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ELEMENTS OF ERGONOMICS PROGRAMS

A Primer based on Workplace Evaluations of Musculoskeletal Disorders

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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A Primer Based on Workplace Evaluations of Musculoskeletal Disorders

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FOREWORD

The National Institute for Occupational Safety and Health (NIOSH) operates an 800-number to provide workers, employers, and organizations information about various workplace safety and health concerns. Over the past several years, the volume of NIOSH 800-number calls concerning work-related musculoskeletal disorders (WMSDs) has grown. They are now second only to questions about chemical hazards. WMSD inquiries, exceeding 3,700 in 1996, have come largely from callers associated with small- and medium-sized businesses, which often have limited resources to deal with occupational safety and health issues. This document has been prepared to respond to the needs of this audience.

This primer describes the basic elements of a workplace ergonomics program. The text is largely built around NIOSH experiences in evaluating risks of WMSDs in a variety of workplaces. Descriptions of these NIOSH experiences provide practical illustrations of ways to identify and evaluate ergonomic hazards and to begin problem-solving efforts.

In response to the widespread concern about WMSDs, and with the knowledge that many workplaces have begun successful programs to control them, a wide variety of organizations have published ergonomics program manuals and primers. We hope that this NIOSH primer will be a useful addition to the existing information.

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ABSTRACT

This primer describes the basic elements of a workplace program aimed at preventing work-related musculoskeletal disorders (WMSDs). Management commitment, worker participation, and training are addressed along with procedures for identifying, evaluating, and controlling risk factors for WMSDs. The text cites NIOSH ergonomics investigations to illustrate practical ways for meeting program needs. The primer includes a "toolbox," which is a collection of techniques, methods, reference materials, and sources for other information that can help in program development.

OVERVIEW

This primer provides basic information that will be useful for employers, workers, and others in designing effective programs to prevent work-related musculoskeletal disorders (WMSDs), one of the most prevalent and costly safety and health problems in the modern workplace. It defines the key elements of an effective program in a format that allows the user to tailor the information to a particular work setting or situation. It also provides a "toolbox" of useful materials for putting a program into place, including reference materials, sources for further information, and generic forms and questionnaires.

The primer is based on the extensive practical experience accumulated by the National Institute for Occupational Safety and Health (NIOSH) in conducting investigations in actual workplace settings, providing technical assistance to employers and workers, and evaluating the latest technical literature.

The seven elements of an effective program comprise a seven-step "pathway" for evaluating and addressing musculoskeletal concerns in an individual workplace. Each step is addressed in more detail in the primer, with examples drawn from actual NIOSH workplace evaluations. The seven steps are as follows:

One: Looking for signs of a potential musculoskeletal problem in the workplace, such as frequent worker reports of aches and pains, or job tasks that require repetitive, forceful exertions.

Two: Showing management commitment in addressing possible problems and encouraging worker involvement in problem-solving activities.

Three: Offering training to expand management and worker ability to evaluate potential musculoskeletal problems.

