
August 1997

WORKER PROTECTION

Private Sector Ergonomics Programs Yield Positive Results



**Health, Education, and
Human Services Division**

B-277451

August 27, 1997

The Honorable Edward M. Kennedy
Ranking Minority Member
Committee on Labor and Human Resources
United States Senate

The Honorable Major Owens
Ranking Minority Member
Subcommittee on Workforce Protections
Committee on Education and the Workforce
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Private sector employers spend about \$60 billion annually on workers' compensation costs associated with injuries and illnesses experienced by their employees. The Department of Labor's Occupational Safety and Health Administration¹ (OSHA) has estimated that as much as one-third of these costs is due to musculoskeletal disorders (MSD), a wide range of illnesses and injuries related to repetitive stress or sustained exertion on the body.² Over the last few years, OSHA has tried to develop a workplace standard requiring employers to take particular actions to reduce MSDs and the contributing workplace hazards (often called ergonomic hazards). But there is disagreement about what workplace conditions cause or contribute to MSD and what actions employers should take to reduce MSDs. A draft standard that OSHA circulated for informal comment in 1995 generated significant opposition from many employers because they believed it required an unreasonable level of effort to identify jobs with ergonomic hazards and to reduce these hazards. Others, including labor organizations, generally supported the draft standard and believed it was consistent with approaches implemented by many employers. Between July 1995 and October 1996, a restriction in an appropriations law prohibited OSHA from spending appropriated funds to do further work to develop a draft standard. The Congress has enacted a modified restriction for fiscal year 1998 that prohibits OSHA from issuing a proposed or final ergonomics standard during the year, but allows OSHA to develop such a proposal in the meantime.

¹OSHA was created to carry out the Occupational Safety and Health Act, which declared a national policy of ensuring safe and healthful working conditions for every working man and woman. OSHA develops and enforces workplace safety and health standards and educates employers and employees about workplace hazards.

²MSDs include conditions such as tendinitis, carpal tunnel syndrome, and lower back injuries and can happen to workers in a myriad of occupations, such as computer keyboard operators, nursing home attendants, and automobile assembly workers. Symptoms of MSDs can include swelling in the joints, limited range of motion, numbness or tingling sensations, and loss of strength.

Despite the controversy surrounding OSHA's draft standard, some employers have taken the initiative to address MSDs through the implementation of ergonomics programs.³ To learn about these programs and their results, you asked that we (1) identify the core elements of effective ergonomics programs and describe how these elements are operationalized at the facility level, (2) discuss whether these programs have proven beneficial to the employers and employees that have implemented them, and (3) highlight the implications of these employers' experiences for other employers and OSHA.

To identify the core elements of effective ergonomics programs, we conducted a literature review and interviewed experts in the business, labor, and academic communities with experience in implementing such programs or expertise in the field of ergonomics. To learn how the elements of ergonomics programs have been operationalized at the facility level and determine whether these programs have proven beneficial, we conducted case studies at selected facilities of five employers, interviewing pertinent program officials and obtaining program and results data (app. I details how these facilities were selected and how the case studies were conducted). Table 1 shows the employers and facilities selected, their product or service, and their staffing level.

³In this report, "ergonomics programs" refers to the set of actions employers are taking to reduce ergonomic hazards and MSDs. Ergonomics itself is a broader field of study addressing the interactions among humans, tasks, and the total work environment, which could include other issues, such as temperature and lighting. Thus, the term "ergonomic hazards" is in a sense a misnomer because, if conditions are truly "ergonomic," no hazards should exist. However, we use the term in this report because it is commonly used and understood by industry, labor, and ergonomic experts.

Table 1: Employers and Facilities Selected for Case Studies

Employer	Facility and location	Product or service	Staffing level
American Express Financial Advisors, Inc.	Headquarters; Minneapolis, Minnesota	Financial planning and other investment services	5,300
AMP Incorporated	Electronic connectors manufacturing facility; Tower City, Pennsylvania	Electronic connection devices production	300
Navistar International Transportation Corporation ^a	Truck assembly facility; Springfield, Ohio	Heavy- and medium-duty truck assembly	4,000
Sisters of Charity Health System	St. Mary's Regional Medical Center and St. Marguerite d'Youville Pavilion; ^b Lewiston, Maine	Medical and nursing home care	780
Texas Instruments	Defense systems and electronics manufacturing facility; Lewisville, Texas	Radar, navigation, and missile guidance system assembly	2,800

^aNavistar is the only unionized facility in our review.

^bThe same ergonomics program covers both Sisters of Charity sites. As a result, we refer to these two operations as a single facility.

To explore the implications of our findings for other employers and OSHA, we interviewed pertinent officials and obtained information about current activities from OSHA and selected states that operate their own OSHA programs⁴ about how employers and employees can be encouraged to reduce or eliminate the occurrence of MSDs. We explored the extent to which these activities responded to employers' needs as reflected through the experiences of our case study employers. We also convened several panels comprising representatives from the business, labor, and academic communities to obtain their views on the implications of our findings. Our findings are based on the experiences of five facilities and, as a result, are not generalizable to all workplaces. For a more detailed discussion of our scope and methodology, see appendix I.

⁴The Occupational Safety and Health Act allows states to operate their own safety and health programs as long as they are determined by OSHA to be at least as effective as the federal OSHA program, and it provides for up to 50-percent federal funding (29 U.S.C. 667, 672 (1994)). Currently, 25 states operate their own programs. Throughout this report, we refer to these programs as state-operated programs.

Results in Brief

Experts, research literature, and officials at our case study facilities generally agreed that effective ergonomics programs must have the following core set of elements to ensure that ergonomic hazards are identified and controlled to protect workers: management commitment, employee involvement, identification of problem jobs,⁵ development of solutions (that is, controls) for problem jobs, training and education for employees, and appropriate medical management. The literature identifies a wide array of alternatives through which employers can implement these elements that require varying degrees of effort from employers and employees.

Although the ergonomics programs at all of the case study facilities displayed each of these elements, there was often significant variety in how they were implemented. This variety typically resulted from factors such as differences in the facilities' industries and product line, corporate culture, and experiences during the programs' evolution. Also, the processes used by the case study facilities to identify and control problem jobs were typically informal and simple and generally involved a lower level of effort than was reflected in the literature. Controls did not typically require significant investment or resources and did not drastically change the job or operation.

Officials at all the facilities we visited believed their ergonomics programs yielded benefits, including reductions in workers' compensation costs associated with MSDs. These facilities could also show reductions in overall injuries and illnesses as well as in the number of days injured employees were out of work; in some cases, however, the number of restricted workdays increased as a result of an increased emphasis on bringing employees back to work. Facility officials also reported improved worker morale, productivity, and product quality, although evidence of this was often anecdotal. Demonstrating overall program performance was complicated by uncertainties associated with determining what types of injuries should be considered MSDs and analyzing the program's effect on injuries in light of other complicating factors, such as limited information collected by employers on the costs to implement the programs.

Our work revealed that positive results can be achieved through an approach incorporating certain core elements that are implemented in a simple, informal, site-specific manner. Federal and state-operated OSHA programs have undertaken a number of initiatives that can provide

⁵A problem job is one where ergonomic hazards—those workplace conditions that may cause MSDs—exist.

employers flexibility, consistent with these case study experiences; however, questions remain as to whether these efforts alone are sufficient to protect employees from ergonomic hazards. Our findings suggest that as OSHA proceeds with its efforts to protect workers from ergonomic hazards, it may be useful for it to consider an approach that sets a framework for a worksite ergonomics program while providing employers the flexibility to implement site-specific efforts and the discretion to determine the appropriate level of effort to make, as long as the efforts effectively address hazards.

Background

MSDs as a workplace concern have received increased attention over the last several years. While there is some debate about what injuries should be considered MSDs,⁶ data from the Bureau of Labor Statistics (BLS) show that, in 1995, there were 308,000 cases of illness due to repeated trauma, accounting for over 60 percent of all work-related recorded illnesses⁷ and continuing the decade-long increase in illness due to repeated trauma. However, the 1995 total was a slight decrease from 1994 and represented a small percentage of the total number of recordable injuries and illnesses. In 1997, the National Institute for Occupational Safety and Health (NIOSH), a federal agency that conducts independent research on workplace safety and health issues, reported that, for all cases involving days away from work in 1994, about 700,000 (or 32 percent) were the result of repetitive motion or overexertion. It also reported that MSDs accounted for 14 percent of physician visits and 19 percent of hospital stays.

To protect employees from workplace hazards, OSHA issues workplace standards and enforces the provisions of those standards through citations issued as a result of on-site inspections of employers. OSHA can also provide information and technical assistance or work with employers and

⁶For example, some employers believe that back injuries, even though they may appear to be acute, should be counted as MSDs, since they may actually result from repetitive activity. Others do not believe back injuries should be counted as MSDs.

⁷BLS does not currently have a simple way to classify an injury or illness as an MSD. Instead, MSDs either are not classified separately from other injuries or appear in a variety of other categories of injuries and illnesses. As a result, there is no single estimate of the total number of MSDs reported. A widely used measure of MSDs is what BLS calls illnesses due to "repeated trauma," which it defines as illnesses due to repeated motion, vibration, or pressure (such as carpal tunnel syndrome or tendinitis). This category would not include items such as back injuries that may result from overexertion and would be classified as injuries rather than illnesses. Concerns have been raised about whether the collection and coding of data in this manner accurately capture all MSDs. BLS collects these data through its Survey of Occupational Injuries and Illnesses, which is administered to a sample of employers. The data for the survey are taken from the employers' OSHA 200 logs, forms that the majority of employers are required to use to record any work-related injury or illness that requires more than first aid. The OSHA 200 log also contains information about whether the injury or illness resulted in days away from work or whether the employee was assigned to restricted work activity.

employees in a cooperative manner that rewards compliance instead of penalizing noncompliance. Because currently no standard exists specifically for MSDs, federal and state-operated OSHA programs have generally relied on what is referred to as the “general duty clause” of the Occupational Safety and Health Act,⁸ or its state equivalent, to cite employers for ergonomic hazards. This clause requires employers to furnish employees with employment and a place of work “free from recognized hazards that are causing or are likely to cause death or serious physical harm.” To justify using this authority, OSHA must prove that the hazard is likely to cause serious harm, that the industry recognizes the hazard, and that it is feasible to eliminate or materially reduce the hazard—conditions that require major OSHA resources to demonstrate.⁹

Over the last several years, OSHA has tried to develop a standard specifically for MSDs to carry out its mandate to protect workers and improve worker health. In 1992, OSHA announced in the Federal Register its intent to develop a standard for MSDs. Before formally proposing a standard, in March 1995, OSHA circulated a draft of a standard to selected stakeholders to obtain their comments. The standard was subsequently distributed widely and has come to be known as the “draft standard.” This draft standard¹⁰ required employers to identify problem jobs on two bases: where there had been one or more recorded MSD (for example, on the OSHA 200 log or as a workers’ compensation claim) and where an employee had daily exposure during the work shift to any “signal risk factor.”¹¹ Employers would have to “score” these jobs using a checklist provided in the draft standard, or an alternative checklist if the employer could demonstrate that it was as effective, to determine the severity of the

⁸29 U.S.C. 654(a)(1)(1994).

⁹Officials from Labor’s Office of the Solicitor said that relying on the general duty clause as a basis for citing employers for ergonomic hazards can be time consuming and expensive. It may also have limited effectiveness for protecting workers from MSDs. For example, in 1988, OSHA cited one employer for repetitive motion hazards associated with assembly line tasks as well as for unsafe lifting practices. The employer appealed, and in April 1997, a final ruling found that OSHA appropriately used the general duty clause to cite the employer for lifting hazards and that assembly line workers were suffering serious physical harm from recognized ergonomic hazards; the ruling also found, however, that OSHA presented insufficient proof to demonstrate how the repetitive motion hazard could be eliminated under the general duty clause. (Pepperidge Farm, Inc., 1997 CCH OSHD 31, 301 (No. 89-0265, 1997)).

¹⁰The draft standard covered all employers and provided detail on how they should identify and analyze jobs, implement controls, ensure medical management, and provide education and training. The draft standard and its several nonmandatory appendixes were several hundred pages long.

¹¹OSHA identified five “signal risk factors”: (1) performance of the same motion or motion pattern, (2) fixed or awkward postures, (3) use of vibrating or impact tools or equipment, (4) using forceful hand exertions, and (5) unassisted frequent or heavy lifting.

problem. If a job received more than five points,¹² the employer would have to conduct a job improvement process to address the hazards on that job. This process involved a detailed job analysis (identification and description of each risk factor) and the selection, implementation, and evaluation of controls.¹³ Some employers opposed this requirement, stating that the net effect of this approach would result in considering virtually every job a problem job and necessitating considerable resources from employers to analyze and develop controls for each problem job. Others said that because MSDs are cumulative or chronic in nature, they may take a long time to develop and may have many contributing factors. Because of this, some employers questioned whether OSHA could demonstrate that provisions in the standard would be able to address the hazards that cause MSDs.

OSHA has now said its 1995 draft standard is no longer under consideration, and it has renewed efforts to determine the best approach to protect workers from ergonomic hazards. OSHA is currently undertaking a “four-pronged approach,” which involves (1) education, outreach, and technical assistance to employers; (2) research on the effectiveness of ergonomic improvements that employers have implemented; (3) enforcement efforts targeted toward high-hazard employers, issuing citations when warranted under the general duty clause; and (4) continued work on a standard that will take findings from these efforts into account.¹⁴

The California state-operated program also spent several years developing a standard, which program officials said was initiated in response to a legislative mandate. The two-page standard, which went into effect in July 1997, covers only those employers with 10 or more employees, thus excluding a significant number of California’s employers. The standard is triggered only when an injury has been reported.¹⁵ While the standard requires employers to implement particular elements of an ergonomics

¹²Points were to be accumulated on the basis of the type of risk and the length of time employees were exposed to the risk. The workplace environment (for example, lighting and temperature) and control over the pace of work (such as machine pace, piece rate, constant monitoring, and daily deadlines) were also factors in accumulating points.

¹³The draft standard also allowed employers to implement an abbreviated “quick fix” approach if the problem was easily identifiable.

¹⁴This approach is consistent with OSHA’s draft strategic plan developed under the Government Performance and Results Act. The plan calls for a comprehensive strategy to identify workplace safety and health problems that combines common sense regulation; a firm, fair, and consistent enforcement policy; and new approaches to compliance assistance to meet the needs of workers and employers.

¹⁵The standard applies only when at least two recorded repetitive motion injuries—another term for MSDs—have been reported within the previous 12 months by employees performing identical job processes or operations. These injuries must also be diagnosed by a physician as being work related.

program, such as worksite evaluation,¹⁶ development of controls, and training, the standard does not require a medical management program, nor are there many requirements as to specifically how these elements should be implemented. An employer who makes an effort to comply will not be cited for being out of compliance unless it can be shown that a control known to, but not taken by, the employer is substantially certain to have caused a greater reduction in these injuries and that this alternative control would not have imposed additional unreasonable costs. Some labor organizations believed this standard fails to provide adequate protection to employees and were skeptical that it would be effective in reducing MSDs. Additionally, even though the standard had been revised significantly to reduce employers' responsibilities in response to employer concerns,¹⁷ some employer groups still question the merit of a standard for MSDs. As a result, both labor and employer groups are challenging the standard.

