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Application of Research Findings Case Study: EPRI Ergonomics Handbooks

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EPRI Project Manager

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Electric Power Research Institute (EPRI)

This is an EPRI Technical Update report. A Technical Update report is intended as an informal report of continuing research, a meeting, or a topical study. It is not a final EPRI technical report.

NOTE

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ABSTRACT

In efforts to better translate its research, the Electric Power Research Institute (EPRI) Occupational Health and Safety (OHS) Program designed and administered an online survey for health and safety professionals who either participate in the OHS program or ordered particular EPRI ergonomic product deliverables. The research investigated the application and use of written and visual ergonomic resources developed over time by the EPRI OHS program. The ergonomic research reports were developed primarily as technical resources for use in ergonomic design interventions, injury prevention programs, and training. The survey gathered information on how the materials were used to identify and mitigate ergonomic risk factors at work sites and as part of worker training activities. Key respondent follow-up interviews were conducted to explore survey topics in greater depth and to understand previously unidentified uses for the ergonomics reports. This Technical Update contains summarized online survey findings, results of the follow-up interviews, and recommendations for the use of current and future OHS research materials.

Keywords
Ergonomics
Intervention(s)
Occupational health
Translational research
Worker training

CONTENTS

LIST OF TABLES

1
INTRODUCTION

This report summarizes findings from a research study conducted by the UCLA Labor Occupational Safety and Health Program (UCLA-LOSH) on behalf of the Electric Power Research Institute (EPRI). The research investigated application and use of written and visual ergonomic intervention resources prepared by EPRI (referred to in this report as the Handbooks) and a companion DVD. The Handbooks and DVD were developed by EPRI to summarize research conducted on ergonomics in the electric power industry and as technical resources for electric power companies to use in ergonomic design interventions, injury prevention programs, and training.

On behalf of the EPRI Occupational Health and Safety (OHS) research program, we designed and administered an online survey to health and safety professionals who have ordered the EPRI Ergonomics Handbooks and/or DVD or those professionals participating in the OHS program. The survey gathered information on how the materials were used to identify and mitigate ergonomics risk factors at worksites and as part of worker training activities. In addition, we conducted follow-up interviews with key respondents to explore survey topics in greater depth. The findings from the online survey are summarized in Part I of this report; results of the follow-up interviews are summarized in Part II. Part III outlines a number of recommendations stemming from the findings from these research activities and worker training experience.

2
OBJECTIVES

The primary goal of the project was to solicit input from occupational health and safety professionals in the electric power industry on use of the Ergonomics Handbooks and the DVD. The project was designed to evaluate the EPRI Handbooks and DVD as practical resources for injury prevention and for implementing ergonomic interventions in the worksite. The project was also intended to gather information on how the Handbooks or other material generated by the OHS program could be better adapted for use in training contexts. The survey and interview findings can enable EPRI to improve the delivery of research information to better serve the needs of electric utility companies.

3
EPRI ERGONOMIC HANDBOOKS FEEDBACK SURVEY

Methods

We developed a computer-based survey to achieve specified objectives. The survey consisted of 19 multiple choice questions that included 7 open ended-answer options. An initial version of the survey was piloted with two ergonomic specialists at different electric utility companies. The final survey tool generated information on different variables that examined injury trends, risk factors in the workplace, and uses of the Handbooks and DVD to identify and mitigate risks and to support Handbooks training activities. Additional questions examined respondents' expectations of injury prevention training and ways EPRI might better support training activities. The questionnaire was designed to be completed in 20 minutes or less. Most multiple choice questions had the option for respondents to choose 'other' and enter a comment. Respondents also had the option to skip questions.

The online survey was hosted and responses collected through Survey Monkey®. Data collection took place from January through April 2013. Individual recipients were sent the survey link embedded in an e-mail which informed them about the background and objectives of the project. All individuals received an initial e-mail inviting them to participate in the survey; follow-up reminders were sent two weeks later to those who had not yet responded. A copy of the survey tool is provided in **Appendix A**.

The survey was sent to 65 individuals representing a total of 30 electric power companies across the United States (and including one in Canada). Survey recipients were selected based on the availability of e-mail information from electrical utility companies who had purchased EPRI Ergonomics Handbooks and/or the DVD and those involved in the EPRI OHS Program. The survey recipients included occupational health and safety professionals, ergonomics specialists, training directors, plant managers and other individuals from former and current EPRI member companies. In some cases, more than one professional from the same company received the survey invitation or the invitation e-mail may have been forwarded to colleagues within a company having expertise in ergonomics.

Survey Findings

Individual and Company Profiles

A total of 11 individuals responded to the survey, representing an overall response rate of 16.9% of the population sampled (11 out of 65 individuals). The overall company response rate was 36.7% (11 out of 30 companies sampled). Results are discussed in detail in the following sections of this report.