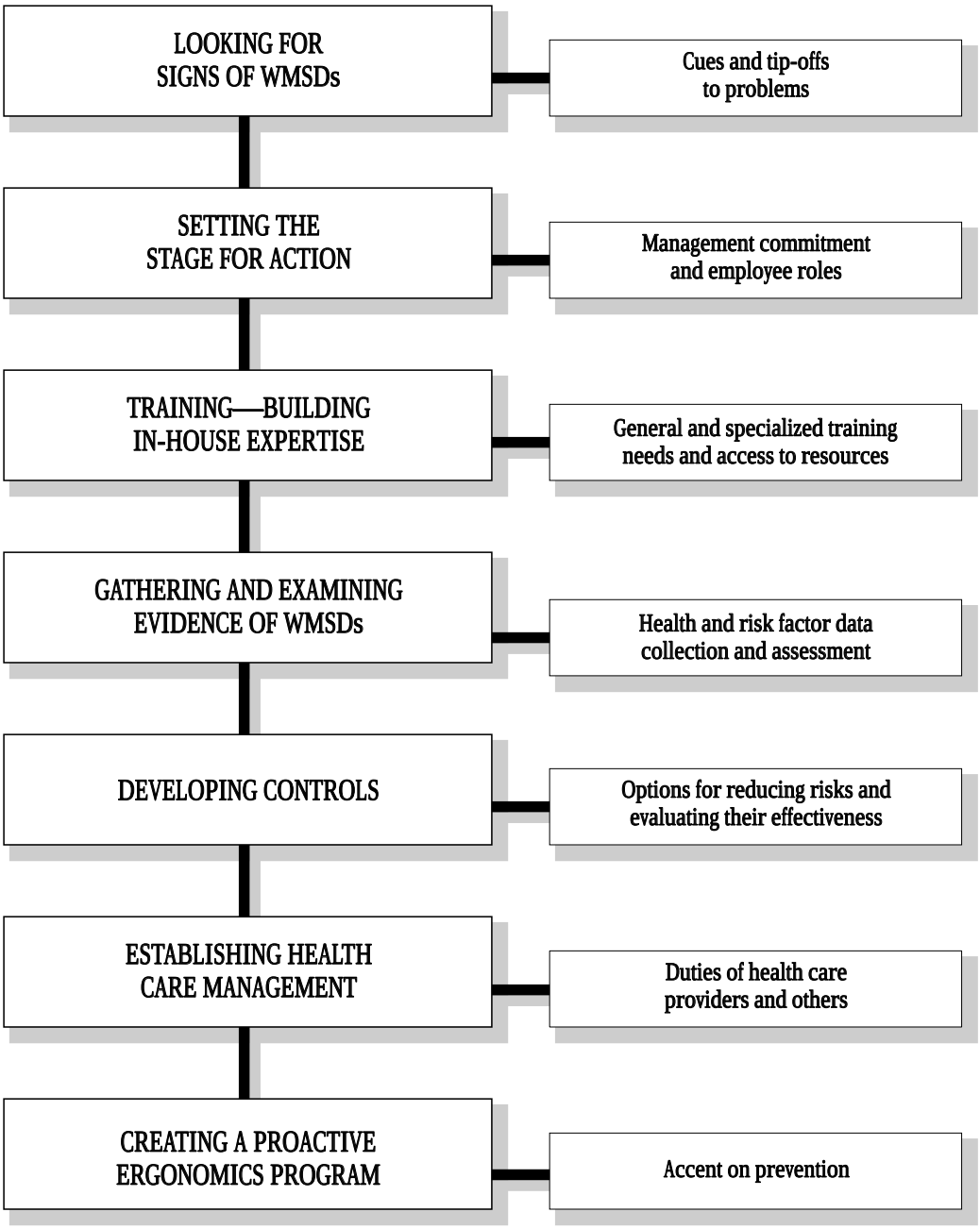
Four: Gathering data to identify jobs or work conditions that are most problematic, using sources such as injury and illness logs, medical records, and job analyses.

Five: Identifying effective controls for tasks that pose a risk of musculoskeletal injury and evaluating these approaches once they have been instituted to see if they have reduced or eliminated the problem.

Six: Establishing health care management to emphasize the importance of early detection and treatment of musculoskeletal disorders for preventing impairment and disability.

Seven: Minimizing risk factors for musculoskeletal disorders when planning new work processes and operations—it is less costly to build good design into the workplace than to redesign or retrofit later.

A Pathway to Controlling Work-Related Musculoskeletal Disorders (WMSDs)



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INTRODUCTION

- **What are Work-Related Musculoskeletal Disorders (WMSDs)?**
- **Why are WMSDs a Problem?**
- **What is Ergonomics?**
- **What is the Purpose of this Primer?**

WHAT ARE WORK-RELATED MUSCULOSKELETAL DISORDERS (WMSDs)?

Although definitions vary, the general term "musculoskeletal disorders" describes the following:

- Disorders of the muscles, nerves, tendons, ligaments, joints, cartilage, or spinal discs
- Disorders that are not typically the result of any instantaneous or acute event (such as a slip, trip, or fall) but reflect a more gradual or chronic development (nevertheless, acute events such as slips and trips are very common causes of musculoskeletal problems such as low back pain)
- Disorders diagnosed by a medical history, physical examination, or other medical tests that can range in severity from mild and intermittent to debilitating and chronic
- Disorders with several distinct features (such as carpal tunnel syndrome) as well as disorders defined primarily by the location of the pain (i.e., low back pain)