An Effective Program Includes a Core Set of Elements

Experts, available literature, and officials at our case study facilities generally agreed that, to be effective, an ergonomics program should include a core set of elements or provisions to ensure management commitment, employee involvement, identification of problem jobs, development of controls for problem jobs, training and education for employees, and appropriate medical management.¹⁸ These core elements are said to be typical of any comprehensive safety and health program and, together, they can help an employer ensure that ergonomic hazards are identified and controlled and that employees are protected. Research provides a wide spectrum of options for how these elements can be implemented, requiring varying levels of effort on the part of employers and employees. In addition, federal and state-operated OSHA programs have undertaken a number of enforcement and education efforts to encourage employers to adopt the core elements of an ergonomics program.

¹⁶“Worksite evaluation” is the identification and analysis of problem jobs.

¹⁷Earlier versions of the standard covered virtually all employers in the state and called for them to undertake specific procedures to implement many of these core elements.

¹⁸Different terminology is sometimes used to refer to these core elements. For example “hazard prevention and control” and “development of controls for problem jobs” can be used to describe the process for analyzing problem jobs and implementing controls. Core elements of safety and health programs are clearly identified in a variety of occupational safety and health literature. A recent NIOSH publication, Elements of Ergonomics Programs, identifies these core elements as they apply to ergonomics programs on the basis of its field investigations. The 1990 Ergonomics Program Management Guidelines for Meatpacking Plants, a voluntary guideline published by OSHA, presents the core elements of an ergonomics program aimed at reducing MSDs in the meatpacking industry.

Management Commitment

Occupational safety and health literature stresses that management commitment is key to the success of any safety and health effort. Management commitment demonstrates the employer's belief that ergonomic efforts are essential to a safe and healthy work environment for all employees. Specific ways in which management commitment can be demonstrated include

- assigning staff specifically to the ergonomics program and providing time during the workday for these staff to deal with ergonomic concerns;
- establishing goals for the ergonomics program and evaluating results;
- communicating to all staff the program's importance, perhaps through policy statements, written programs, or both; and
- making resources available for the ergonomics program itself, such as by implementing ergonomic improvements or providing training to all employees or to staff assigned to the ergonomics program.

Employee Involvement

Involving employees in efforts to improve workplace conditions provides a number of benefits, including enhancing employee motivation and job satisfaction, improving problem-solving capabilities, and increasing the likelihood that employees will accept changes in the job or work methods.¹⁹ Some of the ways in which employee involvement can be demonstrated include

- creating committees or teams to receive information on ergonomic problem areas, analyze the problems, and make recommendations for corrective action;²⁰
- establishing a procedure to encourage prompt and accurate reporting of signs and symptoms of MSDs by employees so that these symptoms can be evaluated and, if warranted, treated;
- undertaking campaigns to solicit employee reports of potential problems and suggestions for improving job operations or conditions; and

¹⁹NIOSH's *Participatory Interventions in Meatpacking Plants* concluded that strong management support and staff expertise in team building and ergonomics are needed for participatory efforts to work. In *Occupational Safety and Health: Options for Improving Safety and Health in the Workplace* (GAO/HRD-90-66BR, Aug. 24, 1990), we found that strengthening the role of both employers and employees in identifying and correcting workplace hazards was a viable strategy to improve workplace safety and health.

²⁰Concerns have been expressed by employer groups as well as by labor organizations that electing employee representatives to workplace committees, including those committees formed by management to address ergonomic issues, could violate a prohibition of the National Labor Relations Act against employers' controlling labor organizations (29 U.S.C. 158 (a)(2)). This issue was outside the scope of this review.

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- administering periodic surveys to obtain employee reactions to workplace conditions so that employees may point out or confirm problems.

Identification of Problem Jobs

A necessary component of any ergonomics program is the gathering of information to determine the scope and characteristics of the hazard that is contributing to the MSD. Especially in this element, research has highlighted a wide variety of ways employers can identify problem jobs or job tasks. For example, a relatively straightforward way to identify problem jobs is for employers to focus on those jobs where there is already evidence that the job is a problem, because MSDs have already occurred or symptoms have been reported. For this approach, employers could use the following methods to identify problem jobs:

- following up on employee reports of MSDs, symptoms, discomfort, physical fatigue, or stress;
- reviewing the OSHA 200 logs and other existing records, such as workers' compensation claims; and
- conducting interviews or symptom surveys or administering periodic medical examinations.

A more complex approach to identifying problem jobs before there is evidence of an injury entails employers' looking for workplace conditions that may contribute to MSDs. This more complex method could include screening and evaluating jobs for particular workplace conditions that may contribute to MSDs, such as awkward postures, forceful exertions, repetitive motions, and vibration. Screening and evaluation could be achieved through walk-through observational surveys, interviews with employees and supervisors, or the use of checklists for scoring risk factors.

Experts and recent literature also recognize that employers may have to prioritize which jobs or job tasks will receive immediate attention. It is generally agreed that jobs in which MSDs are being reported should be given top priority. Factors to consider in prioritizing problem jobs might be whether past records have noted a high incidence or severity of MSDs, which jobs have a large number of affected employees, or whether changes in work methods for that job will be taking place anyway.

Analyzing and Developing Controls for Problem Jobs

The first step in eliminating the hazard is to analyze the job or job task to identify the ergonomic hazards present in the job. Once ergonomic

hazards have been identified, the next step is to develop controls to eliminate or reduce these hazards. Research offers a hierarchy of controls that can be put in place.

Analyzing the job or evaluating an employee's workstation to identify the ergonomic hazards present in the job can involve a variety of activities, including

- observing workers performing the tasks, interviewing workers, or measuring work surface heights or reach distances;
- videotaping a job, taking still photos, measuring tools, or making biomechanical calculations (for example, of how much muscle force is required to accomplish a task) in order to break jobs down into component tasks and identify risk factors present; and
- administering special questionnaires.

Efforts to develop appropriate controls can include

- “brainstorming” by employees performing the job in question or by team members performing the analysis;
- consulting with vendors, trade associations, insurance companies, suppliers, public health organizations, NIOSH, labor organizations, or consultants; and
- following up to evaluate the effectiveness of controls.

The hierarchy of controls is as follows:

- Engineering controls are generally preferred because they reduce or eliminate employees' exposure to potentially hazardous conditions. They include changing the workstation layout or tool design to better accommodate employees (for example, adopting better grips for knives to reduce wrist-bending postures) or changing the way materials, parts, and products are transported to reduce hazards (such as using mechanical assist devices to lift heavy loads).
- Administrative controls²¹ refer to work practices and policies to reduce or prevent employee exposure to hazards, such as scheduling rest breaks, rotating workers through jobs that are physically tiring, training workers

²¹Some of the literature identifies training and similar activities related to proper work techniques as “work practice controls.” For ease of discussion in this report, we refer to them as administrative controls as well.

to recognize ergonomic hazards, and providing instruction in work practices that can ease the task demands or burden.²²

Training and Education

Identifying and controlling MSDs requires some level of knowledge of ergonomics and skills in remedying ergonomic hazards. Recognizing and filling different training needs is an important step in building an effective program. The different types of training that a facility might offer include

- overall ergonomics awareness training for employees so they can recognize general risk factors, learn the procedures for reporting MSDs or symptoms, and become familiar with the process the facility is using to identify and control problem jobs and
- targeted training for specific groups of employees because of the jobs they hold, the risks they face, or their roles in the program, such as for line supervisors and managers to recognize early signs and symptoms of MSDs; for engineers to prevent and correct ergonomic hazards through equipment design, purchase, or maintenance; or for members of an ergonomics team to perform job analysis and develop controls.

Medical Management

An employer's medical management program is an important part of its overall effort to reduce MSDs, even though this program may exist regardless of whether the employer has implemented an ergonomics program. A medical management program emphasizes the prevention of impairment and disability through early detection of injuries, prompt treatment, and timely recovery for the employee. Different ways facilities can carry out medical management include

- encouraging early reporting of symptoms of MSDs and ensuring that employees do not fear reprisal or discrimination on the basis of such reporting;
- ensuring prompt evaluation of MSD reports by health care providers;
- making health care providers familiar with jobs, perhaps through periodic facility walk-throughs or review of job analysis reports, detailed job descriptions, or videotapes of problem jobs; and
- giving employees with diagnosed MSDs restricted or transitional duty assignments (often referred to as "light" duty) until effective controls are

²²There is some controversy about whether personal protective equipment (controls that provide a barrier between the employee and the hazard) is effective against ergonomic hazards. NIOSH reported that these types of devices may decrease exposure to one hazard but increase another because the employee has to "fight" the device to perform the work (for example, wearing wrist splints while repeatedly bending the wrist). Other studies have found that some of these items, such as back belts to provide back support, do provide protection.

installed on the problem job, and conducting follow-up or monitoring to ensure that they continue to be protected from exposure to ergonomic hazards.

Selected OSHA Efforts Encourage Employers to Implement These Core Elements

Federal and state-operated OSHA programs have undertaken a number of enforcement and education efforts to encourage employers to adopt the core elements of an ergonomics program. For example, as a result of inspections under the general duty clause, OSHA has entered into a number of corporate settlement agreements, primarily with automobile manufacturing and food processing employers, that allow these employers to take actions to implement these core elements in an effort to reduce the identified hazards according to an agreed-upon timetable. OSHA monitors the employers' progress under the agreement and will not cite them as long as the terms of the agreement are upheld. In 1996, OSHA introduced a nursing home initiative, under which it targeted nursing homes in seven states for inspection to look for evidence of safety and health programs as evidenced by these core elements. Before launching the enforcement part of the effort, OSHA sponsored safety and health seminars for the nursing home industry to help employers implement safety and health programs.

The North Carolina state-operated program makes extensive use of settlement agreements for employers that have been found during investigations to have ergonomic hazards. Under what it calls the Cooperative Assessment Program (CAP) for Ergonomics, employers are not cited for ergonomic hazards if they enter into and make a good faith effort to comply with these agreements, under which they must take actions to implement the core elements of a safety and health program. To help these and other employers learn how to develop programs, the state recently established an ergonomics resources center that provides a variety of ergonomic services to employers.²³ The California state-operated program creates joint agreements and "special orders"²⁴ for individual employers when ergonomic hazards are identified during an inspection. These agreements and orders require employers to take corrective action to

²³This center is operated by the University of North Carolina through a partnership between the University and the state Department of Labor. Established in 1994 with state funding, the center seeks to enroll employers as "members" in an effort to become self-sustaining. The center provides on-site ergonomic evaluations and other services to members. These services are also available to nonmember employers at prescribed fees.

²⁴Typically, California will first try to enter into a joint agreement with the employer and will only do a special order when employers do not correct the identified hazards voluntarily under the joint agreement.

reduce the identified hazards according to a particular timetable; if the employers take the corrective actions specified, no penalties are assessed.

Instead of using the general duty clause, some states have used existing regulatory authorities that require employers to establish worksite safety and health programs, workplace safety committees,²⁵ or both to encourage employers to address MSDs. These safety and health programs must have particular elements, such as the identification of problem jobs and training, and in some cases, the committees themselves are responsible for undertaking particular activities. For example, in Oregon, workplace committees are required to conduct particular activities as they relate to identification of ergonomic hazards.²⁶

Through Cooperative Compliance Programs, federal and state-operated OSHA programs have targeted certain employers because of their high rates of injuries or high numbers of workers' compensation claims and offered them a chance to work with OSHA to reduce hazards in exchange for not being inspected. If employers agree, they must implement a program containing these elements to reduce hazards and injuries. For example, in the Maine 200 program, about 200 Maine employers were invited to develop a comprehensive safety and health program to reduce the injuries and hazards identified by OSHA.²⁷ Employers "graduate" from this program once they demonstrate that they have successfully implemented the core elements of a safety and health program, not necessarily because they have achieved a particular reduction in injuries or hazards.²⁸ Also, OSHA's Voluntary Protection Program allows employers to be excluded from programmed inspections if they can demonstrate they have an exemplary safety and health program consisting of these core elements.

Federal and state-operated OSHA programs and other organizations also educate employers about how to reduce MSDs and other safety and health

²⁵Since the early 1990s, at least six state-operated programs have legislated requirements for employers to develop and implement comprehensive worksite safety and health programs. See *Occupational Safety and Health: Worksite Safety and Health Programs Show Promise* (GAO/HRD-92-68, May 19, 1992).

²⁶Oregon requires committees to review OSHA 200 log data to determine whether MSDs are a problem, and if so, to take corrective measures.

²⁷Although this program did not target MSDs, OSHA officials said they found that a large number of employers' workers' compensation claims were for injuries and illnesses associated with MSDs. According to officials, this program allowed OSHA to work with employers to address ergonomic hazards that would not have otherwise received attention. One of the facilities in our review—the Sisters of Charity facility—participated in this program.

²⁸OSHA is attempting to expand Cooperative Compliance Programs into additional federal-jurisdiction states.

hazards through consultation and technical assistance. The services are typically coordinated by federal or state-operated programs but are actually delivered by state government agencies, universities, or professional consultants. Consultation programs allow employers to contact OSHA or its designee to identify and address safety and health problems outside the enforcement arena. If employers address the hazards identified by these consultants, they can be exempt from inspections for up to 1 year. The consultation and technical assistance services provide information on how to develop effective safety and health programs. A key document used in the provision of these services is OSHA's Safety and Health Program Management Guidelines, which provides information on how to implement a safety and health program (although it does not include a medical management component).²⁹ Additionally, because of high rates of MSDs in the meatpacking industry, in 1990 OSHA published the Ergonomics Program Management Guidelines for Meatpacking Plants, a voluntary set of guidelines on how to implement the core elements of an ergonomics program in that industry.

Facilities Have Implemented Core Elements in a Variety of Ways

Each of the facilities we visited displayed all of the core elements of an effective ergonomics program, but the facilities implemented them in a variety of ways that reflected their unique characteristics, such as their different industries and product lines, corporate cultures, and experiences during program evolution. For example, although each facility demonstrated management commitment by assigning staff to be specifically responsible for the program, some facilities used ergonomists to lead the program, while others used standing teams of employees. For two of the elements—identification of problem jobs and development of controls—the facilities displayed a lower level of effort than many of the options identified in the literature would entail. To illustrate, the facilities primarily identified jobs on an “incidence basis,” that is, on the basis of reports of injury, employee discomfort, or other employee requests for assistance, and did not typically screen jobs for ergonomic hazards. The facilities also used an informal process to analyze jobs and develop controls, often relying on in-house resources, and did not typically conduct complex job analyses. Finally, facilities typically implemented what they called “low-tech” controls, those solutions that did not require significant investment or resources, as opposed to more complex controls

²⁹Other public and private sector groups provide education and assistance as well. For example, the American National Standards Institute, a private organization that oversees the development of industry consensus standards, is currently working on a voluntary standard for how employers can implement these core elements to reduce MSDs. NIOSH recently issued guidelines on the elements of ergonomics programs as well as a review of the epidemiologic research on the relation between selected MSDs and exposure to physical factors at work.

that drastically changed jobs or operations. Following are selected examples of facility experiences for each of the elements; for more information on how all of the facilities demonstrated these elements, see appendixes III through VII.

