High:** - Within 10 feet of moving vehicle -Within 10 ft of front or back of idling vehicle or 3 ft from sides	**Not used:** -No PPE **Used:** -High-visibility vest -Flag Walkway/jersey barrier
Work with machines/equipment	Possibility of injury due to poorly guarded or dangerous machines/equipment.	**NP:** -Not near machines/equipment -In control cab/booth **Low:** -Working within 5 feet of machines or equipment **High:** -Operating machines/equipment	**Not used** **Used**: Machine safeguards
Maintenance/energy control	Possibility of injury due to maintenance on energized equipment	**NP:** -Not doing maintenance **Low:** -Maintaining inactive equipment **High:** -Maintaining equipment during operation	**Not used** **Used:** Lock or tag
Lacerations	Possibility of cut from contact with sharp equipment or materials	**NP:** ->2 ft from sharp equipment/materials **Low:** -Within 2 ft of sharp equipment/materials **High:** -Touching/using sharp equipment/materials	**Not used:** -No PPE **Used:** -Gloves -Using tools (not hands)
Burns	Possibility of burn from contact with hot equipment or materials	**NP:** ->2 ft from hot equipment/materials **Low:** -Within 2 ft of hot equipment/materials **High:** -Touching/using hot equipment/materials	**Not used:** -No PPE **Used:** -Gloves -Apron - Spats - Faceshield
Chemicals	Possibility of injury due to contact with harmful chemicals	**NP:** ->2 ft from chemicals - In enclosed control cab/booth **Low:** -Within 2 ft chemicals **High:** -Touching/using chemicals	**Not used:** -No PPE **Used:** -Gloves -Apron - Spats - Faceshield

Housekeeping	Slip, trip, or fall possible due to poor condition of walking surface or poor housekeeping (clutter)	**NP:** 0-1 hazard **Low:** 2 hazards or single extreme hazard **High:** 3 or more hazards • wet or oily surfaces • loose, unanchored rugs or mats • obstructed view • poor lighting • clutter • cables, hoses • rough, uneven surface • poor maintenance • restricted egress	**N/A**

Appendix 3: Training materials

Ground rules

- Enjoy yourself
- Listen carefully
- Fully participate
- Respect others
- Value differences
- Be open-minded
- Challenge yourself
- Be on time
- Reserve side conversations for breaks

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"Accidents" at work

- Accident vs.
  - Injury
  - Illness
  - Incident
  - Exposure
- What causes 'accidents' at work?

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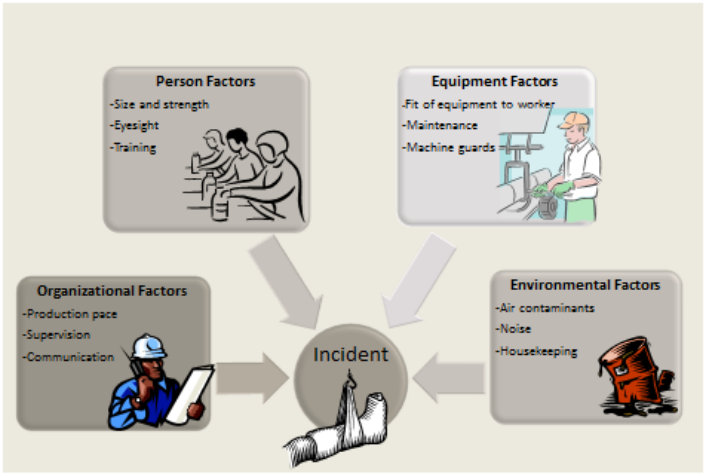

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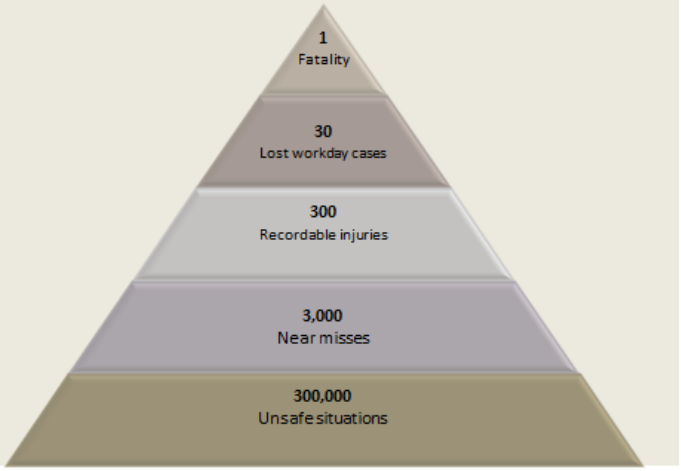

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HEALTH & SAFTY COMMITTEES

"A health and safety committee is a joint worker-management team that assists the employer in creating and maintaining a safe workplace."

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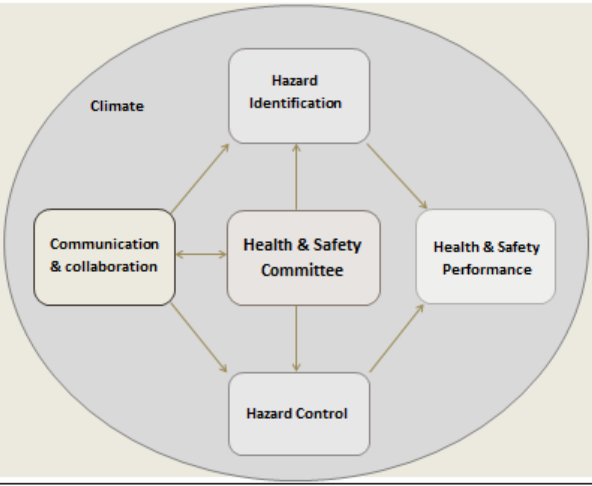

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Washington State regulation

Committee composition

- At least half of members must be employee-elected
- Must have an elected chairperson
- Terms should last one year (no limit to number of terms)

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Washington State regulation

Meetings

- Meetings should last one hour at most
  - Unless the majority votes to extend
- No guidelines for meeting frequency
- Must record attendance and meeting minutes
- Topics to cover
  - Review inspection and investigation reports
  - Evaluate the accident and illness prevention program

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HSC basics – Committee make-up

- Worker-elected members vs. management-appointed members
- Elections
- Representation

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HSC basics - Meetings

- When, where, and how often
- Topics covered
- Making decisions, voting

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HSC basics - Recordkeeping

- Agendas
- Meeting minutes
- Action plans

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HSC basics - Roles

- Chairing the committee
- Member responsibilities

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HSC basics – Self-evaluation

- How do we know if things are working?

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Hazard identification strategies

- Walkthrough inspections
- Accident investigation
- Job Hazard Analysis/Job Safety Analysis
- Hazard reporting by employees (informal and formal)
- Review of incident/investigation reports/data

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HSC– Group Assignment

As a Member

1. Do you know what are your responsibilities as a HSC member?
2. What kind of HSC-training did you receive?
3. What processes are in place for:
   - ID hazards
   - Reporting hazards
   - Take action
   - Follow-up
4. Communication with Co-Workers

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