The term "WMSDs" refers to (1) musculoskeletal disorders to which the work environment and the performance of work contribute significantly, or (2) musculoskeletal disorders that are made worse or longer lasting by work conditions. These workplace risk factors, along with personal characteristics (e.g., physical limitations or existing health problems) and societal factors, are thought to contribute to the development of WMSDs [Armstrong et al. 1993]. They also reduce worker productivity or cause worker dissatisfaction. Common examples are jobs requiring repetitive, forceful, or prolonged exertions of the hands; frequent or heavy lifting, pushing, pulling, or carrying of heavy objects; and prolonged awkward postures. Vibration and cold may add risk to these work conditions. Jobs or working conditions presenting multiple risk factors will have a higher probability of causing a musculoskeletal problem. The level of risk depends on the intensity, frequency, and duration of the exposure to these conditions and the individual's capacity to meet the force or other job demands that might be involved. These conditions are more correctly called "ergonomic risk factors for musculoskeletal disorders" rather than "ergonomic hazards" or "ergonomic problems." But like the term "safety hazard," these terms have popular acceptance.

WHY ARE WMSDs A PROBLEM?

Many reasons exist for considering WMSDs a problem, including the following:

- WMSDs are among the most prevalent lost-time injuries and illnesses in almost every industry [Bureau of Labor Statistics 1995, 1996; National Safety Council 1995; Tanaka et al. 1995].
- WMSDs, specifically those involving the back, are among the most costly occupational problems [National Safety Council 1995; Webster and Snook 1994; Guo et al. 1995; Frymoyer and Cats-Baril 1991].
- Job activities that may cause WMSDs span diverse workplaces and job operations (see Table 1; see also Tray 1-A of the Toolbox).
- WMSDs may cause a great deal of pain and suffering among afflicted workers.
- WMSDs may decrease productivity and the quality of products and services. Workers experiencing aches and pains on the job may not be able to do quality work.
- Because musculoskeletal disorders have been associated with nonwork activities (e.g., sports) and medical conditions (e.g., renal disease, rheumatoid arthritis), it is difficult to determine the proportion due solely to occupation. For example, in the general population, nonoccupational causes of low back pain are probably more common than workplace causes [Liira et al. 1996]. However, even in these cases, the musculoskeletal disorders may be aggravated by workplace factors.

WHAT IS ERGONOMICS?

Ergonomics is the science of fitting workplace conditions and job demands to the capabilities of the working population. Effective and successful "fits" assure high productivity, avoidance of illness and injury risks, and increased satisfaction among the workforce. Although the scope of ergonomics is much broader, the term in this primer refers to assessing those work-related factors that may pose a risk of musculoskeletal disorders and recommendations to alleviate them.

WHAT IS THE PURPOSE OF THIS PRIMER?

Many organizations have published primers and manuals describing programs and techniques to control ergonomic hazards [National Safety Council 1988; Canadian Center for Occupational Health and Safety 1988; Putz-Anderson 1988; UAW-GM Center for Health and Safety 1990; Oxenburgh 1991; American Meat Institute and ErgoTech, Inc. 1990; Occupational Safety and Health Administration 1993]. Some primers are tailored to particular industries; others are more general.

This primer outlines the approach most commonly recommended for identifying and correcting ergonomic problems. This document offers practical information (based on NIOSH experience in a variety of settings) for applying elements of this approach in workplaces. The steps typically used to describe ergonomics programs are used here to tap and organize the NIOSH database of relevant experience.

Information about the techniques, instruments, and methods mentioned in examples of NIOSH work and other reference materials appear in the appendix, referred to as a *Toolbox*. Included in the Toolbox is a master chart listing details of NIOSH evaluations involving WMSDs reported over the past 15 years. Finding work settings or jobs in this chart that are related to the readers' jobs may help the reader capitalize on the information contained in these reports, which are available from the National Technical Information Service (NTIS).

This primer is geared to those who need knowledge of ergonomics because of their roles as employers or as persons responsible for ensuring safe and healthful work conditions in their companies. Use of numerous examples from real workplaces emphasizes practical approaches. Organizations with established ergonomics programs or with a staff having advanced training in ergonomics may find more limited value in this primer.