Program Evolution and Other Factors Have Influenced Implementation of Elements

All of the facilities' programs had evolved over time—often over many years—and a number of factors were key to facilities' decisions to take actions to reduce MSDs.³⁰ Primary among them was an interest in reducing the workers' compensation costs associated with MSDs.³¹ Additionally, the variation in implementation was often explained by industry type, product lines or production processes, corporate cultures, or experiences during program evolution. For example, most of the employees at the headquarters of American Express Financial Advisors, a financial services employer, are engaged in similar operations that require significant use of computers, so they face similar hazards associated with computer use. Because of this similarity, the cornerstones of the ergonomics program are training for all employees on how to protect themselves from these hazards and developing furniture and equipment standards, which is accomplished by involving such departments as real estate and facilities.

Facility product lines, production processes, and other individual facility characteristics also affected implementation of the elements. For example, the Navistar facility's layout has constrained the implementation of some controls. Additionally, Navistar offers customized truck assembly, which often contributes to frequent production and schedule changes. This makes it difficult to ensure that controls are effective in the long run. Finally, because few new employees have been hired in recent years, the facility now has an older workforce that could be more vulnerable to these types of injuries.

Corporate culture may also influence program development. Both AMP's and Texas Instruments' corporate cultures emphasize decentralized operations whereby individual facilities are given considerable flexibility to reach production goals. Local employee teams are key to their

³⁰As a result, officials could not readily identify a date when their programs "began," but rather when the programs were "fully implemented." See app. I for the years these facilities' programs were fully implemented.

³¹According to our analysis of workers' compensation data from each of the facilities, MSDs accounted for about 50 percent or more of their total annual workers' compensation costs for the earliest implementation year for which we had data. Four of the five facilities in our review operated on a self-insured basis, which some experts believe may make it easier for employers to be aware of total workers' compensation costs.

operations because they allow for this type of decentralized approach. As a result, the facilities rely extensively on employee teams to implement their ergonomics programs. Texas Instruments has a number of teams throughout its management structure, which address ergonomics in some aspect. Additionally, performance targets drive all corporate and facility activities at Texas Instruments, so these kinds of targets have also been established for the facility's ergonomics program.

Experiences during program evolution also have influenced the ultimate shape of the program. At the Texas Instruments facility, where the ergonomics program has been in place the longest (since 1992), the facility is beginning to identify problem jobs on a more proactive basis given that many problem jobs identified on an incidence basis have already been addressed. The Sisters of Charity facility, which initiated its program in 1994 at the invitation of OSHA to participate in the Maine 200 program, is still principally working to control problem jobs as a result of employee requests. In addition, because this facility was selected for the Maine 200 program on the basis of its injuries of all types, it set up a safety and health program that addresses MSDs as well as other injuries and illnesses.

Management Commitment Is Demonstrated by Assigning Staff to Be Responsible for the Ergonomics Program

All of the facilities had assigned staff to be specifically responsible for the program and had provided them the resources, time, and authority to operate the program on a daily basis. Some of the other indicators of management commitment were incorporating ergonomic principles into corporationwide accountability mechanisms, such as strategic goals or safety audits, and integrating ergonomic principles into equipment purchase and design. Although some of the facilities had a written program, officials did not view these as key to program operations and said that management commitment was best illustrated in more tangible ways, such as assigning staff to ergonomics programs or incorporating ergonomics into accountability measures. The examples below highlight some of the variety in the ways management commitment was demonstrated and generally reflect the range of activities that appears in the literature.

Assigning Staff Specifically Responsible for Ergonomics

The American Express Financial Advisors facility has an ergonomist who leads the program, an ergonomics specialist who performs the workstation evaluations and develops controls, and a half-time administrative assistant who tracks information about what types of training and ergonomics services each employee has been provided. The AMP facility uses an ergonomics value-added manufacturing (VAM) team of line employees who

are responsible for identifying problem jobs and developing controls. The Texas Instruments facility has both an ergonomics team and an ergonomics specialist who works under the direction of the team.

Establishing Goals and Accountability Mechanisms

The Texas Instruments facility works toward a corporationwide strategic goal of eliminating all preventable occupational and nonoccupational injuries and illnesses by the year 2005, a goal toward which ergonomic activities at all facilities are expected to contribute.³² At the Navistar facility, the 5-year strategic plan sets targets for the number of processes to be redesigned ergonomically, the percentage of technical support staff to receive ergonomic training, and the reduction in lost workdays and associated workers' compensation costs.

Integrating Ergonomic Principles Into Equipment Design

At the Sisters of Charity facility, the on-site occupational health clinic must approve any new construction to ensure that new work areas are designed with ergonomic considerations. At the American Express Financial Advisors facility, the ergonomist works with several departments involved with procurement to establish standards for purchasing furniture and equipment that are ergonomic.

Making Resources Available for the Program

At the AMP and Texas Instruments facilities, most of the suggestions for controlling problem jobs submitted by the ergonomics teams are approved at the facility level.³³ The American Express Financial Advisors facility provides weekly 1-1/2-hour training sessions that are open to all employees. Sisters of Charity spent about \$60,000 to purchase 14 automatic lifts to reduce ergonomic hazards associated with moving residents at the nursing home.

Ensuring That Middle Management Support Is Sustained

The Texas Instruments facility's Site Safety Quality Improvement Team (QIT), which is composed of program managers, provides overall focus and strategy to the ergonomics team and approves most capital investments to improve ergonomic conditions. Twice in 1996, the facility sponsored "Ergonomic Management Seminars" for middle managers to demonstrate

³²Beginning in 1996, Texas Instruments established a yearly target of a 20-percent reduction from the previous year's number of injuries and illnesses and number of cases with lost or restricted workdays. Although only 1 year into this goal, the Lewisville facility achieved its 1996 target. However, concerns have been raised by labor representatives about whether the incorporation of such objectives into facility safety goals or managers' performance evaluations discourages employees from reporting injuries and discomfort.

³³Several of the facilities require cost justifications for these controls; in most cases, these justifications are required for all capital investments, not just for ergonomic investments. At two of the facilities, only when the cost of the controls surpasses a certain threshold (\$1,500 at Texas Instruments; \$2,000 at AMP) is a written cost justification required in order to get approval. When developing these cost justifications, the AMP team uses estimates of the costs of future MSDs should the suggested control not be implemented.

how ergonomically related losses affected the bottom line by discussing the costs of these injuries and their impact on productivity.

Employee Involvement Demonstrated Through Teams, Direct Employee Access to Ergonomic Services

Employee involvement at these facilities was often demonstrated through the use of employee teams or committees charged with identifying problem jobs and developing controls for them. In addition, employees had direct access to services; for example, some facilities had procedures that ensured a job analysis was done upon employee request. The examples below highlight some of the variety of ways that these facilities fostered employee involvement and generally reflect the range of activities that appears in the literature.

Creating Committees or Teams

The AMP facility's ergonomics VAM team consists of about 12 employees from different departments who meet biweekly during work hours. This team, led by an industrial engineer, is responsible for identifying and prioritizing problem jobs as well as for developing controls for the jobs. Both the team leader and secretary of the team are elected by the team members. Individual team members play leadership roles in "championing" various projects. At the Navistar facility, the ergonomist and local union representative form the nucleus of the ergonomics committee, with other employees involved on an ad hoc basis to provide information and feedback for the particular problem job being addressed.

Establishing Procedures So Employees Can Directly Access Ergonomic Services

At the Navistar facility, any employee can request a job analysis by filling out a one-page "Request for Ergonomic Study" form and passing it along to the ergonomist or the union representative. At the American Express Financial Advisors facility, employees can request a workstation evaluation through a phone call, by E-mail, or even by scheduling an evaluation themselves on the ergonomics specialist's electronic calendar.

Administering Surveys and Conducting Campaigns

American Express Financial Advisors' discomfort surveys help the ergonomics staff identify areas of concern for employees as well as the type of discomfort employees are feeling in various body parts. The Texas Instruments facility sponsors "wing-by-wing" measurement campaigns in which the team proceeds through the facility "wing by wing" to measure employees and adjust the workstations of those who may be experiencing problems but who have not requested services.

Simple, Incidence-Based Process Used to Identify Problem Jobs

All of the facilities in our review identified most of their problem jobs on an "incidence basis," that is, from reports of MSDs or employee discomfort or as the result of an employee request for assistance. The procedures

instituted for identifying problem jobs in this way were typically quite simple, with little paperwork involved. In most cases, only after problem jobs identified on an incidence basis were dealt with did officials at these facilities report they used more “proactive” methods to identify problem jobs where injuries might occur in the future. While the facilities used a variety of proactive methods for identifying problem jobs, they did not typically screen jobs for risk factors. Therefore, we characterize the facilities’ efforts to identify problem jobs as a lower level of effort than is reflected in the literature. The examples below highlight some of the ways facilities carried out this lower level of effort.

Identifying Problem Jobs on an Incidence Basis

All facilities had a system in place whereby any report of an MSD automatically triggered a job analysis. At the Sisters of Charity facility, the employee and supervisor must each complete a “Report of Employee Incident” form within 24 hours after an MSD is reported. This form is sent to staff at the on-site occupational health facility who conduct a physical examination of the employee, if necessary, and an evaluation of the employee’s workstation. A job analysis was also generally triggered whenever an employee reported discomfort or requested assistance. At the AMP facility, employees are encouraged to bring up any discomfort they are feeling with members of the ergonomics team. The Texas Instruments facility identified problem jobs on the basis of the high numbers of injuries and illnesses recorded in its workers’ compensation database.

Identifying Problem Jobs on a Proactive Basis

Because the Texas Instruments facility had already addressed many of the hazards at its manufacturing workstations, it launched an administrative workstation adjustment campaign in recognition of its need to shift its focus to identify potential hazards at administrative workstations. The Navistar facility has begun to identify problem jobs as those with high employee turnover and those staffed by employees with low seniority. The AMP facility uses an Ergonomic Prototype Work Center to set up alternative types of workstations in order to determine the best types of tools to use and the most efficient workstation layouts to avoid future injuries.

Informal Process Used to Analyze Problem Jobs and Develop Controls

All of the facilities in our review used a simple, fairly informal procedure to analyze problem jobs, as compared with some of the more complex options detailed in the literature. Often the facilities’ efforts focused only on the particular job element that was thought to be the problem (for example, drilling or lifting). Facilities also said the process for developing controls was informal, relying heavily on brainstorming and the use of

in-house engineering and medical resources. In some cases, facilities did conduct a detailed job analysis when the problem job was particularly complex, hazardous, or labor intensive. Also, while typically able to develop controls using in-house resources, the facilities on occasion used consultants and other external resources to develop controls for problem jobs.

The process used to develop controls was typically iterative, in that the ergonomics staff at these facilities continually reviewed the job in question to ensure that the control was working. In some cases, eliminating the hazard would have been difficult without significant capital investment in a soon-to-be-phased-out product or without disruption to the production process. In other instances, even when a control was identified, resource limitations sometimes extended the length of time it took to introduce the control. However, officials emphasized that they always tried to take some kind of action on all problem jobs.

Facilities used a mix of the controls described in the literature in their attempts to eliminate or reduce ergonomic hazards for problem jobs, generally preferring “low-tech” engineering controls—those that did not require significant capital investments and did not drastically change the job’s requirements. The examples illustrate the processes used by these facilities to identify problem jobs and the types of controls used. Appendix II profiles particular problem jobs at these facilities and the controls that were implemented.

Analyzing Jobs Through Observation, Interviews, and Measurements

The AMP facility uses a one-page “Ergonomic Evaluation Form” that is tailored to the specific job and asks simple “yes/no” questions about the employee’s ease and comfort when performing certain job tasks. After reviewing this form, a member of the ergonomics VAM team interviews the employee and observes the employee performing the job.³⁴ The ergonomics specialists at the American Express Financial Advisors and Texas Instruments facilities take workstation and personal measurements (for example, height of work surface and height of chair when seated properly), in addition to making observations or collecting information from employees through interviews.

For more complex or hazardous jobs, facilities may videotape or collect more detailed documentation. The AMP facility videotaped its re-reeling job

³⁴As an incentive for employees to complete the form, the facility allows those who do so to try out any new tools or equipment and help decide what equipment or tools should be purchased. Officials also said the current form had been simplified to encourage employees and members of the ergonomics VAM team to complete it.

and used an additional evaluation form, which is several pages long, that provides space to record detailed observations about the adequacy of the work space, environmental conditions, and hand tool use. A physical assessment survey capturing the frequency of discomfort by various body parts was also conducted because the re-reeling department historically had higher numbers of MSDs. The Texas Instruments facility videotaped its manual electronic assembly job because it had identified this as an “at-risk” job—that is, one with high numbers of recordable injuries and illnesses. (See app. II for more detailed information.)

Developing Controls by Brainstorming and Using In-House Resources

Officials at all of the facilities said brainstorming was key to developing controls. At the Navistar facility, for example, the ad hoc committee informally develops prospective solutions and looks at other operations within the facility with similar job elements to get ideas for controls. Facility officials at Texas Instruments also said that, in addition to their own employees and line supervisors, their production engineering department was also a resource for developing controls on more complex or technical jobs.

In other instances, outside resources were important contributors to developing effective controls. For example, the AMP facility regularly works out arrangements for vendors or suppliers to provide tools and equipment at no cost to the facility so the facility can test the products before purchasing them. Through AMP’s Ergonomic Prototype Work Centers, which are set up within each work area, these tools are then evaluated by the employees themselves in alternative workstation layouts. The Texas Instruments facility has used a consultant to help develop controls for its at-risk jobs, including its manual electronic assembly job. Because recommendations for controls came from the consultant, the ergonomics team found it was easier to get management buy-in to make the necessary job changes. (See app. II.)

Developing Controls Is an Iterative Process

Ergonomics staff assess how well a control is working and, if necessary, continue to address the problem job. At AMP, the ergonomics VAM team administers the same Ergonomic Evaluation Form that is administered when first analyzing the job after the controls are in place to determine whether or not they are working. At the Texas Instruments facility, an adjustable-height workstation design was tested on the production floor, and employee feedback revealed that it was unstable and allowed products to fall off. Using this feedback and working with a vendor, the ergonomics staff developed a new design. The result was an adjustable

table, referred to as “Big Joe” (essentially a fork lift with the wheels removed), which proved to be much more stable.

Because the Navistar facility is still not satisfied with controls introduced to address its “pin job,” which it described as its most onerous job, it also is taking an iterative approach. The pin job requires several employees to manually handle the heavy frame of a truck in order to attach it to the axle. Because of the significant force, “manhandling,” and vibration involved, the ergonomics staff has focused considerable effort on controlling this job. However, changing the product and the line is difficult to justify, given constraints associated with the facility’s design. In the meantime, facility officials have tried to reduce employees’ exposure using administrative controls and personal protective equipment and have recently formed a special committee of line employees to develop ideas for controls for this job. According to Navistar Officials, this committee has been given 6 months, an “unlimited” budget, and the latitude to consider alternative design options for the production line.