Of the companies represented by survey respondents, almost all had over 1,000 full-time employees. The median number of employees was 6,700, with a range from 600 to 29,000 employees. About half of respondents reported that their companies provided most or all of their employees with at least some type of safety training. Three respondents reported that all employees were provided with some type of safety training.

Individuals who responded to the survey were asked to describe their roles in their organizations. Most held job titles indicating health and safety roles within their organizations, such as Health and Safety Supervisor, Safety Director, Health and Safety Specialist, or Plant IH Coordinator. Most respondents reported spending at least a quarter of their time on injury prevention activities.

Work Tasks and Risk Factors

Respondents were asked about typical job tasks, risk factors for musculoskeletal disorders (MSDs) and repetitive motion injuries (RMI), and also their most common workplace injuries. The survey gathered information on the range of work tasks and operations performed by employees (Table 3-1). Ten of the 11 respondents reported that employees perform overhead line tasks, plant operations or mechanic tasks, and fleet vehicle maintenance. Eight out of 11 respondents also reported employees perform manhole, vault, and conduit tasks, and direct-buried cable tasks.

Table 3-1
Which of the following work tasks or operations do your employees perform?

	Response Percent	Response Count (N=11)
Overhead line tasks	90.9%	10
Plant operations or mechanic tasks	90.9%	10
Fleet vehicle maintenance	90.9%	10
Manhole, vault, and conduit tasks	72.7%	8
Direct-buried cable tasks	72.7%	8
Other (please specify)		3

Other work tasks included:

- Substations and relay tasks to maintain compliance with the Federal Regulatory Energy Commission (FERC) and North American Electric Reliability Corporation (NERC)
- Other support functions including supply chain, real estate management, lake management, appliance sales and repair, building/property management
- Construction and forestry and electrical maintenance

Respondents also reported a number of similar risk factors for MSDs and RMIs. All respondents reported that employees face risks from awkward postures (twisting, extending, bending), gripping (hand tools, steering wheels), overhead work (reach), lifting/carrying and pushing/pulling (Table 3-2). Most respondents also reported risks from repetitive tasks, static postures and contact pressure.

Table 3-2
What kinds of risk factors for musculoskeletal disorders (MSD) do employees in your organization face?

	Response Percent	Response Count (N=11)
Awkward postures (twisting, extending, bending)	100%	11
Gripping (hand tools, steering wheels)	100%	11
Overhead work (reach)	100%	11
Lifting/carrying	100%	11
Pushing/pulling	100%	11
Repetitive tasks	90.9%	10
Static postures (standing or sitting for long periods)	90.9%	10
Contact pressure (against counter edges, equipment)	81.8%	9
Other (please specify)		2

Other risk factors included:

- Extended ladder use including static posture and limited space
- Vibration and cold/heat
- Psychosocial stressors

In an open-ended question, respondents were asked to indicate the three most common MSDs/RMIs or related risk factors among their workforce. The open-ended responses were more varied. The most common MSDs/RMIs or related risk factors were back injuries (N=8), shoulder injuries (N=6), and knee/lower extremity injuries (N=5). Other less common MSDs/RMIs or risk factors included general strain, sprain, and tears (N=3), hand or arm sprains and strains (N=2), and repetitive tasks (N=2).

Company Safety Training Activities

The survey asked respondents a number of questions about worker health and safety training activities, including training on ergonomics and injury prevention. Nine of the 11 respondents (81.8%) indicated their companies currently provide some form of training to employees on ergonomics and the prevention of MSDs or RMIs (Table 3-3). Among those 9 companies, all provide training on back safety, materials handling (i.e. moving manhole covers, heavy equipment) and safe lifting. Eight of the 9 also reported employees receive training on repetitive manual tasks and safe hand tool use. Less frequent topics covered included office ergonomics, ergonomics of overhead work, safe digging and shoveling, safe cable/wire pulling, and ergonomics of working in vaults.

Table 3-3
What topics are covered in the training your company provides to employees on ergonomics and the prevention of MSDs or RMIs? (Check all that apply.)

	Response Percent	Response Count (N=9)
Back safety	100%	9
Materials handling (i.e. moving manhole covers, heavy equipment)	100%	9
Safe lifting	100%	9
Repetitive manual tasks & safe hand tool use	88.9%	8
Office ergonomics	66.7%	6
Ergonomics of overhead work	56.6%	5
Safe digging and shoveling	44.4%	4
Safe cable/wire pulling	33.3%	3
Ergonomics of working in vaults	22.2%	2
Ergonomics for vehicle operators	11.1%	1
Other (please specify)		2

In addition, one respondent indicated a companywide stretching program, while another reported training is provided on construction, forestry, lines and maintenance, with specifically designed training packages on these topics that include an MSD training video.