STEP 1
LOOKING FOR SIGNS OF WORK-RELATED MUSCULOSKELETAL PROBLEMS

- **Recognizing Signs That May Indicate a Problem**
- **Determining a Level of Effort**

What are clues or tip-offs to WMSDs as a real or possible workplace problem? Some signs are obvious while others are more subtle. The first step is to look for these signs or clues.

RECOGNIZING SIGNS THAT MAY INDICATE A PROBLEM

- Company OSHA Form 200 logs or workers' compensation claims show cases of WMSDs such as carpal tunnel syndrome, tendinitis, tenosynovitis, epicondylitis, and low back pain. Sometimes these records contain non-specific entries like "hand pain," which (while not a specific diagnosis) may be an indicator of a significant health problem if severe or persistent.
- Certain jobs or work conditions cause worker complaints of undue strain, localized fatigue, discomfort, or pain that does not go away after overnight rest.
- Workers visiting the clinic make frequent references to physical aches and pains related to certain types of work assignments.
- Job tasks involve activities such as repetitive and forceful exertions; frequent, heavy, or overhead lifts; awkward work positions; or use of vibrating equipment.

Signs like these have triggered requests for NIOSH evaluations of possible ergonomic problems and risks of WMSDs. Some examples of reasons that have been given for requesting NIOSH ergonomic evaluations are described in Exhibit 1. These examples show that WMSDs can occur in a variety of workplaces.

Other signals that could alert employers to potential problems include the following:

- Trade publications, employers' insurance communications, or references in popular literature indicating risks of WMSDs connected with job operations in the employer's business
- Cases of WMSDs found among competitors or in similar businesses
- Proposals for increasing line speed, retooling, or modifying jobs to increase individual worker output and overall productivity

Table 1 illustrates a variety of industries and job tasks in which NIOSH evaluations found evidence of WMSDs. A table listing NIOSH findings for an even larger sample of workplaces is provided in the Toolbox section of this primer (Tray 1-A).

DETERMINING A LEVEL OF EFFORT

Clues that indicate ergonomic problems may also suggest the scope of the effort required to correct them. For example, signs implicating multiple jobs in various departments and involving a large percentage of the workforce would indicate the need for a full-scale, company-wide program. Alternatively, signs that the suspected problems are confined to isolated tasks and relatively few

Exhibit 1: Triggers for NIOSH Evaluations

Manufacturing Work Setting

A plumbing-ware manufacturing company asked NIOSH to assist in an ergonomics evaluation of their production operations after an OSHA inspection found a high number of back injuries at the facility relative to the rates at other manufacturing plants in the same industrial classification. This industry as a whole had the tenth highest OSHA reportable incidence rate in the United States for 1986. The work areas where most back injuries had occurred were identified by the plant's safety director, and the jobs believed most stressful to the workers' backs became the main targets of the evaluation that ensued [HETA 88–237–L1960].

Office Work Setting

NIOSH received a request from a local union representing office and professional employees of a health insurance company to evaluate potential hazards from the use of video display terminals (VDTs) in data entry operations. Numerous, wide-ranging symptomatic complaints had been voiced by the terminal operators, including headaches, general malaise, eyestrain and other visual problems, back pain, and stiffness and soreness in the neck and shoulder areas and upper extremities. A questionnaire used for data gathering during the evaluation verified more complaints of this nature among VDT users than nonusers, and environmental and workstation measurements suggested that certain ergonomic factors contributed to these differences [HETA 79–060–843].

Service Work Setting

The owner and employees of a preschool day care center asked NIOSH to identify possible causes of musculoskeletal problems, chiefly back pain and lower extremity (knee) pain and discomfort, reported by the teachers and aides at the school. Subsequent data collected on symptomatic complaints and observations and analyses of work activities indicated that factors such as frequent lifting of infants and sustained periods of kneeling, stooping, squatting, and trunk bending were responsible for the problems [HETA 93–0995–242].

workers may suggest starting with a more limited, focused activity.