In some cases, facilities made efforts to ensure the long-term effectiveness of controls they had implemented. For example, both the Texas Instruments and American Express Financial Advisors facilities had developed databases that contained the results of workstation evaluations and employee preferences. At both of these facilities, employees are relocated frequently, so the information in the databases is used to ensure that, when an employee is relocated, his or her new workstation will be properly set up.

Focus on Low-Tech
Engineering Controls

The Navistar facility installed hoists to lift heavy fuel tanks and mechanical articulating arms to transport carburetors. It is gradually replacing “impact” guns—which are used to drill in bolts—with “nutrunner” guns, which expose employees to lower levels of vibration. American Express Financial Advisors has adjusted employee workstations (for example, repositioned monitors, designed corner work surfaces, and provided equipment to support forearm use) and introduced ergonomic chairs for employees’ use. (For more detail, see app. II.)

Facilities also used administrative controls, particularly for problem jobs where they have been unable to eliminate the ergonomic hazards through engineering controls. For example, in the re-reeling job at the AMP facility, employees are rotated every 2 hours so they are not reeling the same product over long periods of time. The Texas Instruments facility also uses job rotation to protect circuit board welders from ergonomic hazards and

other administrative controls rather than major investments, particularly when the product is soon to be discontinued. Some of the facilities also used personal protective equipment; for example, the Navistar facility has made extensive use of such equipment as padded gloves and elbow supports to provide protection and absorb vibration.

Training Generally Targeted to Specific Groups of Employees

Some of the facilities provided general awareness training to all employees, but this information was generally offered informally through written employee guidelines, posters, literature, and web sites. Most of the facilities emphasized training targeted to specific populations of employees. Examples below highlight some of the ways in which facilities provide training and education and were generally consistent with the literature.

General Awareness Training

Not every facility offered formal general awareness training to all employees. For those that did, such training was brief and sometimes offered infrequently. For example, at Sisters of Charity, ergonomics training in the form of body mechanics and instruction on the proper use of video display terminals was offered as part of the 4-1/2-hour basic safety training that each employee is required to take once a year. At the Texas Instruments facility, all employees are required to take 1 hour of general ergonomics awareness training every 3 years.

Targeted Training

Training is the cornerstone of the American Express Financial Advisors ergonomics program, where the ergonomics specialist teaches a 1-1/2-hour course every week targeted to the many computer-oriented jobs at this facility. Employees are generally required to take this training before their workstations will be adjusted. Personal measurements are taken during training, and participants are taught how to make their workstations fit their needs. The Texas Instruments facility offers a wide range of targeted training, with an emphasis on instruction of production teams within their own work areas in which team members actually work together to develop controls for problem jobs. Courses offered at the facility include “Ergonomics for Computer Users,” “Factory Ergonomics Awareness,” and “Advanced Ergonomics for Electronic Assemblers and Teams That Handle Materials.”

Ergonomics Programs Strongly Linked to Medical Management Programs

The ergonomics programs at these facilities had strong links with the medical management staff³⁵ in ways that were consistent with the literature. For example, a report of an MSD automatically triggered a job analysis; medical management staff were often members of the ergonomics teams; and medical management staff were also familiar with jobs at the facility, which helped them identify the hazards to which employees were exposed. The facilities also emphasized a return-to-work policy that gave employees with diagnosed MSDs the opportunity to work on restricted or transitional (sometimes referred to as light duty) assignments during their recovery period. Facilities also conducted follow-up during the time an employee was on restricted duty. Examples below highlight some of the ways these facilities demonstrated this element.

Encouraging Early Reporting and Ensuring Prompt Evaluation

The Navistar facility has an on-site occupational health clinic and medical management staff who are easily accessible to all employees and who can treat most injuries, including MSDs. The medical director can request a job analysis whenever an employee reports an injury or discomfort to the clinic. The medical director participates on Navistar's ad hoc ergonomics committee to help develop controls for problem jobs and on the facility's workers' compensation causation committee, which looks for the root cause of selected workers' compensation claims.

Making Health Care Providers Familiar With Jobs

The American Express Financial Advisors facility has established a relationship with several local health care providers who are familiar with MSDs and has encouraged these health care providers to visit the facility to understand the jobs its employees perform. These health care providers provide early treatment to avoid unnecessary surgery, which is sometimes called conservative treatment. At Texas Instruments, the disability coordinator is responsible for developing a relationship with local health care providers and identifying doctors who are conservative in their treatment approach.

Using Transitional or Restricted Duty to Return Employees to Work and Conducting Follow-Up

At the Texas Instruments facility, the lost time intervention manager monitors health conditions of out-of-work employees and coordinates with all other medical management staff to determine if the employee can return to work on a restricted basis. Typically, the employee can be accommodated within his or her home work area. Several things have been done to facilitate these placements, including developing a database

³⁵Medical management staff can include on-site doctors and nurses, workers' compensation staff (including staff responsible for monitoring lost time and workers' compensation costs), disability coordinators, and off-site health care providers. Not every facility has all of these staff, and facilities may share these staff with other facilities owned by the same company.

of available jobs for workers on restriction and creating a special account that covers the payroll costs of employees on transitional duty so the costs are not charged to that home work area's budget. If the limitations are permanent and prohibit the employee from performing essential job functions with reasonable accommodation, the employee is referred to the Texas Instruments placement center for job search and other placement assistance.

Ergonomic Programs Bring Benefits, Although Measurement Problems Exist

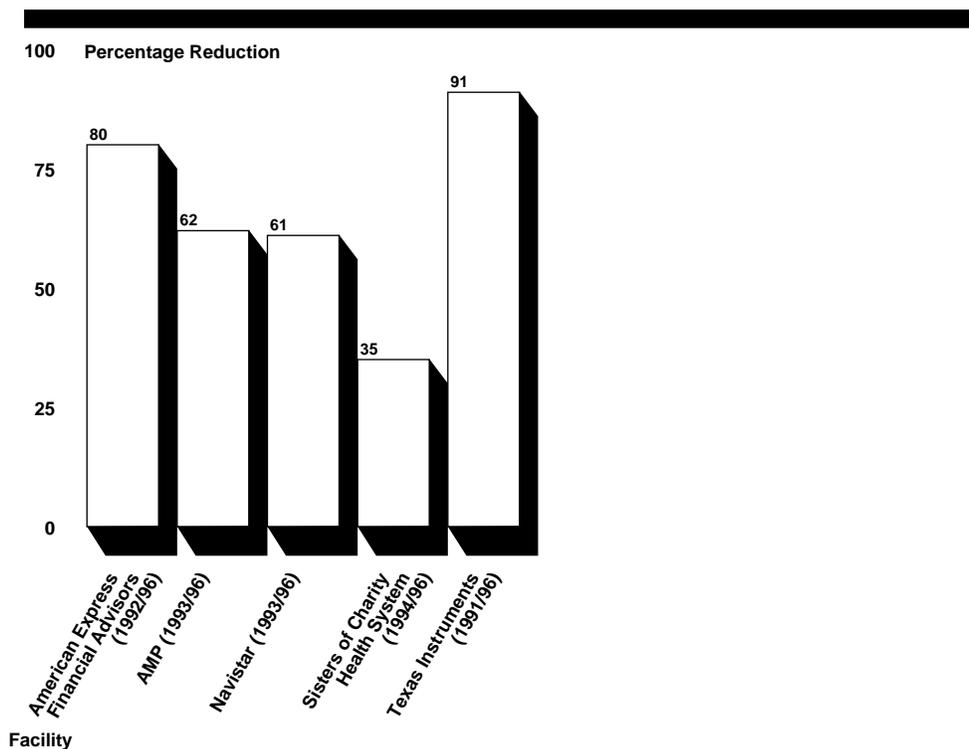
Officials at all the facilities we visited believed their ergonomics programs brought benefits, including reductions in workers' compensation costs associated with MSDs. These facilities could also show reductions in facilitywide overall injury and illness incidence rates,³⁶ and in the number of days injured employees were away from work, although some facilities reported an increase in the number of days employees were on restricted job assignments. Facility officials also reported improved worker morale, productivity, and quality, although evidence of this was sometimes anecdotal. However, measuring program performance—assessing these outcomes in light of program efforts—was complicated by uncertainties associated with determining which injuries should be included as MSDs and with tracking changes in those injuries in light of complicating factors. For example, facilities did not track the total costs of their ergonomics programs so they could not assess whether benefits gained exceeded the investments made. As a result, these employers found it helpful to track the progress they were making in implementing the program.

Facilities Have Realized Reduction in Costs of MSDs

All five facilities experienced a reduction in total workers' compensation costs for MSDs (see fig. 1). Reductions are not comparable across facilities, but officials at each of these facilities said they believed the facility's ergonomics program had contributed toward these reductions. At the Texas Instruments facility, where the ergonomics program has been in place for the longest period of time, workers' compensation costs for MSDs have dropped appreciably—from millions of dollars in 1991 to hundreds of thousands of dollars in 1996. The achievement of these reductions is significant, given that high MSD costs were a major impetus for initiating these programs and lowering these costs was often a major outcome goal.

³⁶The incidence rate is the number of injuries and illnesses for every 100 full-time employees per year.

Figure 1: Percentage Reduction in Workers' Compensation Costs for MSDs at the Case Study Facilities



Notes: Data are not adjusted for inflation. Years typically represent the year before full implementation of the program for each of the facilities compared with 1996. Exceptions are described in app. I.

American Express Financial Advisors' workers' compensation database operates on a policy year basis, which is from Sept. of one year through Sept. of the next. In other words, policy year 1991 is Sept. 30, 1991, through Sept. 29, 1992. For clarity of discussion, we refer to policy year 1991 as "1992"; policy year 1992 as "1993"; and so on. Also, workers' compensation data are not available for headquarters only (the facility we visited). Data represented here are for all of American Express Financial Advisors. However, most of the employees work in the headquarters office.

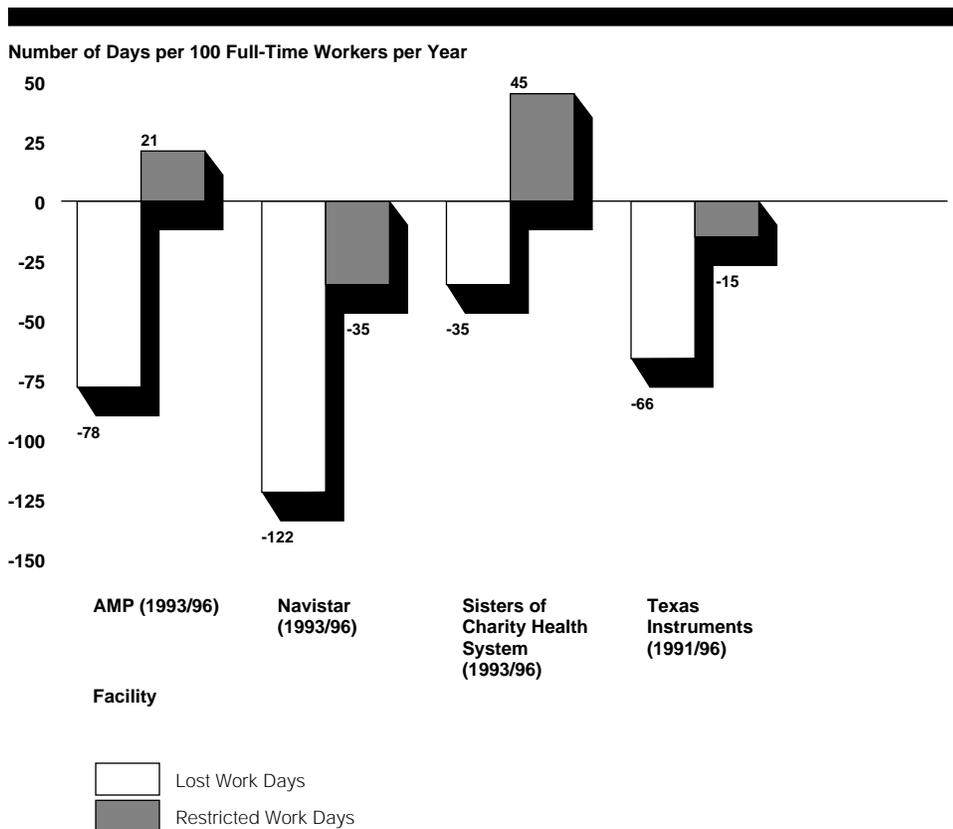
For yearly data, see apps. III through VII.

Source: GAO analysis of case study facilities workers' compensation databases.

These reductions can be attributed to a strong medical management component in the ergonomics program. As the medical director of the Navistar facility explained, the key to a cost-effective ergonomics program is getting injured employees back to work as soon as appropriate, minimizing lost workdays. Officials at several of the facilities said one of their first activities when implementing this program was to assist

employees in returning to work. As figure 2 shows, the facilities were able to reduce the number of days injured employees were away from work. Conversely, restricted work days increased at facilities owned by AMP and Sisters of Charity, which officials said reflected their success at bringing employees back to work. This reflects an important challenge to a return-to-work policy, however, because bringing employees back to work as soon as possible may require a greater number of available restricted- or light-duty positions than are often available. For example, according to Navistar officials, light-duty positions for returning employees must be allocated according to the seniority provisions of the collective bargaining agreement, so if an injured employee does not have sufficient seniority, there may not be any light-duty jobs available. Or, the jobs available to less senior employees, such as clean-up duty, are often not appealing to employees who desire productive work. Sisters of Charity officials said they do not have difficulty finding light-duty jobs for employees, but there have been cases in which employees' restrictions were so severe that it was difficult for these employees to be productive.

Figure 2: Change in Lost and Restricted Workdays for Case Study Facilities



Notes: Years typically represent the year before full implementation of the program for each of the facilities compared with 1996. Exceptions are described in app. I. As a financial institution, the American Express Financial Advisors facility is not required to maintain an OSHA 200 log, so it did not have the information available to calculate lost and restricted workdays. As a result, it is not included in this figure.

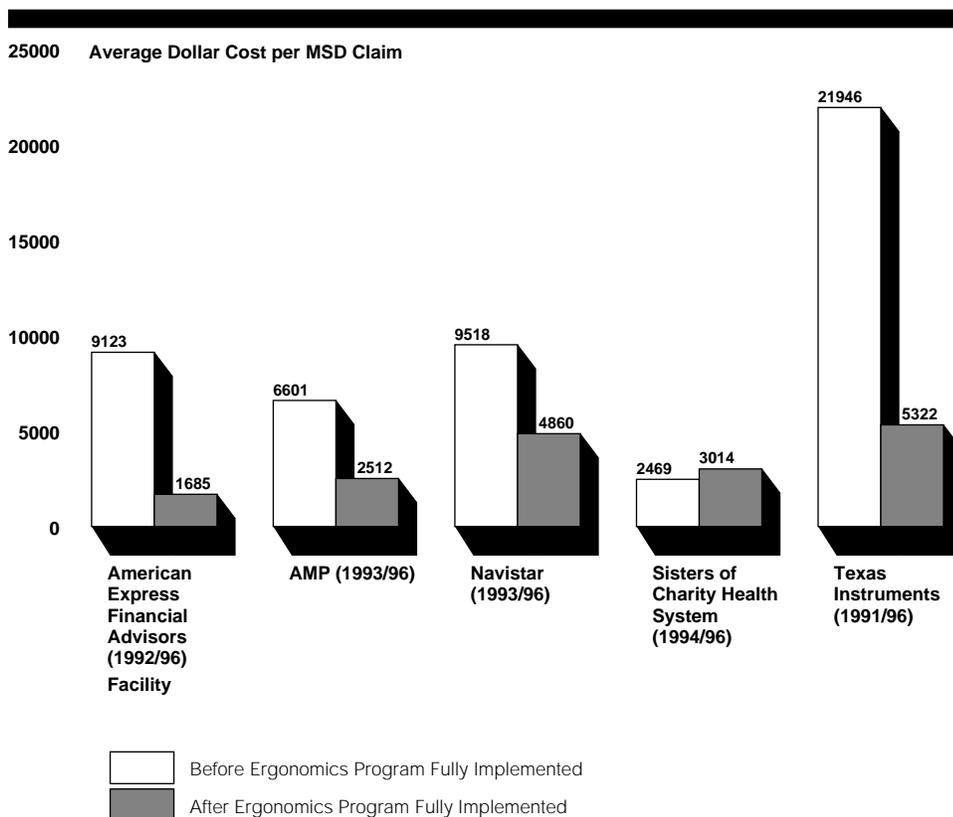
For data used for calculations, see apps. IV through VII.