Respondents were asked what other health and safety training is provided to employees aside from ergonomics safety and MSDs (Table 3-4). All respondents reported that employees receive training in confined space, lock-out/tag-out, electrical safety, fall protection, forklift safety, safe driving, and ladder safety. Training in Hazardous Waste Operations and Emergency Response (HAZWOPER) and aerial lifts was also common.

Table 3-4
What other health and safety training is provided to employees in your organization? (Check all that apply.)

	Response Percent	Response Count (N=11)
Ladder Safety	100%	11
Confined Space	100%	11
Lock-out/Tag-out	100%	11
Electrical Safety	100%	11
Fall Protection	100%	11
Forklift Safety	100%	11
Safe Driving	100%	11
HAZWOPER	90.9%	10
Aerial Lifts	81.8%	9
Don't know	9.1%	1
Other (please specify)		2

Other responses included training in onsite stretching, bloodborne pathogens, and cargo securement.

All respondents indicated that health and safety training is provided by in-house instructors, while 4 out of 11 (36.4%) also utilize outside consultants.

Use of EPRI Ergonomics Handbooks

Determining the current use and application of Handbooks in workplace safety programs was one of the principal objectives of this survey. A number of questions were asked to examine respondents' familiarity with and use of the Handbooks.

Survey respondents reported owning a number of different EPRI Ergonomics Handbooks (Table 3-5). The most commonly owned handbook was Ergonomic Interventions for Plant Operators and Mechanics in Fossil-Fueled Generating Stations (Product ID: 1015631). The number of respondents owning additional EPRI products is indicated below. Two respondents did not own any of these products.

Table 3-5
Please indicate which of the following EPRI Ergonomics Handbooks you currently own. (Check all that apply.)

	Response Percent	Response Count (N=11)
Ergonomic Interventions for Plant Operators and Mechanics in Fossil-Fueled Generating Stations (12/15/2008) Product ID: 1015631	72.7%	8
Ergonomic Design for Substations and Ergonomic Interventions for Overhead, Underground, and Substation Applications (10/20/2010) Product ID: 1021128	63.6%	7
Ergonomic Design Handbook for Fossil-Fueled Electric Generating Stations (3/11/2008) Product ID: 1014942	63.6%	7
Ergonomic Interventions for Electrical Workers in Fossil-Fueled Power Plants (1/11/2008) Product ID: 1014042	63.6%	7
Process Guidelines for Vehicle Acquisition and Maintenance and Ergonomics Guidelines for Vehicle Maintenance (11/03/2011) Product ID: 1021836	54.5%	6
Ergonomic Interventions for Manhole, Vault and Conduit Applications (3/30/2004) Product ID: 1005430	54.5%	6
Overhead Distribution Line Workers Interventions (11/29/2001) Product ID: 1005199	54.5%	6
Ergonomics Interventions for Direct-Buried Cable Applications (3/21/2005) Product ID: 1005574	36.3%	4

Respondents were then asked how familiar they are with the content of the Handbooks they own (Table 3-6). Seven respondents (63.6%) reported they were "somewhat familiar." Two reported very high or very low familiarity with the Handbooks, while one reported not knowing about the Handbooks at all.

Table 3-6
How familiar are you with the content of the EPRI Ergonomics Handbooks you own?

	Response Percent	Response Count (N=11)
Very familiar (I have reviewed the information in the handbook(s) in detail and/or use it on a regular basis)	18.2%	2
Somewhat familiar (I have looked over the handbook(s) but don't use them frequently)	63.6%	7
Not at all familiar (I know about the handbook(s) but haven't used them)	9.1%	1
I didn't know there were EPRI Ergonomics Handbooks	9.1%	1

When respondents were asked how they have used Handbooks in their organization, seven of the 10 respondents (70.0%) reported they had used Handbooks to implement recommended ergonomics interventions (Table 3-7). Half of respondents indicated they had used the Handbooks to make changes to other practices and procedures, while four respondents reported they had used the Handbooks to conduct job hazard analyses.

Table 3-7
How have you used the EPRI Ergonomics Handbooks in your organization? (Check all that apply.)?

	Response Percent	Response Count (N=11)
Implement recommended ergonomics interventions	70.0%	7
Make changes to other practices and procedures	50.0%	5
Conduct job hazard analyses	40.0%	4
Incident investigations	30.0%	3
Develop design specifications or make purchasing decisions	30.0%	3
Justify costs/benefits of interventions	20.0%	2
Use in employee safety training	20.0%	2
None of these	20.0%	2
Determine return-to-work eligibility	0.0%	0
Other (please specify)		2

Other responses included using the Handbooks to encourage business to consider changes, and using the Handbooks as a "discussion tool" within training.