The program elements offered in this primer describe the development of a full-scale ergonomics program for use in a company-wide approach. All companies may benefit from such an approach. However, the intensity of the program may need to be calibrated to the magnitude of the problem. For smaller-scale efforts that are directed at specific problems or situations in which problem jobs or affected workers are quite limited, selected elements of the overall program may be useful. Exhibits in this primer cover a range of efforts and will clarify aspects of both full-scale and more limited approaches. Understandably, a company's initial efforts in ergonomics will be directed toward fixing the most obvious problem jobs. The program elements described here offer a framework for an orderly undertaking of such activities. Moreover, even if the evidence for WMSDs is not clear, implementing the program can have value by enabling early detection of (and more timely interventions in) potential ergonomic problems. Also, an ergonomics program can influence the design of future changes in work processes to reduce the possibility of WMSDs. In these instances, the envisioned efforts have proactive benefits that will help prevent WMSDs.

Table 1. Selected work settings from NIOSH investigations showing evidence of WMSDs

Work setting	Job
Meatpacking	Cleaning metal tubs, shank trimming, removing lard and internal organs
Warehousing	Lifting and carrying containers of assorted weights
Metal fabrication	Cutting, threading, shaping bar stock, and coupling parts to form product
Electronics assembly	Coil winding or trimming wire, circuit board wiring, fastening parts and packing products
Supermarket	Express checkout operations
VDT office and clerical	Sustained data entry and nonadjustable workstations
Clothing manufacture	Sewing tasks
Glass products	Decorating or etching glass
Plumbing fixtures	Lifting and moving toilet bowls weighing 45 to 70 lb
Sheet metal products	Riveting, seaming, assembly work
Plastic products	Parts molding, trimming excess material, filing, and reaming and sanding to finish product
Logging	Extended driving of log stackers or haulers over rough terrain
Film and paper products	Repackaging larger bulk materials into smaller units for distribution
Day care	Lifting and bending in tending to infant needs
Jewelry manufacturing	Waxing, cutting, finishing tasks
Cabinetmaking	Lifting and push-pull tasks
Auto products	Lifting and handling parts weighing 36 to 78 lb
Tool and die making	Grinding, polishing, deburring tasks

STEP 2
SETTING THE STAGE FOR ACTION

- **Ergonomics as Part of a Company Safety and Health Program**
- **Expressions of Management Commitment**
- **Benefits and Forms of Worker Involvement**
  Who Should Participate?

As with other workplace safety and health issues, managers and employees both play key roles in developing and carrying out an ergonomics program.

ERGONOMICS AS PART OF A COMPANY SAFETY AND HEALTH PROGRAM

Ergonomics programs should not be regarded as separate from those intended to address other workplace hazards. Aspects of hazard identification, case documentation, assessment of control options, and health care management techniques that are used to address ergonomic problems use the same approaches directed toward other workplace risks of injury or disease. Although many of the technical approaches described in this primer are specific to ergonomic risk factors and work-related musculoskeletal disorders, the core principles are the same as efforts to control other workplace hazards.

The financial benefits of comprehensive safety and health programs have been well documented. Workplaces safe from hazardous conditions have lower costs due to decreased lost time, absenteeism, worker compensation premiums, etc. [Office of Technology Assessment 1995]. Ergonomics programs have been shown to be cost effective for similar reasons [McKenzie et al. 1985; Lapore et al. 1984]. In addition, ergonomic improvements may result in increased productivity and higher product quality [McKenzie et al. 1985; LaBar 1994; LaBar 1989].

The ergonomics program elements outlined in this primer and the cases used to illustrate them follow a course that is mainly *reactive* in nature. The steps offer a plan to identify current problems that need to be addressed and actions aimed at resolution or control of such problems. This approach recognizes that management's first efforts to deal with ergonomic problems will probably be reactive. However, *proactive* approaches that seek to anticipate and prevent problems should be the ultimate goal. More will be said about proactive ergonomic approaches later in this document.

EXPRESSIONS OF MANAGEMENT COMMITMENT

Occupational safety and health literature stresses management commitment as a key and perhaps controlling factor in determining whether any worksite hazard control effort will be successful [Cohen 1977; Peters 1989; Hoffman et al. 1995]. Management commitment

can be expressed in a variety of ways. Lessons learned from NIOSH case studies of ergonomic hazard control efforts in the meatpacking industry [Gjessing et al. 1994] emphasize the following points regarding evidence of effective management commitment:

- Policy statements are issued that
  - — treat ergonomic efforts as furthering the company's goals of maintaining and preserving a safe and healthful work environment for all employees,
  - — expect full cooperation of the total workforce (managers, supervisors, employees, and support staff) in working together toward realizing ergonomic improvements,
  - — assign lead roles to designated persons who are known to "make things happen,"
  - — give ergonomic efforts priority with other cost reduction, productivity, and quality assurance activities, and
  - — have the support of the local union or other worker representatives.
- Meetings between employees and supervisors allow full discussion of the policy and the plans for implementation.
- Goals are set that become more concrete as they address specific operations. Goals give priority to the jobs posing the greatest risk.
- Resources are committed to
  - — training the workforce to be more aware of ergonomic risk factors for work-related musculoskeletal disorders,
  - — providing detailed instruction to those expected to assume lead roles or serve on special groups to handle various tasks,
  - — bringing in outside experts for consultations about start-up activities and difficult issues at least until in-house expertise can be developed, and
  - — implementing ergonomic improvements as may be indicated.
- Release time or other compensatory arrangements are provided during the workday for employees expected to handle assigned tasks dealing with ergonomic concerns.
- Information is furnished to all those involved in or affected by the ergonomic activities to be undertaken. Misinformation or misperceptions about such efforts can be damaging: If management is seen as using the program to gain ideas for cutting costs or improving productivity without equal regard for employee benefits, the program may not be supported by employees. For example, management should be up-front regarding possible impacts of the program on job security and job changes. All injury data, production information, and cost considerations need to be made available to those expected to make feasible recommendations for solving problems.
- Evaluative measures track the results of the ergonomic efforts to indicate both the progress that has been made and the plans that need to be revised to overcome apparent problems. Reporting results of the program and publicizing notable accomplishments also emphasize the program's importance and maintain the interest of those immediately involved and responsible.

BENEFITS AND FORMS OF WORKER INVOLVEMENT

Promoting worker involvement in efforts to improve workplace conditions has several benefits [Lawler III 1991; Cascio 1991; Schermerhorn et al. 1985; LaBar 1994; Noro and Imada 1991]. They include

— enhanced worker motivation and job satisfaction,

— added problem-solving capabilities,

— greater acceptance of change, and

— greater knowledge of the work and organization.

Worker involvement in safety and health issues means obtaining worker input on several issues. The first input is defining real or suspected job hazards. Another is suggesting ways to control suspected hazards. A third involves working with management in deciding how best to put controls into place. One NIOSH experience of worker involvement with ergonomic issues is illustrated in Exhibit 2.

Employee participation in an organization's efforts to reduce work-related injury or disease in general, and ergonomic problems in particular, may take the form of direct or individual input as described in Exhibit 2. A more common form is participation through a joint labor-management safety and health committee, which may be company-wide or department-wide in nature. Membership on company-wide committees includes union leaders or elected worker representatives, department heads, and key figures from various areas of the organization. At this level, typical committee functions consist of (1) discussing ways to resolve safety and health issues, (2) making recommendations for task forces or working groups to plan and carry out specific actions, and (3) approving use of resources for such actions and providing oversight. Committee make-up and function at the department level are more localized, since they are directed to issues specific to the operations found therein. Composition here can be limited to workers from the department or area engaged in similar jobs who, with their supervisors and select others (e.g., maintenance), propose ways for reducing work-related problems, including those posing injury or disease risks. Because of their smaller size and opportunities for closer contacts among members, such committees may be referred to as a work group [Davis and Newstrom 1985].

The department or area work group approach appears to be a popular one in addressing ergonomic problems. Factors identified in the literature that are influential to success in these efforts

Exhibit 2: Worker Involvement

NIOSH was asked to evaluate musculoskeletal pain and discomfort in the upper neck and shoulder areas as well as the lower back, buttocks, and legs of cashiers. The pain was thought to result from operating registers at express checkout counters in a supermarket. In analyzing workstation design and job task factors that could account for the above problems, the investigators interviewed a number of cashiers. The cashiers related their musculoskeletal complaints specifically to certain design characteristics of the checkout counters. They indicated that

— the far corner of the checkout counter required extended reaching for items, resulting in excessive trunk flexion and bending,

— the register keyboard height and distance induced static stress and shoulder flexion, and

— other tasks performed at the workstations required constant twisting because of the layout.