Source: GAO analysis of case study facilities' OSHA 200 logs.

Medical management also includes encouraging employees to report symptoms of MSDs before they become serious injuries requiring more expensive treatment or surgery; as a result, reductions in the average cost per claim reflect early reporting and treatment. The Sisters of Charity facility was the only facility that had not yet experienced a decline in the

average cost per claim (although this cost is well within the range of the average cost per MSD claim at other facilities).³⁷ (See fig. 3.)

Figure 3: Average Cost per MSD Workers' Compensation Claim for Case Study Facilities



Notes: Data are not adjusted for inflation. Years typically represent the year before full implementation of the program for each of the facilities compared with 1996. Exceptions are described in app. I.

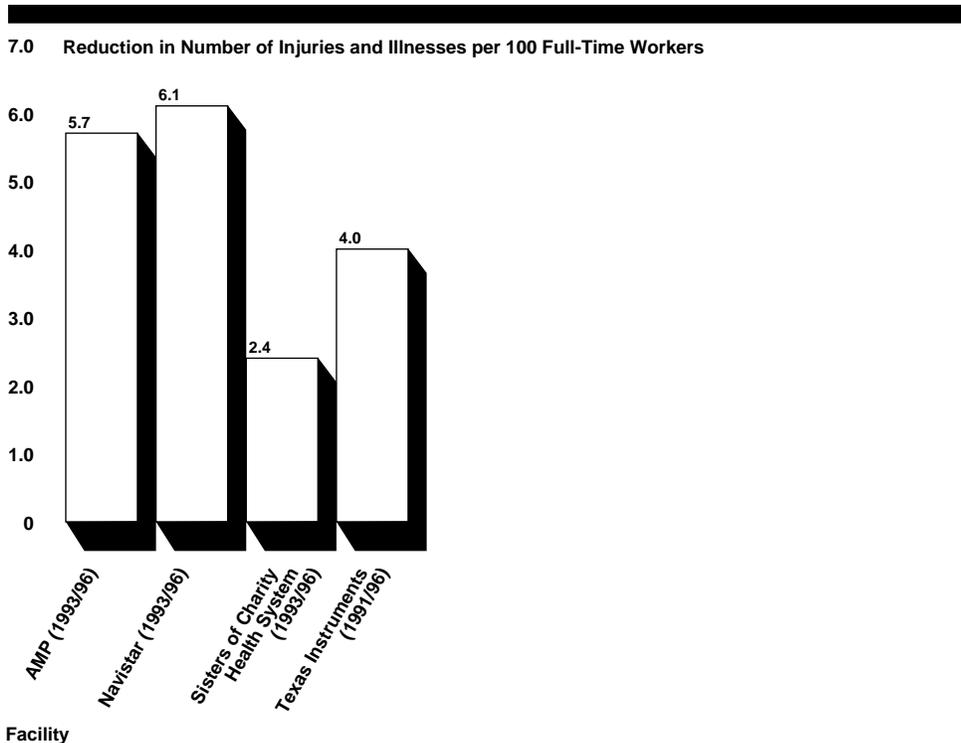
American Express Financial Advisors' workers' compensation database operates on a policy year basis, which is from Sept. of one year through Sept. of the next. In other words, policy year 1991 is Sept. 30, 1991, through Sept. 29, 1992. For clarity of discussion, we refer to policy year 1991 as "1992"; policy year 1992 as "1993"; and so on. Also, workers' compensation data are not available for headquarters only (the facility we visited). Data represented here are for all of American Express Financial Advisors. However, most of the employees work in the headquarters office.

Source: GAO analysis of case study facilities' workers' compensation databases.

³⁷Sisters of Charity officials said the increase was primarily due to a high-cost claim that involved a large number of lost workdays.

These facilities could also show reductions in the number of injuries and illnesses for their facilities as a whole, according to their OSHA 200 log records (see fig. 4). Trends in overall injuries and illnesses from the OSHA 200 log are important because MSDs accounted for a large portion of all injuries and illnesses and because these data are part of the information OSHA compliance officers review in the early stages of an inspection to focus their inspection efforts.

Figure 4: Reduction in Injury and Illness Incidence Rates at Case Study Facilities



Notes: Years typically represent the year before full implementation of the program for each of the facilities compared with 1996. Exceptions are described in app. I. As a financial institution, the American Express Financial Advisors facility is not required to maintain an OSHA 200 log, so it did not have the information available to calculate incidence rates. As a result, it is not included in this figure.

For data used for calculations, see apps. IV through VII.

Source: GAO analysis of case study facilities' OSHA 200 logs.

Gains Have Been Observed in Productivity, Quality, and Employee Morale

Facility officials also reported improved employee productivity, quality, and morale since they had implemented the programs, although evidence of these outcomes was primarily anecdotal. For example, some facility officials said employees are more likely now to exercise control over their jobs and to be more actively involved with line supervisors in how jobs are performed. Officials from Sisters of Charity believed that turnover and absenteeism had been reduced and they had been able to hire better employees as a result of their efforts, even though employees initially resisted some of the changes proposed, such as the use of automatic lifts to move residents. The American Express Financial Advisors facility reported reductions in discomfort experienced by employees.³⁸

Officials at several of the facilities said that as the program evolves, goals need to change as well, from reducing workers' compensation costs to increasing productivity and quality. For example, officials at the Texas Instruments facility stressed that they were moving toward using productivity and other quality measures as indicators of the program's success, since they had already achieved large reductions in workers' compensation costs.

Facilities also provided evidence, often only anecdotal, of productivity or quality improvements associated with implementing ergonomic controls.³⁹ Several facilities have found that ergonomic hazards often contribute to production bottlenecks or problems. By minimizing employees' stressful hand exertions during a windshield installation process, for example, the Navistar facility was also able to increase the quality of the installation, reducing a high rate of warranty claims (see app. II). Additionally, by identifying a newly automated way of extracting remnant metals when electronic connectors are stamped, the AMP facility not only eliminated awkward positions for employees but also reduced the volume of scrap waste and enhanced the quality of recycled metals made from these scrap metals.

³⁸These results are from American Express Financial Advisors' annual discomfort survey. About three-quarters of employees surveyed experienced headaches and discomfort in the neck and back in 1993. As of 1996, only about a third of employees surveyed said they experienced discomfort in these body parts.

³⁹Officials at two facilities had concerns that ergonomic controls might not always lead to productivity gains, particularly if they slowed down production processes or spread existing workloads among a greater number of employees. This concern may indicate the need to identify a different control that would address the ergonomic hazard without negatively impacting productivity.

Measuring Program Performance Poses Many Challenges

Facility officials said they faced a number of challenges in measuring the overall performance of their programs and tying outcomes to the efforts they were making in implementing their programs. Primary among these challenges was determining what injuries should be included as MSDS, and effectively tracking the changes in the number and severity of those injuries in light of what officials referred to as “confounding” factors that complicated their ability to interpret outcomes or changes that accompanied their program efforts.

Although many of the officials from the facilities said a major influence for initiating the program was a concern about increased workers’ compensation costs due to MSDS, in the early stages of implementing the ergonomics programs some of the facilities reported uncertainties about what injuries and illnesses should be categorized as MSDS. American Express Financial Advisors officials said the lack of agreement about MSDS makes it difficult to know what to track when trying to isolate MSDS from other kinds of injuries and illnesses. Sisters of Charity officials said, in many cases, incident reports must be reviewed to identify whether the injury was caused by ergonomic hazards. Ergonomics staff at the facilities said the OSHA 200 log was not very useful to them for identifying MSDS because it does not allow various injuries that they believe are a result of ergonomic hazards to be recorded as such. For example, officials at several of the facilities said that back injuries, which are often a result of repetitive lifting, are not recorded in the OSHA 200 log in a way that they can be identified as MSDS.

These employers used their respective corporate workers’ compensation databases to help them identify what types of injuries should be included as MSDS for the program, as well as to track reductions in these injuries and illnesses. Several of the facilities worked with their insurance company, or the administrator of their insurance policy, to help track these injuries and illnesses and related costs. However, because corporate workers’ compensation databases included different categories of injuries, and because facilities differed in the frequency and type of injuries experienced, facilities used different categories of injuries to track MSDS. For example, while all of the facilities included injuries or illnesses that resulted from obviously repetitive activity, some also included those that were the result of a one-time occurrence. Differences of opinion also existed in at least one facility between the ergonomist and corporate

management as to what categories should be included to track MSDs.⁴⁰ Using cost data, like workers' compensation costs, to interpret outcomes is also problematic, because health care costs in general continue to rise and there is often a several-year lag between the time injuries occur and when a workers' compensation claim is finally closed. Such lags, if large, could make tracking program performance difficult.

Facilities experienced other factors that made it difficult to interpret outcomes in light of program efforts, including limited data on program costs, the effects of growing employee awareness of MSDs, changes in staffing levels, and the effect of increasing workloads. For example, facilities did not track the total costs of the ergonomics programs, so they did not know whether the reductions in MSD costs and other outcomes exceeded program expenditures.⁴¹ Facility officials said it was also difficult to know whether these outcomes resulted solely from investments taken to reduce ergonomic hazards or from other productivity and quality investments as well. However, these officials said that many ergonomic investments were small, and at several facilities, a written justification was needed only when the cost of proposed controls was over a certain threshold.⁴² Despite their strong commitment to their program, officials at AMP emphasized that the limited number of years of its trend data makes it difficult to draw any conclusions at this time regarding the impact of its program.

Facility officials also stated that increases in MSDs and claims, at least initially, could result from growing awareness of ergonomic hazards. At the Texas Instruments facility, ergonomics awareness training contributed to employees' making more MSD claims in 1994 (see app. VII). MSDs and workers' compensation claims can also be affected by changes in staffing levels, as new employees may be more likely to get hurt, and the threat of layoffs may encourage employees to report discomfort or injuries. Since 1988, American Express Financial Advisors has experienced significant increases in staffing levels and workloads, increases that officials said need to be considered when looking at its claim experience (see app. III).

⁴⁰At the Navistar facility, the ergonomist preferred to track progress by individual injury category (for example, a back injury or carpal tunnel syndrome) when the contributing ergonomic hazard was direct (that is, lifting or repetitive activity), while corporate management preferred to track all injuries to which all types of ergonomic hazards might have contributed.

⁴¹None of the facilities had cost accounting systems designed to track ergonomic program costs alone.

⁴²The Texas Instruments facility estimated that changes to its administrative workstations to control ergonomic hazards cost on average only \$15 to \$20; changes to manufacturing workstations were on average \$50 to \$1,000. However, in some cases, these expenditures were more significant, like the \$60,000 spent by the Sisters of Charity facility on 14 lifts for nursing home attendants to use to move residents.

Other facility officials said claims tend to increase before a layoff, then decline again when employees are recalled to work. Workload pressures and other work organization factors can also affect program outcomes.⁴³ Several facility officials said issues associated with stress, workload demands, or other intangible work factors are more difficult to address than are physical hazards.

Facilities Track Progress in Implementing Their Programs

Perhaps because of these difficulties in tying outcomes to program efforts, facility officials found it useful to track the actions taken to implement the core elements of the program. Several of the facilities, for example, had a corporationwide audit, which included a section on ergonomics. These audits assessed items such as whether a team had been established, whether the facility was providing ergonomics training, and whether the facility was conducting analyses of problem jobs. For example, in response to last year's safety audit, the Navistar facility decided to form an ergonomics committee of high-level management personnel to spread awareness of its ergonomics program and to obtain greater commitment from these managers.

Some facilities used other measures to track program implementation. The Texas Instruments facility uses a "productivity matrix" to track progress on various projects or initiatives, including its workstation adjustment campaigns, which have helped identify ergonomic hazards before injuries occur. Both the Texas Instruments and American Express Financial Advisors facilities' databases, which include employee workstation measurements and preferences, allow them to track the number of employees who have received workstation evaluations and whose workstations have been adjusted. Some facilities are also tracking the number of requests for assistance they receive from employees.

Case Study Experiences Highlight Employers' Success in Reducing MSDs

These private sector experiences highlight that employers can achieve positive results through simple, informal, site-specific efforts, with a lower level of effort to identify and analyze problem jobs than that generally reflected in the safety and health literature or in OSHA's draft ergonomics standard. These experiences suggest that OSHA may need to provide flexibility to employers to customize their programs under a specified framework for a worksite ergonomics program and give them some

⁴³The work organization factors (sometimes called psychosocial factors) can also include production line speed, workload, the level of control an employee has over his or her job, and degree of job security. A 1995 study by the Communication Workers of America found that consideration of these factors is essential to future progress in reducing MSDs among video display terminal operators.

discretion in deciding the appropriate level of effort necessary to effectively reduce identified hazards. Federal and state-operated OSHA programs' current efforts to reduce MSDs in the absence of a standard provide employers this kind of flexibility; however, questions exist about whether current efforts alone are sufficient to address MSDs. Finally, the information problems that complicated these facilities' efforts to identify their problem jobs, and then to measure their progress in addressing these hazards, suggest that OSHA's recent efforts to revise injury and illness data collection methods are a step in the right direction.

Flexibility in Implementation and Lower Level of Effort Can Produce Results

All of the facilities in our review implemented the core elements of effective ergonomics programs. In other words, each of the facility's programs included all of the elements highlighted by literature and experts as necessary for an effective program. However, the facilities often customized the elements to adapt to their own often unique site-specific conditions. We also found that the processes for identifying and developing controls for problem jobs, and often the controls themselves, were simple and informal, generally requiring a lower level of effort than that called for in the OSHA draft standard or described in the literature. Yet, in all cases, the facilities were able to reduce workers' compensation costs associated with MSDs and the number of days employees were away from work, as well as report improvements in product quality, employee morale, and productivity. This similarity in overall framework but variety in implementation suggests that there may be merit to an approach that requires programs to have these core elements but gives facilities some latitude to customize the elements as they believe appropriate, as well as some discretion to determine the appropriate level of effort necessary to effectively identify and control problem jobs. This approach may also mean that facilities would be able to identify problem jobs—at least initially—on an incidence basis (a report of an MSD or employee discomfort or a request for assistance) and move toward a more proactive identification as the program matures. Although this approach is viewed by some as inconsistent with accepted safety and health practices that emphasize prevention, our case study facilities found it to be a viable approach when starting their programs.