Respondents were then asked specifically how they had incorporated information from the Handbooks into training (Table 3-8). Six of the 7 respondents who answered this question (85.7%) indicated they had used the Handbooks to describe ergonomic interventions or recommended best practices. Four also reported having used the Handbooks to support recommended best practices with quantifiable measures, such as lift equation data or strength requirements.

Table 3-8
How have you incorporated information from the EPRI Ergonomics Handbooks into training? (Check all that apply.)

	Response Percent	Response Count (N=7)
Describe ergonomic interventions/recommended best practices	85.7%	6
Support recommended best practices with quantifiable measures (lift equation data, strength requirements)	57.1%	4
Identify and explain risk factors for specific work practices	42.9%	3
Incorporate figures and illustrations in training materials	28.6%	2
References/attachments	28.6%	2

The explanations respondents provided for not using the Handbooks included that the material is outdated, the recommendations are not practical, and they had not gotten buy-in from the company for their use. One respondent indicated having only become aware of the Handbooks recently and just starting to identify applications.

Use of EPRI Ergonomics DVD

In addition to the Handbooks, respondents were also asked separately about the EPRI Ergonomics DVD. Five respondents reported they owned the DVD. One respondent indicated using it in their training by showing the DVD and discussing it with the employees. The other four respondents who own the DVD indicated they do not currently use it in employee training. Reasons included that the DVD was not applicable, it was too long, and it was difficult to skip to the needed parts. Other respondents were either not aware of the DVD, have not been able to obtain it, or are just currently assessing its application.

Expectations of Employee Training

The final section of the survey examined respondents' opinions about the relative effectiveness of different training methods. The goal of these questions was to help guide potential adaptations of the EPRI Handbooks and DVD for wider use in employee safety training activities.

Respondents were first asked their opinion of the effectiveness of various employee training methods (Table 3-9). Hands-on demonstrations and on-the-job training was considered very effective by all respondents. Tailgate meetings were considered very effective by most respondents (63.6%). Videos and classroom presentations were considered somewhat effective by most respondents. Respondents ranked online/computer-based training from somewhat effective to not very effective.

Table 3-9
In your experience, how effective are each of the following employee training methods?

	Very Effective	Somewhat Effective	Not Very Effective	Does not contribute	Respons e Count
Hands-on demonstrations/on-the-job training	11	0	0	0	11
Tailgate meetings	7	3	1	0	11
Classroom presentations	4	7	0	0	11
Videos	1	7	2	1	11
Online/computer-based training	0	6	5	0	11

When asked about the relative importance of various factors in contributing to a successful training, all respondents ranked communication of accurate information by the instructor as very important (Table 3-10). Most respondents also indicated that audience engagement in training and the opportunity for students to provide feedback are very important in determining training success.

Table 3-10
In your opinion, how important are each of the following in contributing to a successful training?

	Very Important	Somewhat Important	Not Very Important	Does Not Contribute	Response Count
The instructor communicates accurate information	11	0	0	0	11
The audience engages in the training by asking questions or discussing how it relates to their job	10	1	0	0	11
The students have an opportunity to provide feedback	9	2	0	0	11

When asked their opinions about the relative importance of various training outcomes, all respondents ranked as very important that changes be implemented in the workplace following training (Table 3-11). Other important training outcomes included meeting regulatory requirements and that injury or accident rates go down. Positive student feedback was somewhat important as a training outcome.

Table 3-11
In your opinion, how important are each of the following training outcomes?

	Very Important	Somewhat Important	Not Very Important	Does Not Contribute	Response Count
Changes are implemented in the workplace	11	0	0	0	11
Regulatory requirements are met	7	3	1	0	11
Our injury or accident rates go down	8	3	0	0	11
Student feedback is positive	5	6	0	0	11

Respondents were asked what other resources and materials they use in employee health and safety training besides the Handbooks and DVD. Respondents reported using a variety of references sources for training, including materials available through the National Safety

Council, the American Society for Engineering Education (ASEE), the Edison Electric Institute (EEI), the U.S. Occupational Safety and Health Administration (OSHA), and JJ Keller. A number of respondents reported developing their own materials using state or provincial regulations, accident investigations, company statistics, trends and employee feedback.

Finally, respondents were asked how they thought their company health and safety training could be improved. Some respondents indicated they felt that making better use of information from the Handbooks would improve their training and they could get more buy-in from management with better communication on the benefits of using EPRI resources. Multiple respondents also recommended increasing the hands-on, interactive and multimedia aspects of training, while others simply suggested freshening the content. One individual requested "videos of actual cases to walk through." Another recommended: "Make the EPRI Handbooks available to the larger community—they are crucial in providing scientific and research-based information."

4
FOLLOW-UP INTERVIEWS

The goal of follow-up interviews was to obtain more in-depth information on the topics covered in the survey, and to provide opportunities to include information that was not covered in the survey. The phone interview allowed researchers to ask open-ended questions and to uncover related concerns relevant to the Handbooks.