At a meeting with management and workers, initial interventions that gave priority to these problematic factors were agreed upon. A barrier was placed at the far corner of each checkout counter to reduce the extended reaching and bending for groceries, and height-adjustable keyboards were installed to relieve the static stress and shoulder flexion. Reductions in the number of symptoms associated with these active areas of the intervention were found following the implementation of these measures [HETA 88–345–2031; Orgel et al. 1992].

are identified in Table 2. Also shown in Table 2 are factors that can enhance direct worker inputs in workplace problem solving.

NIOSH assistance to the work of a joint labor-management safety committee is noted in Exhibit 3, which describes the actions of a plant-wide committee dealing with ergonomic hazards and work-related musculoskeletal problems in a piston manufacturing plant. Exhibit 4 outlines the results of work group efforts in a NIOSH study of meatpacking operations that focused on participatory approaches to control ergonomic and musculoskeletal problems. A direct worker input approach was described in Exhibit 2, but another example is offered in Exhibit 5 to reveal a limitation.

As noted in Exhibits 3, 4, and 5 and in Table 2, two factors are critical to the different forms of worker involvement. One is the need for training both in hazard recognition and control and in group problem solving. The second is that management must share information and knowledge of results with those involved.

No single form or level of worker involvement fits all situations or meets all needs. Much depends on the nature of the problems to be addressed, the skills and abilities of those involved, and the company's prevailing practices for participative approaches in resolving workplace issues.

Who Should Participate?

Ergonomic problems typically require a response that cuts across a number of organizational units. Hazard identification through job task analyses and review of injury records or symptom surveys, as well as the development and implementation of control measures, can require input from

- safety and hygiene personnel,
- health care providers,
- human resource personnel,
- engineering personnel,
- maintenance personnel, and
- ergonomics specialists.

In addition, worker and management representatives are considered essential players in any ergonomics program effort.

In small businesses, two or more of the functions noted on this list may be merged into one unit, or one person may handle several of the listed duties. Regardless of the size of the organization, persons identified with these responsibilities are crucial to an ergonomics program. Purchasing personnel in particular should be included, since the issues raised can dictate new or revised specifications on new equipment orders.

How best to fit these different players into the program could depend on the company's existing occupational safety and health program practices. Integrating ergonomics into the company's current occupational safety and health activities while giving it special emphasis may have the most appeal.

Table 2. Factors affecting worker participation in workplace problem solving

Committee or work group approach	Direct worker input
Work group sizes of 7 to 15 afford ample interaction and cohesive actions.	Procedures are in place that facilitate worker direct reporting to responsible officials on real or alleged problems. Both formal and informal channels can be used.
Work group leaders committed to the process of group problem solving increase chances of success, as does prompt recognition and rewards from higher-level management.	Campaigns are undertaken to solicit worker reports of potential problems and suggestions for improvement in job operations or conditions.
Precautions need to be taken to prevent supervisors, managers, or other team members from dominating discussions or intimidating workers.	Periodic surveys are undertaken to obtain worker reactions to workplace conditions that may suggest or confirm problems.
Adoption of orderly procedures in (1) defining problems, (2) data gathering and analysis, and (3) developing proposed remedies and plans for implementation ensure likely acceptance and support.	Timely feedback and indications of actions taken in response to worker inputs have motivating qualities. Publicizing suggestions implemented and results in newsletters are similarly reinforcing.
Training is needed in the technical aspects of the target problems as well as group interaction. For the latter, workers need training in communication skills; supervisors, in feedback and listening skills.	Workers are most likely to detect hazards having physical, structural features or distinct environmental characteristics. They tend to be less aware or more accepting of risks posed by functional or procedural practices. More hazard awareness training is needed.
Work group expectations and goals need to be realistic; solving easier problems first can build confidence to overcome later frustrations.	
Committees that oversee work groups engaged in problem solving should not overextend their roles in dictating or implementing solutions. A top-down approach sends the wrong signal in efforts to promote worker participation.	

Exhibit 3: A Joint Labor-Management Committee Approach

The ergonomics committee at a plant that manufactured pistons and piston sleeves asked NIOSH to conduct an ergonomics evaluation to further their efforts at reducing cases of musculoskeletal disorders. This committee had been formed as a result of contract negotiations with the local union and in recognition of excessive cases of musculoskeletal disorders and increased production demands. The committee consisted of one hourly and one salaried person from each of six plant departments, one industrial engineer, three manufacturing engineers, three department superintendents, and one secretary, who provided input on office ergonomics. The plant manager chaired the committee, which met for 1 to 2 hours each month. Education and training in ergonomics were provided through viewing videotapes and reading literature received from the State safety councils. Selected workers in the plant workforce also viewed this material.