OSHA's Current Efforts in Absence of Standard Provide Employers Flexibility

In the absence of a standard specifically for MSDs, federal and state-operated OSHA programs have limited authority to take action against employers for ergonomic hazards, which has resulted in a variety of strategies and approaches to foster employer awareness and action to

protect employees from these hazards. These efforts include a number of new initiatives at the federal and state levels as well as some long-standing efforts to encourage employers to take action against ergonomic hazards. These initiatives appear to provide the kind of flexibility that is consistent with the experiences of our case study employers. Although these initiatives illustrate the potential value of a flexible approach, many are small in scope, are resource intensive, are still being developed, or depend largely on an employer's willingness to participate, so they may not offer a complete solution to protecting employees from MSDs, especially in light of the large numbers of employees that experience MSDs. Federal and state-operated OSHA programs have tried to provide information, technical assistance, and consultation in an effort to respond to employers' interest in these initiatives.

The flexibility provided by OSHA under the Maine 200 cooperative compliance program was key to the success of the Sisters of Charity facility in reducing MSDs. Sisters of Charity was not given targets for reduction of injuries or hazards, but it was required to implement a comprehensive safety and health program. To help Sisters of Charity accomplish this, an OSHA compliance officer was specifically assigned to it (and to other employers in the health care industry as well) for the duration of its participation in the program. The compliance officer was responsible for becoming familiar with the facility to help identify and evaluate controls, perform on-site monitoring inspections to ensure Sisters of Charity was implementing the core elements of a safety and health program, and review quarterly progress reports Sisters of Charity provided to OSHA. The compliance officer monitored Sisters of Charity's progress against the provisions in the Safety and Health Program Management Guidelines, looking for continuous improvement and "scoring" the facility on how well it was implementing key elements of the program. Sisters of Charity graduated from the program in 1996 because it had, in the judgment of OSHA, made sufficient progress in establishing the elements of an effective program. Sisters of Charity officials said the value of this approach was not only the hands-on assistance provided by OSHA, but also the compliance officer's familiarity with the facility, which made it possible for OSHA to appropriately judge the efforts Sisters of Charity was making. OSHA is currently developing a safety and health program

management standard based on the guidelines and on evidence that such worksite programs can reduce injuries and illnesses.⁴⁴

OSHA's settlement agreements for MSDs have also provided some degree of flexibility, as they require employers to implement core elements of an ergonomics program but allow employers to carry out these elements under negotiated timetables with little threat of citation unless the company fails to comply with the overall agreement.⁴⁵ OSHA attributes significant progress made by selected employers in reducing ergonomic hazards to a great extent to these agreements. In addition, we interviewed officials from two states with regulations that require employers to establish worksite safety and health programs or committees who view these regulations as a way to leverage existing resources to encourage employers to address ergonomic hazards, especially when MSDs constitute a significant portion of their injuries and illnesses. Officials said these programs require employers to take actions to reduce injuries and illnesses but allow the employers some discretion about what actions they will take.

North Carolina offers a model of combining a flexible regulatory approach—as reflected in the CAP program, which has general requirements for implementing the core elements of an ergonomics program—with the provision of technical assistance through the state's Ergonomics Resources Center. Several employers involved with this effort said that the flexibility in these agreements and the availability of technical assistance were very helpful to them, because they were new to ergonomics and did not know where to begin.

Although these initiatives reflect the value of employer-provided flexibility, they may not offer a complete solution to protecting employees from MSDs. For example, while the Sisters of Charity facility demonstrated significant reductions in workers' compensation costs for MSDs and in the number of days employees lost from work, progress was more mixed in terms of reducing all injuries and illnesses, the average cost per MSD, and

⁴⁴In its draft strategic plan, OSHA reported that effective implementation of safety and health programs has proven that safety pays in monetary savings as well as in better economic performance, improved labor/management relations, reduced worker turnover rates, and improved worker morale. We have previously reported that comprehensive safety and health programs can help employers reduce injuries, illnesses, and fatalities. See [GAO/HRD-92-68](#), May 19, 1992.

⁴⁵OSHA is currently evaluating the effectiveness of its settlement agreements in improving worker health and safety.

the number of days employees were assigned to restricted work activity.⁴⁶ While these results would suggest that the facility has made some progress, it is not clear whether the requirements of the Maine 200 program ensure that this would be the case for every employer or that employees are adequately protected. Additionally, OSHA officials in Maine said the Maine 200 program required more resources than originally anticipated and that if they were to do this again, they might be more selective in the number of employers they targeted.⁴⁷ Moreover, safety and health program requirements exist only in some states and often for selected industries, which limits the number of employers covered. The North Carolina initiative is small and new and has not yet been fully evaluated. OSHA's efforts to expand Cooperative Compliance Programs similar to Maine 200 to other states continue to evolve, as OSHA deals with the difficult issues raised by employers and labor advocates alike about the most effective ways to target employers for inclusion into these programs, provide employers flexibility to take action, and adequately protect employees. Additionally, labor representatives have stressed the need for OSHA to provide (1) the necessary guidance to employers who are targeted by these programs so they know what actions to take and (2) the tools to OSHA compliance officers to help them adequately evaluate employer efforts. In the absence of a standard, these programs rely largely on an employer's willingness to take action to reduce ergonomic hazards.

Our case study employers reported that, although they had made significant use of in-house engineering and other resources to analyze problem jobs and develop controls, they did, on occasion, call upon outside resources, including consultants, for information and technical assistance. These officials said that other employers, especially smaller ones, may have an even greater need for help from outside resources to learn how to implement a program or develop controls. This suggests a role for OSHA's consultation assistance programs in providing, or facilitating the dissemination of, information and technical assistance. For example, 34 states have ergonomics resource personnel among their consultation program staff, according to a recent OSHA survey, and many states offer clearinghouses of information on MSDs, provide training, or have launched technical assistance initiatives specifically for ergonomics.

⁴⁶For example, the nursing home operation actually experienced a slight increase in injuries and illnesses during the period, but the significant reductions in injuries and illnesses at the medical center enabled the Sisters of Charity facility as a whole to realize a reduction in workers' compensation costs and incidence rates. One evaluation of the Maine 200 program raised questions about its success because, even though there were often reductions in costs and injuries, it was not possible to determine with certainty how much improvement was due to specific elements of the Maine 200 program.

⁴⁷Additionally, California state-operated program officials said that they are now more selective about the use of special orders because the orders are labor intensive to develop and monitor.

Federal and state-operated OSHA programs also provide grants to employers—for example, to smaller employers to provide for ergonomic training, or, as in Oregon, to employers or employer groups to develop and implement solutions to workplace ergonomic problems that cannot be solved with available technology. The Washington state-operated program is conducting research to help employers address MSDs, and it has formed a task force to develop a strategy to reduce MSDs in high-risk industries. OSHA has also undertaken projects to help employers understand the financial benefits of taking action and to share practical experiences about how to implement an ergonomics program.⁴⁸

Lack of Adequate Information Complicates Program Operations and Measurement

At the facilities we visited, the impetus for developing an ergonomics program was often an initial concern with excessive workers' compensation costs. At these facilities, this concern led to an examination of workers' compensation and other data that ultimately identified MSDs as a cause of a major proportion of their total workers' compensation costs. Later, to facilitate the tracking of their programs' progress, these companies, either on their own or through their workers' compensation insurers or third-party administrators, set up systems for tracking MSD-related injuries and associated costs.

However, other companies, even if they have high workers' compensation costs, may not have access to the information needed to determine whether they have a problem with MSDs and, if so, how to address the problem. Further, although employers are currently required to record information on workplace injuries and illnesses on the OSHA 200 log, the case study facilities have found that the log does not facilitate the collection of accurate data on MSDs. In 1996, OSHA proposed changes to simplify how all injuries and illnesses could be recorded on the OSHA 200 log.⁴⁹ As a part of this proposal, OSHA specified criteria for recording MSDs that would include a diagnosis by a health care provider that an injury or illness is an MSD and an "objective" finding, such as inflammation, or a report of two or more applications of hot or cold therapy. These criteria would be applied equally to all cases involving any part of the body, including backs. This proposal would respond to concerns raised by the case study employers that the "repeated trauma" illness category in the OSHA 200 log does not adequately capture all MSDs.

⁴⁸For example, in Jan. 1997, OSHA and NIOSH jointly sponsored a conference entitled "Ergonomics: Effective Programs and Practices." OSHA officials have announced they plan to hold additional conferences throughout the country.

⁴⁹This proposal was explained in detail in the Feb. 2, 1996, *Federal Register* and is currently under review at the Department of Labor and the Office of Management and Budget.

Conclusions

Currently, billions of dollars are spent by private sector employers on workers' compensation claims associated with MSDs, and hundreds of thousands of workers each year suffer from MSDs. Our work has demonstrated that employers can reduce these costs and injuries and thereby improve employee health and morale, as well as productivity and product quality. More importantly, we found that these efforts do not necessarily have to involve costly or complicated processes or controls, because employers were able to achieve results through a variety of simple, flexible approaches. Our findings are based on a small number of cases and are not generalizable to all workplaces. However, the qualitative information provides important insights into employers' efforts to protect their workers from ergonomic hazards. Additionally, experts from the business, labor, and academic communities reviewed the results of our case studies and said our findings on employer efforts to reduce MSDs were consistent with their experiences.

Our work also found that these facilities' programs included all of the core elements highlighted in the literature and by experts as key to an effective program—management commitment, employee involvement, identification of problem jobs, analyzing and developing controls for problem jobs, training and education, and medical management—with the elements customized to account for local conditions. Uncertainties continue to exist about particular aspects of MSDs that may complicate regulatory action by OSHA, and our analysis does not allow us to draw any conclusions about whether a standard for MSDs is merited. However, any approach OSHA pursues to protect workers from ergonomic hazards that sets a well-defined framework for a worksite ergonomics program that includes these elements while allowing employers flexibility in implementation would be consistent with the experiences of these case study employers.

Agency Comments and Our Evaluation

We obtained comments on a draft of this report from the Department of Labor's Acting Assistant Secretary for Occupational Safety and Health. OSHA also provided technical changes and corrections to this report, which we incorporated as appropriate.

In his comments, the Acting Assistant Secretary said that our report is a valuable contribution to the extensive literature on the benefits of ergonomic programs and that it reinforces conclusions found elsewhere in the literature that ergonomic interventions in the workplace significantly reduce work-related injuries and illnesses. He described the reduction in

workers' compensation costs for MSDs for these facilities as impressive and noted that these facilities had implemented substantially the same core elements as those OSHA has recognized as fundamental to ergonomics programs.

Although the Acting Assistant Secretary described the report as consistent with OSHA's ergonomics experience, he pointed out that our study cannot be used to draw any conclusions about the relative advantages of an incidence-based approach (identifying problem jobs on the basis of a report of injury or discomfort or an employee request for assistance) versus more proactive approaches. Although the facilities we studied used an incidence-based approach to identify problem jobs, the Acting Assistant Secretary expressed the view that incidence-based approaches are unlikely to work as effectively where there is a small number of workers in a job, as is typical of many small and medium-sized firms. We agree that our study does not allow us to compare the relative advantages of different approaches for identifying problem jobs. Rather, we found that these facilities believed an incidence-based approach was a viable way to start identifying where their problems lay. We also reported that these facilities are now moving to more proactive approaches to identify potential problem jobs, before complaints or discomfort occur. The comments of Labor's Acting Assistant Secretary appear in their entirety in appendix VIII.

We are providing copies of this report to the Secretary of Labor; the Acting Assistant Secretary for Occupational Safety and Health; state-operated program representatives; and others, upon request. If you have any questions on this report, please contact me on (202) 512-7014. Staff who contributed to this report are listed in appendix IX.



Carlotta C. Joyner
Director, Education and
Employment Issues

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Abbreviations

AEFA	American Express Financial Advisors, Inc.
AMP	AMP Incorporated
BLS	Bureau of Labor Statistics
CAP	Cooperative Assessment Program
CAT	corrective action team
CNA	certified nursing assistant
CSO	Client Service Organization
MSD	musculoskeletal disorder
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
QIT	Quality Improvement Team
SAFE	Safety Assessment of Facility Excellence
SOCHS	Sisters of Charity Health System
TI	Texas Instruments
UAW	United Auto Workers
VAM	value-added manufacturing

Objectives, Scope, and Methodology

We were asked to (1) identify the core elements of effective ergonomics programs and how these elements are operationalized at the local level, (2) discuss whether these programs have proven beneficial to the employers and employees that have implemented them, and (3) highlight the lessons to be learned from these experiences by other employers and by OSHA. We conducted our work in accordance with generally accepted government auditing standards between June 1996 and June 1997.

To identify the core elements of effective ergonomics programs, we

- reviewed the pertinent literature, including key reports, studies, and guidelines issued by the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health, the American National Standards Institute, and others over the last decade on ergonomics and implementation of safety and health programs; the OSHA 1995 draft ergonomics standard; the American National Standards Institute Voluntary Draft Standard on musculoskeletal disorders (MSD); public comments received in response to OSHA's 1992 Advance Notice of Public Rulemaking for an ergonomics standard; OSHA's settlement agreements regarding MSDs; and other OSHA efforts leading up the draft standard and
- interviewed and obtained data from experts in ergonomics and related fields and representatives from the employer and labor community with experience in implementing such programs.

To identify how these elements were operationalized at the local level and determine whether these programs have proven beneficial, we

- interviewed and obtained data from experts known for their research on the costs and benefits of these programs to obtain information on how employers can measure effectiveness of programs, interviewed Bureau of Labor Statistics (BLS) officials about their efforts to track injuries and costs of those injuries, and obtained information on workers' compensation costs;
- selected facilities of five employers that experts believed to have fully implemented programs and that had achieved reductions in workers' compensation costs resulting from MSDs and conducted case studies between January and February 1997 to obtain information about their experiences implementing these programs;
- administered a results survey to the selected facilities to collect data used by these facilities to measure their success, such as data used to track program progress and information pertinent to the evaluation of these

data, such as workforce size (we did not independently validate these data); and,

- following a detailed protocol that obtained information on how core elements were implemented and that identified results achieved, difficulties in implementing the programs, barriers faced, lessons learned by the employers from their experiences, and employers' views of OSHA and others' roles to reduce MSDS, visited each of these facilities and interviewed facility management, other officials responsible for or involved with the ergonomics program, and staff-level employees; obtained additional results information in order to corroborate information gained during interviews, as well as documentation of the program, training provided, and information provided to employees about the program; and interviewed pertinent officials from the corporate headquarters about the selected facilities' experiences compared with those of the employers' other facilities.