Methods

We reviewed and analyzed survey results in order to develop questions for follow-up interviews. A list of questions was then assembled as a starting point for phone interview discussion.

Follow-up interviews were conducted with five individuals, each from different companies. The questions used in these interviews are provided in **Appendix B**. In addition, each respondent's individual survey results were reviewed to inform questions particular to their experience with the Handbooks.

Interview Findings

Uses for Training

Among those interviewed, the overall impression of the content of the EPRI Ergonomics Handbooks was positive, with reports that they provided interventions relevant and useful to injury prevention. The consensus was that the Handbooks are useful in the creation of safety trainings and curriculum design. The Handbooks are a good resource for trainers to understand ergonomic interventions and to develop lesson plans. However, the Handbooks are not typically looked at directly during training, since the heavy research component can be too detailed for the audience. Some liked the organization of the manual, and found it easy to locate desired information by job task and by position, and then incorporate text and images into their training. The illustrations were appreciated by several respondents, and some thought the content was understandable for both line workers and management.

Training styles and the application of EPRI research materials to lesson planning varied. One interviewee reported that the most effective way to train employees is to implement a mix of training methods, such as online, hands-on, and instructor-led. Others prefer hands-on training. A number of the interviewees explained that initial training is done through the company apprenticeship program. Various individuals indicated that ergonomics training for electrical workers and contractors is provided by other stakeholders. Companies often design lectures and slideshow presentations for employees and apprenticeship trainings based on handbook topics. Since the interviewees were mostly general safety professionals and spend only a small portion of their time on ergonomic issues, there is a need for ready-to-use ergonomic training programs and lessons.

When discussing ways to improve the format of the Handbooks, some interviewees noted that having an easily accessible handbook available on a subscriber-only website, with a table of contents to link to chapters and other media, and searchable text, would improve the ease of locating specific topics. (However, one interviewee expressed that having a hard copy of the

handbook is most useful for using in and around the plant, and applying its recommendations to real-time observations.) One interviewee described difficulties in accessing the Handbooks online due to the frequently changing interface between the user and the EPRI website.

To diversify safety training, the DVD has been used for its visual nature. Although some find the DVD helpful for this reason, others report that it is inconvenient to skip to the needed parts to be used in training. Some were not able to locate the DVD via the website when they tried to purchase it. One person suggested creating shorter online videos as a way to make the presentation more accessible and user-friendly.

Uses for Hazard Assessment and Control

A number of interviewees reported that their ergonomic teams have drawn on the EPRI materials for performing safety audits and hazard assessments. The EPRI Handbooks have been used for intervention ideas and human factors analysis to improve tool use and body mechanics. Several interviewees reported using the Handbooks during incident investigations to analyze root causes and to educate workers on improving their biomechanics. Others have used them to implement stretching programs for their existing workforce and physical testing (e.g., range of motion, ability and general fitness) at time of hire.

The Handbooks have also been used by companies to make purchasing decisions, such as replacing manual hand tools with battery powered crimpers, or in reviewing design recommendations. Interviewees indicated Handbook information has been useful for financial justification of purchasing decisions and in performing cost benefit analyses. The Handbook recommendations have been used to communicate directly to management and as a resource for safety committees. Several comments emphasized the importance of timing recommendations for equipment interventions in parallel with new equipment purchases or when existing tools are being phased out.

In terms of improving Handbook content, recommendations for new material included ergonomic interventions for tasks involving high voltage and grounding practices. With high voltage work, electrical workers have to perform tasks with heavy 10-foot poles called hot sticks in order to be at a safe distance from the conductor. Because of the reaching required and the heavy pole, these tasks have an increased risk for musculoskeletal disorders. One interviewee noticed that many companies are more frequently performing overhead work, and would like to see more ergonomic resources on this subject. Although a few interviewees expressed concern that some job tasks in the electrical power industry are not covered by the Handbooks, several interviewees commented on their thoroughness, and one noted that only very specific tasks missing.

Since many companies have already purchased ergonomic toolsets, their focus has shifted toward workplace design for ergonomic improvement. A number of interviewees reported that their companies are focusing on how to make improvements to design specifications for certain universal components (such as step ladders and stairs) and implemented buying guides with purchasing departments for certain tools and vehicle requirements. Workplace design is a new topic that could be addressed in future EPRI research.

For additional ergonomic resources, interviewees mentioned turning to the other institutions such as the University of Michigan, or EPRI collaborators at Marquette University (Dr. Richard Marklin) and Ergonomics Solutions, LLC (Trisha Seeley).