The committee focused on problem areas identified through examining safety logs, talking with the equipment operators, and observing job operations. Linkages between injury patterns, operator reports, and observations served to target major problem areas for priority attention. In one instance, a cluster of upper-limb problems was reported by the milling machine operators who had to open and close the machine doors manually for each piston sleeve being milled. The committee decided to install automatic door openers and closers. Workers suggested these and other ergonomic solutions to apparent problems, and the controls were fabricated in the plant's maintenance department. However, because of their limitations in addressing the less obvious ergonomic problems, the committee asked for NIOSH assistance.

NIOSH recommended specific control measures on the basis of its investigators' observations and acknowledged the need for more on-site training of workers in recognizing ergonomic hazards and risks of musculoskeletal injury in their jobs. In light of the plant safety data and observations of job operations, guidance was offered to create a more proactive effort in preventing WMSDs. A limitation of the committee approach used in this plant was that most of the input came from management. Their preoccupation with production demands could override the time and effort needed to resolve job tasks presenting risks of WMSDs. On the other hand, the committee benefited from their increased knowledge and experience in dealing with ergonomic hazards. One result was that decisions about future procurements of machines and proposed changes in manufacturing processes were to include ergonomic considerations [HETA 94–0040–2496].

Exhibit 4: A Work Group Approach

In 1992, NIOSH commissioned three case studies to demonstrate the efficacy of using "ergonomics teams" in addressing hazards in meatpacking plants. The studies, conducted at three different sites, depicted a variety of contexts and opportunities for observing the merits of this form of worker involvement. The studies showed the following:

- Sustained participatory efforts in ergonomics problem solving require strong in-house direction and support plus significant staff expertise in both team building and ergonomics. In one of the three cases in which the effort was largely driven by an outside investigator, there were indications the program would not be sustained.
- Accomplishments, in terms of number of tasks or jobs analyzed and solutions offered and implemented, were most apparent in those cases showing significant training efforts in both team building (group techniques in task analyses, interpersonal processes, developing consensus) and ergonomics (defining risk factors related to musculoskeletal disorders and techniques for job analyses). The case indicating the least progress had limited formal training in ergonomics and used the team simply to brainstorm possible solutions to problems without much other background preparation.
- Most team progress was evident if teams were kept small and included production workers engaged in the jobs under study, area supervisors, and maintenance and engineering staff who could effect proposed job improvements. In two cases, higher personnel served on second-level groups providing oversight to the team activities and approval of actions as needed.
- Team members in the three case studies shared information (injury and production data) bearing on job problems. In addition, reports about the teams' objectives, progress, and accomplishments were circulated to keep the plant workforce informed. Problem-solving goals, as established by the teams, took more time than anticipated to attain. More realistic goals may need to be set [Gjessing et al. 1994].

Note: In two of the three plants in which these case studies were conducted, worker members were chosen by the unions to serve on the work team. The formation of these teams did not violate the existing collective bargaining process.

Exhibit 5: An Individual Input Approach

NIOSH sponsored a study at a major hospital site in which a plan was followed based on employee hazard recognition and problem solving. A special committee was developed to encourage workers to report unsafe conditions and to make suggestions for corrective measures. The committee provided prompt feedback about actions taken through the hospital-wide posting of bulletins on progress, as well as other forms of publicity.

Measurements taken before and 12 months after the program was implemented showed a 33% increase in the number of hazards reported by workers, with a corresponding drop in injury rates of 25%. These rates suggested an increased safety consciousness among the workers and a consequent reduction in injuries. Relevant to the subject of ergonomics were results found in comparing the content of the hazard reports with the actual agent or injury data. Workers tended to detect more physical hazards (slip and trip hazards, struck by or against hazards) than were accounted for in terms of actual injury, but they clearly underestimated those involving overexertion, such as in patient lifting or other procedural-type situations. These data suggested the need for more worker training devoted to these kinds of concerns [Lin and Cohen 1983].