To identify the lessons learned from employer experiences and the implications for OSHA strategies to reduce MSDS, we

- obtained case study employers' views on OSHA's role in reducing MSDS on the basis of employers' experiences;
- interviewed officials in selected states that operated their own safety and health programs—California, Maryland, Michigan, Minnesota, North Carolina, Oregon, Washington, and Virginia—and obtained information about their efforts to encourage employers to reduce MSDS; reviewed the benefits and disadvantages of these approaches in light of our case study findings; and conducted on-site interviews with officials from North Carolina and California to discuss the merits and disadvantages of their particular efforts—an ergonomics resources center in North Carolina and a standard for repetitive trauma in California—to reduce MSDS;
- interviewed various OSHA officials, officials from Labor's Solicitor's office, and other Labor officials to obtain information on Labor's efforts to encourage employers to reduce MSDS; interviewed OSHA officials in Maine to obtain information on the merits and disadvantages of the Maine 200 program; and reviewed the status of Labor's past efforts to reduce MSDS, including challenges by employers of Labor's use of the general duty clause for MSDS and of other OSHA programs; and
- reviewed results with several panels of business and labor representatives and noted experts in the field of ergonomics.

Selection Process Used for Case Study Facilities

Through interviews, a review of the literature, and requesting nominations using trade association bulletin boards, we identified 132 employers that experts believed had made gains in reducing workers' compensation costs associated with MSDs. We used a multitiered screening process to select the five case study facilities.

We had decided that three of our five case studies would be in the manufacturing industry since the manufacturing industry has had the longest experience with MSDs. BLS 1994 data reported this industry had the highest number of occupational injuries and illnesses involving days away from work for repetitive motion, and OSHA had targeted sectors of this industry in the early 1990s for the presence of ergonomic hazards. We decided that the other two case studies would be in industries where concerns about emerging ergonomic hazards were increasing. BLS 1994 data showed that other industries (such as services, retail trade, and communications) known for office environments and the use of computers were reporting high rates of illnesses due to repeated trauma, and interviews with experts and a review of the current articles in the press revealed increasing concerns about hazards in the office environment. There was also concern about the hazards in the health care industry; in fact, in 1996, OSHA instituted an initiative to provide training to nursing homes to reduce injuries. As a result, we decided the other two case studies would include an employer whose employees worked largely in an office or computer environment and an employer in the health care industry.

We categorized the 132 nominations by manufacturing and other industries. Focusing on the nominations in the manufacturing industry, we narrowed the selection to 25 employers on the basis of the data available at that time about the employer's program; general knowledge of the employer's safety and health practices; and other factors, such as whether these employers had already been subjects of other case studies. We discussed each of these 25 employers and then, through a multivoting approach, narrowed the selection to 11 employers that we would contact for further information. We followed the same procedure for the nominated employers in the other industries and narrowed the selection to 11 employers that we would call for additional information.

We then attempted to contact the headquarters office of each of these employers and, using a screening protocol, obtained basic information about program implementation and results. We asked for additional information to allow us to make a final selection, including whether these

employers used data to track their programs' success, whether they believed the program was fully implemented, and any results data that had already been collected.

Given the results of the screening protocols and information subsequently provided by these employers, including their willingness to participate, we selected five employers for our case studies: American Express Financial Advisors (AEFA), AMP Incorporated (AMP), Navistar International Transportation Corp. (Navistar), Sisters of Charity Health System (SOCHS), and Texas Instruments (TI). We asked each of these employers to nominate a facility that it felt had the most fully implemented program.

Review of Case Study Results

Our work is based predominantly on case studies of five employers that believe their programs are effective at reducing workers' compensation costs for MSDs. It was not possible for us to discern whether the characteristics of effective programs are unique to these programs. The information we present is not generalizable to the employer community as a whole.

We reviewed the findings of our case studies with representatives from the employer, labor union, and academic communities who were knowledgeable about ergonomics and worksite ergonomics programs to gauge the plausibility of the information we collected. The first panel, held in San Jose, California, on March 18, 1997, was cosponsored by the Silicon Valley Ergonomics Institute, which is part of San Jose State University. The business panel members were predominantly high-tech computer manufacturers who had experience with or were interested in implementing ergonomics programs. Medical practitioners and researchers also sat on this panel. The second panel was held on April 8, 1997, in Washington, D.C., with members of the Center for Office Technology, which is a trade association representing employers in the manufacturing, communications, and other industries. The third panel was held on April 15, 1997, in Alexandria, Virginia, with selected members of the National Coalition on Ergonomics. We also reviewed our findings with a labor union panel on May 15, 1997, that consisted of employee representatives from the manufacturing, construction, and service industries, among others. These panelists said our findings regarding the level of effort being made by employers to identify and address MSDs, the results of the efforts, and the issues regarding the difficulty of measuring program effectiveness were generally consistent with their experiences and knowledge about employers' current efforts to implement worksite

ergonomics programs. We also provided the draft report to a selection of representatives from business, labor, and academia for their review and comment and incorporated their comments as appropriate. The following employers, unions, and associations were represented in these panels or reviewed our draft report.

AFL-CIO
American Federation of Government Employees
American Federation of Musicians
Apple Computer, Inc.
Association of Flight Attendants
AT&T
Auburn Engineers
Bank of America
Bell Atlantic
Center for Office Technology
Center to Protect Workers' Rights
CIGNA Corporation
Communication Workers of America
Environmental and Occupational Risk Management
Peter Estacio, Ergonomics Consultant
Ford Motor Company
General Motors Corporation
Hewlett Packard
IBM
Keller and Heckman
Massachusetts Coalition for Safety and Health
MCI
NCR Corporation
Newspaper Association of America
Palo Alto Medical Center
San Jose State University
Semiconductor Industry Association
Service Employees International Union
Silicon Graphics
Silicon Valley Ergonomics Institute
Sports and Occupational Medicine Association
3Com Corporation
3M
Transport Workers Union
Travelers Property Casualty
Union of Needle Trades, Industrial, and Textile Employees

United Auto Workers
United Food and Commercial Workers
USAA

**Issues to Consider
Regarding Data for
Case Study Employers**

Significant differences in the data provided by the case study facilities make comparison among the facilities inappropriate. For example, data presented for each of the facilities vary depending upon when the facility believes the program was fully implemented (according to its own definition of what constitutes “fully implemented”) and the availability of data. We made every effort to present cost and injury- and illness-related data starting with the year prior to the program’s full implementation through 1996 in order to show changes at the facility during the program’s operation. We worked with each of these facilities to agree upon a date that could be appropriately used as the year before the program’s full implementation and obtain the appropriate data. However, in some cases, appropriate data were not available, and we were unable to present data prior to the program’s full implementation. Table I.1 shows the years the programs were fully implemented at the facilities and the resulting years used for the data.

**Appendix I
Objectives, Scope, and Methodology**

Table I.1: Years Facilities' Programs Were Fully Implemented and Years of Data Used

Case study facility	Year program fully implemented	Years of data used
AEFA	1993	1992-96 ^a
AMP	1993	1993-96 ^b
Navistar	1994	1993-96
SOCHS	1994	1994-96 ^c
TI	1992	1991-96

^aThe "OSHA 200 log" is the form used by most employers to record work-related injuries and illnesses that require more than first aid. AEFA is not required by law to maintain the OSHA 200 log but does so because the facility is included in the employer universe for BLS' Occupational Injury and Illness Survey, which is based on the OSHA 200 log data. Officials said no OSHA 200 log data are available prior to 1994, nor are any data available on work hours, which are necessary to compute specific injury and illness rates. As a result, OSHA 200 log data are not included in this report for AEFA. Also, workers' compensation data are categorized by policy year rather than calendar year. For example, policy year 1991 is from Sept. 30, 1991, through Sept. 29, 1992. For purposes of this report, we refer to policy year 1991 as "1992," policy year 1992 as "1993," and so on.

^bAMP workers' compensation data for 1992 (the year of full implementation) are not comparable with data for later years. As a result, we did not use 1992 workers' compensation data, nor did we use available injury- and illness-related data from the OSHA 200 log for that year.

^cWorkers' compensation data for SOCHS are not available for 1993 because it was insured through a carrier for the majority of 1993 and only has information on premiums paid. As a result, figures based on workers' compensation data use 1994 as the base year. However, injury- and illness-related data from the OSHA 200 log were available for 1993, the year before the program's full implementation. Because there were so few years' data available for workers' compensation costs, we decided to use OSHA 200 log data starting in 1993. SOCHS officials said that, in some cases, early years of data (such as for work hours and numbers of claims) have been estimated.

Case study facility data also cannot be compared because each facility tracks different categories of injuries, illnesses, or both as MSDs at their facilities. Table I.2 shows the categories used by the facilities.

**Appendix I
Objectives, Scope, and Methodology**

Table I.2: Categories of Injuries and Illnesses Tracked as MSDs at Case Study Facilities

Case study facility	Injuries and illnesses tracked
AEFA	Computer, mouse, and other repetitive motion injuries ^a
AMP	Sprains and strains in which a cause of injury is lifting, repetitive motion, pushing, or pulling
Navistar	Injuries due to repetitive trauma, carpal tunnel syndrome, thoracic outlet syndrome, tendinitis, epicondylitis, rotator cuff injuries, torn meniscus, and acute strains to the back
SOCHS	Cumulative trauma injuries (for example, carpal tunnel syndrome and overuse syndrome), tendinitis, epicondylitis, and back injuries ^b
TI	Injuries from repetitive motion and body stress (from performing lifting tasks)

^aOther repetitive motion injuries do not include stress, strain, or lifting injuries because the program is just starting to address these types of injuries.

^bOfficials said not all back injuries that occur are considered MSDs for the purposes of the ergonomics program. For example, in many cases, injuries have been caused by trips and falls on icy parking lots. As a result, including all back injuries for the purposes of this report may be overestimating the number that are due to ergonomic hazards.

Profiles of Selected Problem Jobs at the Case Study Facilities

AEFA: Improving Workstations for Employees Providing Client Services

The Problem:

Employees in the Client Service Organization (CSO) of AEFA provide administrative services to financial advisers as well as to individuals who purchase AEFA's financial services. Various employees in this work unit are on the telephone or working on computer terminals much of the day. Employees are given two scheduled breaks during the day and are held to production goals. These employees had one of the highest rates of MSDs at AEFA.

Controls Implemented:

Larger monitors were provided to each employee to reduce eye strain. A variety of standardized ergonomic accessories was also provided to employees, including ergonomic chairs, keyboards with built-in wrist rests, and head sets to relieve neck strain while talking on the telephone. In addition, corner work surfaces were added to workstations to create a continuous work surface and reduce the amount of reaching and awkward postures for these employees. Some employees were given an articulating arm rest to provide additional support to the forearm for mouse use. Because employees are frequently moved from one location to another, a database of employee "profiles" (for example, preferences for appropriate workstation setup) is kept by the ergonomics staff. This means that when employees move, their new workstations can be easily personalized.

AMP: Reducing Hazards in the Re-reeling Department

The Problem:

In this department, connectors and terminals that have been manufactured at the facility are wound onto reels for packaging and distribution. This department has been the focus of the ergonomic team's efforts because of the historically high numbers of MSDs reported here. The team identified a number of risk factors associated with the jobs in this department, including significant vibration and tension on employees' wrists to maintain the tension needed to accurately wind the connectors and terminals onto the reels; repetitious leg extensions required to stop the reeling machine; awkward reaches that were necessary to insert paper between layers of connectors and terminals as they were wound onto reels; and awkward reaching and repetition associated with manually tearing or ripping this paper.

Controls Implemented:

After videotaping these jobs and collecting information from employees, the team developed and implemented a number of controls, including adding a mechanical arm to maintain the reeling tension; adopting a smaller, lighter reel with slots cut into it for easier handling (or loading older reels only half-way); developing a prototype paper cutoff device to tear the paper; and providing more comfortable chairs and surrounding flat surfaces to encourage better posture and less reaching. While some discomfort and injuries have been reduced through these improvements, additional improvements are still needed because high numbers of MSDs continue to be reported here, compared with other departments. The team has requested assistance from the engineering group to automate the paper cutoff device. The facility also rotates workers in this department every 2 hours so they are not reeling the same product.

Navistar: Redesigning the Windshield Installation Process

The Problem:

In this process, employees attach the glass windshield to the cab of a truck while it is coming down a moving assembly line. In the past, employees had to reach as high as 6 to 7 feet off the ground (because of the height of the cab), while lifting a piece of pre-cut glass to fit it into a designated cut out area of the cab. Rubber insulation had already been placed around the perimeter of the cut out area of the cab, and employees had to exert a great deal of wrist and arm strength to attach the glass to the rubber insulation. Employees complained of discomfort resulting from the reaching and force required to keep the glass in place. Several injuries were reported, and employees usually transferred to other jobs when possible. Navistar also experienced leakage and other quality problems because employees were unable to put the glass in properly.

Controls Implemented:

Because the assembly line moved, it was not possible to build a platform for employees to stand on while attaching the windshield. As a result, when the facility was planning a schedule change, the facility decided to address the problems with this job. After brainstorming several controls, the facility decided to put the rubber insulation on the windshield glass instead of on the cut out area of the cab. It also decided to put an employee inside the cab to help hold the glass while it was being attached to the cut out area of the cab. Although employees still have to reach, these controls reduced the force employees had to use to fit the windshield glass into place. Navistar officials said this control is common in the industry and was actually used by Navistar in prior years on other product lines. After these actions were taken, injuries and reports of discomfort decreased, and warranty claims for leakage and other quality problems also declined.

SOCHS: Purchasing Automatic Lifts for the Nursing Home

The Problem:

In the nursing home, the certified nursing assistants (CNA) are the employees primarily responsible for transferring residents from their beds to chairs, toilets, or other locations. Although the CNAs had access to automatic lifts ("Hoyer" lifts) that they could use to move the residents, the employees were not using these lifts because they thought the lifts were bulky and difficult to use. Instead, the CNAs were using a traditional "two-man" manual lift and, as a result, were experiencing a significant number of back injuries. These back injuries were a predominant reason that SOCHS was selected to participate in the Maine 200 program.

Controls Implemented:

SOCHS selected several different types of automatic lifts and brought them into the facility for a trial period, during which time employees were encouraged to test them and provide feedback on which ones they liked. SOCHS subsequently bought 14 lifts of two different kinds--one that brings residents from a sitting position to a standing position and one that brings residents from a supine position to a standing position. Proper operation of these lifts still requires two employees--one to operate the lift, the other to secure the resident. As a result, in the beginning, some of the CNAs resisted using these lifts because they thought the traditional two-man lift was faster. A contributing problem was that there were not enough lifts, so if the nearest one available was not in working order, the CNAs would resort to a manual lift. The facility now has 15 lifts--one for every department and a spare. The facility also is offering training to CNAs on how to use these lifts. SOCHS officials said these lifts have been very effective in reducing back injuries and that several other departments are considering obtaining these lifts to reduce injuries and discomfort.

TI: Improving Workstations for Manual Assembly of Microwave Circuit Boards

The Problem:

Manual assembly of microwave circuit boards involves hand-intensive work to prepare and weld extremely small circuits. Employees were experiencing back and shoulder discomfort from working over microscopes and wrist discomfort from the strain associated with holding down the circuit boards while they worked on them. Employees were exposed to particular risks, such as awkward postures, force, and repetition, when using hand tools.