Workforce Information

Interviewees responded that the majority of electrical workers at their companies are 35 to 50 years old. Employees' work tenure ranged from 6 to 40 years, with an estimated 15 to 25 years of experience for most employees. A number of interviewees expressed concern that their aging workforce may soon retire, requiring the hiring and training of a younger, less experienced workforce. Having a primarily older workforce also demands that ergonomic issues for aging populations be modified accordingly (see, for example, Ilmarinen 2001; Costa & Sartori 2007; Silverstein 2008; Kenny, Yardley, Martineau & Jay 2008). Ergonomics for an aging workforce may be a topic that EPRI can address in future research. All interviewees responded that English was the main language of their electrical workers.

5
RECOMMENDATIONS

Based on the findings from the online survey and follow-up interviews, we developed a number of recommendations to make the EPRI Ergonomics Handbooks and DVD, and future EPRI OHS work, more accessible. Geared to adapt the technical content of the Handbooks for use in training contexts, the recommendations are organized into three broad areas: (1) format and accessibility of Handbook content; (2) adaptation of Handbook materials for training purposes; and (3) areas for further research.

Format and Accessibility

Revising the format of the Handbooks and DVD may have the biggest impact on its use for electric utility companies. A number of respondents requested that the EPRI Handbooks be made available through a web interface, with a hyperlinked table of contents, and search and find features. Easier access of Handbooks on the EPRI website was requested, since some companies have had trouble locating the Handbooks and DVD online. However, since some Handbook users prefer a hard copy for plant walk-throughs, creating smaller, more portable versions of the Handbooks was also suggested. Some requested slide presentation modules prepared from the Handbook content complete with facilitator notes.

Similarly, the EPRI Ergonomics DVD could be improved by adding a menu, dividing content into shorter segments, allowing searches by topic, and making it web accessible. Currently, it is reported that the DVD is too inconvenient to use for training because of the difficulty in skipping to needed parts. Shorter, web-hosted videos were suggested by several individuals as a way to make presentation of the DVD more user-friendly.

Adaptation for Training

The findings from the survey and follow-up interviews indicate opportunities to adapt the EPRI Ergonomics Handbooks and DVD for use in training contexts. A number of respondents suggested the style and delivery of their company health and safety training could be improved and that the Handbooks could be better integrated into these training settings. Several also suggested the development of some user-friendly training modules covering Handbook information.

One useful adaptation of the Handbook content would be the development of short worksheets targeted to frontline workers that describe common job tasks, analyzing associated risk factors, and recommending proper biomechanics, equipment, and other interventions. The worksheets could be framed as mini case studies and used for new employee/on-the-job training, safety tailgates, or longer classroom-based courses. The Handbook illustrations could be highlighted and made more accessible to reinforce the information in the text, and a few key questions provided at the end of the worksheets could be used to trigger interactive discussions. Sample worksheets developed by UCLA-LOSH and our partner organizations that address general ergonomics issues in schools, for example, are available online (CHSWC 2013). We have found such worksheets to be valuable as training tools in both classroom and tailgate training settings. The worksheets illustrate how hazards relate to specific job tasks and to engage audience

members in discussion and reflection. Given survey respondents' overall interest in audience engagement during training (Q10), such tools may prove especially valuable.

In addition, Handbook highlights could be compiled into a larger package of curriculum materials used in the context of ergonomics training courses. The package could include modules on Handbook topics most frequently used by companies. Modules could be designed to present information on common job tasks, associated risk factors, and proper biomechanics, equipment, and other interventions, and could incorporate activities and tools (such as short videos, clips from the DVD, or the worksheets described above) to promote audience interaction and engagement. Each module could include detailed facilitator notes and related presentation slides featuring Handbook content and imagery.

Another recommendation is to adapt Handbook content into an accident investigation module designed for supervisors and safety committee members. A sample accident investigation report could be prepared for a work task based on an ergonomic analysis in the manual, then the manual information presented as a means of analyzing risk factors and root causes and used to improve the accident investigation report. Group exercises could include a discussion of strategies to implement and assess Handbook recommendations, participating effectively in the design review process, and aligning injury prevention goals with equipment purchasing timeframes. An action plan for implementing the manual recommendations could be developed following this exercise.

In addition to these curriculum components, online videos (as suggested above) may also be adapted for training purposes, particularly when incorporated into classroom activities and used as a trigger for discussion. Here again, videos that illustrate hazards in the context of recognizable and frequent work tasks are likely to be most effective.

Finally, we recommend the development of tools targeted to the needs of specific training audiences. Aging workers may require training on work task adaptations to mitigate risk for MSDs and RMIs, whereas younger workers may need more detailed health and safety training to accommodate their relative inexperience on the job. Training materials could be developed targeting specific audiences to address age-specific risk factors.

Areas for Further Research

In terms of areas for future research, survey and interview findings were helpful in highlighting gaps in current resources. Respondents expressed a need for ergonomic risk assessment tools on overhead work, high voltage grounding practices, and work in temperature extremes. Many have already taken steps to implement the use of ergonomic tools at their companies, but others could use resources that describe effective methods for justifying the cost of interventions and collaborating successfully with the design and purchasing process. Other research suggestions include determining the effectiveness of behavioral incentives, and providing supervisor-specific materials. It may also be helpful for EPRI to consider other stakeholders as safety training partners.

6
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A
SURVEY TOOL

Thank you for agreeing to complete this short survey. The goal of the questionnaire is to determine how EPRI member companies use the EPRI Ergonomics Handbooks and related materials in the course of their work. The information you provide will be used to improve application of the Handbooks and inform the development of new training materials that are customized to be of maximum benefit to member companies.

This survey includes 19 questions and is designed to be completed in 15 minutes or less. If you have any questions or concerns about this project, please contact Gabor Mezei, EPRI Occupational Health and Safety Program Manager, at gmezei@epri.com.

Work Tasks and Musculoskeletal Disorder (MSD) Risk Factors

1. Which of the following work tasks or operations do your employees perform?

- ☐ Overhead line tasks
- ☐ Manhole, vault, and conduit tasks
- ☐ Direct-buried cable tasks
- ☐ Plant operations or mechanic tasks
- ☐ Fleet vehicle maintenance

Other (please specify)

2. What kinds of risk factors for musculoskeletal disorders (MSD) do employees in your organization face?

- ☐ Repetitive tasks
- ☐ Static postures (standing or sitting for long periods)
- ☐ Awkward postures (twisting, extending, bending)
- ☐ Contact pressure (against counter edges, equipment)
- ☐ Gripping (hand tools, steering wheels)
- ☐ Overhead work (reach)
- ☐ Lifting/carrying
- ☐ Pushing/pulling

Other (please specify)

3. What are the three most common MSDs among your workforce?

1.
2.
3.

4. What percent of your time do you devote to injury prevention?

- ○ Most of the time
- ○ Around half of the time
- ○ Up to a quarter of the time
- ○ Little to none of the time

Company Safety Training Activities

5. Does your company currently provide any training to employees on ergonomics and the prevention of MSDs or repetitive motion injuries (RMIs)?

- ○ Yes
- ○ No
- ○ Don't know

5a. What topics are covered in the training your company provides to employees on ergonomics and the prevention of MSDs or RMIs? (Check all that apply.)

- ☐ Back safety
- ☐ Materials handling (i.e. moving manhole covers, heavy equipment)
- ☐ Safe lifting
- ☐ Ergonomics for vehicle operators
- ☐ Repetitive manual tasks & safe hand tool use
- ☐ Safe cable/wire pulling
- ☐ Ergonomics of overhead work
- ☐ Ergonomics of working in vaults
- ☐ Safe digging and shoveling
- ☐ Office ergonomics

Other (please specify)

6. What other health and safety trainings are provided to employees in your organization? (Check all that apply.)

- ☐ HAZWOPER
- ☐ Confined Space
- ☐ Lock-out/Tag-out
- ☐ Electrical Safety
- ☐ Fall Protection
- ☐ Forklift Safety
- ☐ Safe Driving
- ☐ Aerial Lifts
- ☐ Ladder Safety
- ☐ Don't know

Other (please specify)

7. Who provides health and safety trainings at your organization?

- ☐ In-house instructors
- ☐ Outside consultants

Use of EPRI Ergonomics Handbooks and Other Resources

8. Please indicate which of the following EPRI Ergonomics Handbooks you currently own. (Check all that apply.)

- ☐ Ergonomic Design for Substations and Ergonomic Interventions for Overhead, Underground, and Substation Applications (10/20/2010) Product ID: 1021128
- ☐ Process Guidelines for Vehicle Acquisition and Maintenance and Ergonomics Guidelines for Vehicle Maintenance (11/03/2011) Product ID: 1021836
- ☐ Ergonomic Interventions for Plant Operators and Mechanics in Fossil-Fueled Generating Stations (12/15/2008) Product ID: 1015631
- ☐ Ergonomic Design Handbook for Fossil-Fueled Electric Generating Stations (3/11/2008) Product ID: 1014942
- ☐ Ergonomic Interventions for Electrical Workers in Fossil-Fueled Power Plants (1/11/2008) Product ID: 1014042
- ☐ Ergonomics Interventions for Direct-Buried Cable Applications (3/21/2005) Product ID: 1005574
- ☐ Ergonomic Interventions for Manhole, Vault and Conduit Applications (3/30/2004) Product ID: 1005430
- ☐ Overhead Distribution Line Workers Interventions (11/29/2001) Product ID: 1005199

8a. How familiar are you with the content of the EPRI Ergonomics Handbooks you own?

- ○ Very familiar (I have reviewed the information in the handbook(s) in detail and/or use it on a regular basis)
- ○ Somewhat familiar (I have looked over the handbook(s) but don't use them frequently)
- ○ Not at all familiar (I know about the handbook(s) but haven't used them)
- ○ I didn't know there were EPRI Ergonomics Handbooks

8b. How have you used the EPRI Ergonomics Handbooks in your organization? (Check all that apply.)

- ☐ Conduct job hazard analyses
- ☐ Implement recommended ergonomics interventions
- ☐ Make changes to other practices and procedures
- ☐ Incident Investigations
- ☐ Use in employee safety training
- ☐ Determine return-to-work eligibility
- ☐ Justify costs/benefits of interventions
- ☐ Develop design specifications or make purchasing decisions
- ☐ None of these

Other (please specify)

8c. How have you incorporated information from the EPRI Ergonomics Handbooks into training? (Check all that apply.)

- ☐ Identify and explain risk factors for specific work practices
- ☐ Describe ergonomic interventions/recommended best practices
- ☐ Incorporate figures and illustrations in training materials
- ☐ Support recommended best practices with quantifiable measures (lift equation data, strength requirements)
- ☐ References/attachments

Other (please specify)

8d. If you have not used material from the EPRI Ergonomics Handbooks, why not? (Check all that apply.)

- ☐ It's hard to find what I need
- ☐ Some of the material is outdated now
- ☐ The specific information doesn't quite apply to job tasks at my facility
- ☐ The information is too technical

Other (please specify)

8e. Do you own the EPRI Ergonomics DVD (Product ID 1019014)?

- ○ Yes
- ○ No

8f. Do you currently use the EPRI Ergonomics DVD in your employee training?

- ○ Yes
- ○ No

8g. If yes, how do you use the EPRI Ergonomics DVD in your employee training?

8h. If you are not currently using the EPRI Ergonomics DVD, why not?

Expectations of Employee Training

Now we would like to ask a few general questions about your thoughts on employee health and safety training.

9. In your experience, how effective are each of the following employee training methods?

	Very Effective	Somewhat Effective	Not Very Effective	Does not contribute
Classroom presentations	○	○	○	○
Online / computer-based training	○	○	○	○
Videos	○	○	○	○
Tailgate meetings	○	○	○	○
Hands-on demonstrations/On the job training	○	○	○	○

Other (please specify)

10. In your opinion, how important are each of the following in contributing to a successful training?

	Very Important	Somewhat Important	Not Very Important	Does Not Contribute
The instructor communicates accurate information	○	○	○	○
The audience engages in the training by asking questions or discussing how it relates to their job	○	○	○	○
The students have an opportunity to provide feedback	○	○	○	○

Other (please specify)

11. In your opinion, how important are each of the following training outcomes?

	Very Important	Somewhat Important	Not Very Important	Does Not Contribute
Changes are implemented in the workplace	○	○	○	○
Regulatory requirements are met	○	○	○	○
Our injury or accident rates go down	○	○	○	○
Student feedback is positive	○	○	○	○

Other (please specify)

12. What resources and materials (besides the EPRI Handbooks and DVD) do you use in your employee health and safety training?

13. What do you think are some ways your employee health and safety training could be improved?

Company Information

14. Approximately how many employees work at your company (full-time equivalents, or FTEs)?

15. Approximately how many employees at your company receive ergonomics or other health and safety training each year?

16. Personal information:

Name:

Title:

E-mail:

Phone number:

17. Briefly describe your role in the organization:

18. Additional comments:

19. Would you be willing to be contacted by EPRI to further discuss EPRI ergonomics resources?

- Yes
- No

B
FOLLOW-UP INTERVIEW QUESTIONS

1. How have you used the EPRI Ergonomics Handbooks?
2. How could the information be presented so that it is more accessible? (for example, a Menu/ Table of Contents (TOC) that is searchable).
3. Is the EPRI Handbook document searchable? Can you find what you are looking for?
4. Are subjects in the handbook organized clearly/logically?
5. Are there products that would make the handbook information more easily applied? (for example, slides with sample curriculum, Fact Sheets or summarized guidelines & recommendations, participatory or hands on training exercises, podcasts/online videos, standalone modules available online)
6. Do you have any similar suggestions for the DVD?
7. Does your company have exposures that are not covered by the handbook content?
8. We noticed many members are doing a lot of overhead work. Is this information adequately covered in the handbook?
9. What other resources do you use for Ergo information?
10. Where is more injury prevention research needed?
11. What training methods are most effective for you?
12. What kind of resource is most helpful to you when you are designing curricula?
13. What is the typical age and level of work experience of your classroom participants? How many speak English as a second language?
14. Any literacy concerns or other issues to consider in designing effective activities and materials?

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