Controls Implemented:

With the help of in-house engineering staff, adjustable tables were brought in so that employees could easily manipulate the height of the table they were working on. Additionally, foam was placed under and around the circuit boards to raise them and make close-up work easier. To increase comfort, corners of the workstation were padded and rounded off, and adjustable scopes were provided, including "ergoscopes" specifically designed for user comfort. Special tables for microscope use were also brought in because another TI facility had found they worked well and reduced strain. Employees now also take 10- to 15-minute stretch breaks twice a day. The work area where these controls were implemented realized a major reduction in overall injury and illness rates, which was attributed to the elimination of all recordable MSDs during the 6 months prior to our visit. The welding job itself, however, continues to pose hazards despite these engineering controls. As a result, the facility has implemented administrative controls, such as rotating welders to other jobs during the day, to reduce their exposure to hazards.

The Ergonomics Program at AEFA Headquarters, Minneapolis, Minnesota

Background

Formerly Investors Diversified Services, Inc., American Express Financial Advisors, Inc., was acquired by American Express in 1984 and provides financial planning services. AEFA is headquartered in Minneapolis, Minnesota, and employs about 8,000 nonunion employees in about 250 locations throughout the country.⁵⁰ Most of the employees work at the headquarters office, and the majority of AEFA employees work in an office environment using computers, so they face similar types of hazards. To date, the ergonomics program has focused on these employees but is now beginning to study more closely employees who face lifting and other manual material handling hazards.

The culture of AEFA has influenced program implementation. AEFA's efforts began many years ago as a commitment to improving employee comfort and satisfaction. AEFA officials told us they believed a significant portion of their employees' injuries, and resulting workers' compensation costs, was MSD-related, caused by repetitive motion, stress, strain, and lifting. AEFA has made a significant investment in training employees in the office environment to increase their awareness of hazards and the need for early reporting. Recent managerial and organizational changes, such as changes in program staff and the results of decisions by corporate management, pose new challenges for the continuity of the program.

Program implementation also needs to be considered in light of the local facility characteristics. AEFA as an organization has experienced significant growth in staffing levels since 1988. Additionally, many of AEFA's employees work in the Client Service Organization (CSO), which is one of the most computer- and phone-intensive units in AEFA. Employees in this unit are responsible for responding to client questions or problems, accessing information from their computers, and recording information in manual logs. Some employees spend 3 to 4 hours a day answering about 30 to 40 telephone calls, while others average about 6-1/2 to 7 hours per day on the telephone answering 80 to 100 calls. Issues related to workload and increased staffing levels present special challenges to the program; officials told us these issues are more difficult to address than are physical workplace hazards.

⁵⁰There are also about 8,000 to 10,000 independent contractors (called financial advisers) who sell AEFA's services. These individuals are not considered AEFA employees.

Initiating the Ergonomics Program at AEFA

The current ergonomics program at AEFA was fully implemented in 1993, when a full-time ergonomist and other ergonomics staff were hired, training was provided to all employees, and an effort was made to infuse ergonomic principles into equipment purchase and design. The current program has evolved from a decade of effort originally based on the goal of making AEFA “the best place to work” by removing employee discomfort and reducing workers’ compensation costs associated with MSDs.

AEFA started to address ergonomics in 1986, when it established an ergonomics task force and began conducting a limited number of workstation evaluations. In 1990, it hired a consultant to provide ergonomics awareness training to selected departments that faced ergonomic hazards. AEFA’s safety department began to receive employee complaints about physical discomfort and requests to evaluate their workstations to improve the layout, which officials believed was at least partly the result of this training. AEFA staff tried to accommodate these requests but were unable to keep up with the demand. Additionally, in 1992, workers’ compensation costs for MSDs increased significantly. Then, after the 1993 budget had been approved, the director of support services decided to establish an ergonomics function in his department. Assuring top management that this action would not affect budget or personnel ceilings, he reallocated a portion of his furniture budget to support a full-time ergonomist to be responsible for the program. This ergonomist was hired in 1993 and took the lead in implementing the program.⁵¹

A major staff reorganization also provided the opportunity to develop an ergonomics function. This reorganization required a physical relocation to new space and new furniture. In determining what type of furniture to obtain, the purchasing, real estate, and facilities departments believed that, if AEFA could buy furniture that could be easily adjusted for different employees, AEFA could reduce the costs associated with retrofitting workstations every time employees moved. Because AEFA employees move offices or work locations quite frequently (referred to as the “churn” rate), costs associated with these moves can be significant. This adjustability would also make the furniture “ergonomic”; that is, it could be appropriately adjusted for each employee and provide additional savings from reduced discomfort and reported injuries.

⁵¹This employee was selected to be the ergonomist for American Express; a new ergonomist was hired for AEFA.

Structure and Core Elements of the Program at AEFA

AEFA's ergonomics program is led by the ergonomics staff (the ergonomist, the ergonomics specialist, and a half-time administrative assistant) and is currently located in the support services department. Various other departments work with the ergonomics staff (such as the real estate, purchasing, facilities, and risk management departments) to design equipment standards, purchase equipment, adjust workstations, and track workers' compensation claims and costs.

Management Commitment

Management commitment to the ergonomics program at AEFA is demonstrated in a number of ways. AEFA has no formal written program laying out the elements of its ergonomics program. AEFA officials told us a written program is not as key to daily program operations as is the information disseminated during the training and discussed in the employee guidelines, which are provided to each employee (see the training and education section below).

Primary among the ways AEFA has demonstrated management commitment has been the assignment of staff—the ergonomist, the ergonomics specialist, and the administrative assistant—to be responsible for the program. The ergonomics staff identifies problem jobs, conducts workstation evaluations, develops controls, provides training to employees, and tracks information about what training and services employees have been provided. Various employees we interviewed said they knew whom to call when they had a question or complaint; the response was quick; and, in most cases, necessary changes were made in a reasonable period of time.

AEFA has also integrated ergonomic principles into the purchase and design of equipment. For example, AEFA assembled a team of employees (for example, the ergonomist, officials from the real estate department, and representatives from various on-line jobs) to select chairs to offer to all employees. This team reviewed available information and selected several potential chairs, which employees then tested and rated. On the basis of employee feedback and other criteria (such as delivery time and warranty), the team selected for purchase the two highest rated chairs. In so doing, AEFA reduced purchasing costs, by buying in large quantities, as well as increased employee comfort. In much the same manner, a team was assembled to design and select new adjustable furniture for private offices. The team, which included the ergonomist, developed specifications for the furniture, then the purchasing and real estate departments worked with a vendor to develop furniture that met these

specifications. In the end, AEFA was able to buy this adjustable furniture for about the same price as other furniture, while it also increased comfort, reduced future injuries, and now expects to save additional resources from not having to retrofit furniture every time employees relocate.

AEFA also has invested significant resources to train employees. Office ergonomics training is strongly encouraged, and employees generally are not able to have their workstations adjusted by the facilities department without first attending training. Additionally, several of the line managers we spoke with said they encourage their employees to go to ergonomics training if they believe any productivity or quality problems may be due to ergonomic hazards. Moreover, many of the employees we spoke with told us they feel their managers take training seriously and encourage them to attend training and obtain the necessary ergonomic equipment to improve comfort. This training is offered every week for 1-1/2 hours—more time than is devoted to any other subject of training, according to AEFA officials. AEFA officials reported that about 70 percent of the headquarters staff have received training since 1993.

Employee Involvement

AEFA does not use employee committees to identify problem jobs or develop controls. Instead, AEFA has established procedures that enable employees to directly access services. For example, at AEFA, employees are encouraged to attend the weekly ergonomics training, which provides employees information about office ergonomics and how to maintain comfort and health while working on computers. Additionally, during training, employees are measured for appropriate workstation setup (for example, chair height when sitting) and asked to complete an anonymous discomfort survey so that the ergonomics staff can obtain information on the extent to which employees are experiencing discomfort on their current jobs, and on what body parts they are experiencing that discomfort. This survey has also been provided to a random sample of employees annually since 1993. The results of this survey are used to track program performance and, in some cases, identify problem jobs. Additionally, at the end of each training session, employees are asked to provide feedback on the quality of the training received and whether they anticipate making changes to their daily work as a result of the training.

Employees also have direct access to ergonomic services through a process that allows them to order computer accessories (such as foot rests, wrist rests, document holders, and monitor risers) from a standard

listing. Costs for these accessories are not charged back to the employees' home work area; instead they are paid for by the real estate department. Employee requests also trigger workstation evaluations, and, during these evaluations, employees also are asked for their input about controls they believe would be appropriate. Employees we interviewed acknowledged their responsibility to look for ergonomic hazards and apply ergonomic principles to their work habits.

Identification of Problem Jobs

AEFA identified problem jobs primarily on an incidence basis. In other words, most of AEFA's efforts result from a report of injury or discomfort or an employee request for assistance based on other reasons.⁵² AEFA officials said reports of discomfort and employee requests account for the majority of workstation evaluations performed. On a more proactive basis, AEFA strongly encourages any employee who is relocating to attend training in order to be measured so the facilities department can set up the employee's new workstation appropriately. The ergonomics specialist also regularly walks the floor to look for potential problems. Moreover, officials told us that AEFA builds in what it learns to furniture and equipment design.

At AEFA, a simple system has been established to ensure that a problem job is identified when an injury is reported. When an employee reports an injury to the risk management department, the department fills out a "First Report of Injury" form.⁵³ If the risk management department determines the injury was due to ergonomic hazards, it forwards the form to the ergonomics staff. After receiving the form, the ergonomics staff contact the employee (after the employee has returned to work, if appropriate) to schedule a workstation evaluation.

There is also an informal system to identify problem jobs when no injury has occurred but employees are feeling discomfort or want an evaluation. Employees can request a workstation evaluation through a phone call or an E-mail message to the ergonomics specialist, or by scheduling the evaluation on the ergonomics specialist's electronic calendar. In some instances, AEFA has also used the results of the discomfort surveys to identify problem jobs.

⁵²For example, a supervisor may suggest that a new employee request a workstation evaluation to address productivity or quality problems.

⁵³This form lists six categories of nature of injury: repetitive motion; slips, trips, and falls; cuts; stress; strain; and lifting. Back injuries are classified according to their cause.

The ergonomics staff respond to every request for an evaluation (whether due to an injury, report of discomfort, or other request for assistance) within a few days, typically on a first-come, first-served basis. Several employees we spoke with said the ergonomics staff usually perform evaluations within 48 hours of the request.

Analyzing Problem Jobs and Developing Controls

AEFA officials emphasized that, in most cases, they do not do job analysis but instead perform workstation evaluation, and the process used is simple and informal. The process used to develop controls is also typically informal, relying on in-house resources, such as the employees doing the work or staff in the facilities department. AEFA has implemented a mix of controls, focusing on those that increase employee comfort while using computers. Appendix II profiles some of the controls AEFA has implemented.

Process Used to Analyze Jobs

At AEFA, workstation evaluations are typically performed rather than job analysis. AEFA officials said the reason for this is that they focus primarily on identifying what changes need to be made to the physical characteristics of a workstation to make the employee more comfortable performing the tasks. In so doing, certain risk factors (such as awkward postures) may be eliminated, but others (such as repetition) may remain. A job analysis would assess whether the actual job tasks should be changed to reduce hazards associated with that particular job.

The ergonomics specialist conducts about 10 workstation evaluations a week during two set periods (at other times, if neither of these is convenient for the employee). During these evaluations, which take about 30 minutes, the ergonomics specialist interviews the employee, watches him or her perform the job, and determines whether he or she is performing any activities outside of work that may be contributing to the discomfort or injury. When the evaluation is triggered by an injury, the ergonomics specialist adheres to a questionnaire that collects information about the job (such as whether the workstation is shared, what types of tasks are performed, and how often tasks are performed) as well as about the workstation itself (such as height of the work surface, location of the keyboard and mouse, and height of the monitor). The questionnaire also asks for information about the presence of risk factors for particular parts of the body. As a part of this questionnaire, the employee is asked to provide information about what tasks he or she believes contributed to the discomfort. A less detailed version of this questionnaire is used for evaluations triggered by reports of discomfort or requests for assistance.

In some cases, AEFA has done job analysis for problem jobs identified through the discomfort survey. Officials said a job analysis studies the actual tasks of the job and work organization and determines whether actual job tasks should be changed to reduce hazards. AEFA analyzed the CSO job categories several years ago, a task that included interviewing the employees working in these positions, evaluating the job tasks, and determining what type of equipment and furniture would be best suited for these tasks. Additionally, the ergonomics staff is currently looking for controls that reduce or eliminate the hazards associated with a mailroom job that requires lifting often heavy packages out of a large mail bin. Officials said they would like to do more job analysis so that problem jobs could be addressed on a broader basis. However, this would require additional resources that are not necessarily available.

Process Used to Develop Controls

AEFA officials described their process for developing controls for problem jobs as “informal” and using in-house resources. AEFA takes this approach to have the resources available to provide some type of control for every job it evaluates.

The ergonomics specialist uses the information obtained during the evaluation to develop and implement controls, often brainstorming with the affected employee or relying on in-house expertise. Because most employees covered by the program face similar computer-related hazards, in many cases, controls have been developed by first determining whether employees have the equipment available from the approved computer accessories listing. If necessary, AEFA works with its real estate and purchasing departments to design or obtain a piece of furniture or equipment that is not already available in-house. If the ergonomics specialist recommends controls such as taking rest breaks, the employee and supervisor are supposed to work together to achieve this. If adjustments to the employee’s workstation are required, the ergonomics specialist will put in a requisition to the facilities department to adjust the workstation, which is typically done within a week.

To ensure that these controls are effective over the long term, AEFA has developed a database that contains the results of each workstation evaluation performed. Each employee’s “profile” (that is, workstation measurements, preferences such as left- or right-handed mouse, appropriate monitor height, and equipment used) is kept in this database; currently the database contains about 4,000 employee profiles. The availability of this information means that the facilities department can set up an employee’s workstation correctly the first time when an employee

relocates. This ensures that employees continue to work in appropriately designed workstations and eliminates “post-move” adjustments (readjusting the workstation after the employee has moved in).

Officials said they follow up if employees continue to feel discomfort or if injuries continue to be reported. For workers’ compensation cases, the ergonomics specialist follows up monthly to update the questionnaire used during the first evaluation. This iterative approach is important when financial or organizational issues affect the implementation of controls. For example, a number of employees still do not have adjustable furniture, because it is not feasible from a cost perspective to replace all of the existing furniture at once. Instead, AEFA is gradually providing this furniture to more and more employees.

Types of Controls Implemented

AEFA has implemented a mix of controls, primarily focused on improving the comfort of employees working with computers. In many cases, these controls can be considered “low-tech” engineering controls, since they did not change the job or the employee’s tasks. For example, AEFA has provided ergonomic chairs to employees and adjusted workstations (for example, adjusting work surfaces, moving equipment, repositioning monitors, or providing corner work surfaces⁵⁴). AEFA has also provided articulating arm rests to selected employees. These arm rests fasten to the edge of the workstation and allow the employees to rest their forearms on a moveable padded support while using the mouse.

AEFA has also used administrative controls, such as encouraging employees to take stretch breaks and providing information and training. For example, AEFA published guidelines that provide information about the best colors to use on monitors for the best viewing. Many of the computer accessories supplied serve as personal protection equipment—such as wrist rests, foot rests, and holders to support documents referred to while keying.⁵⁵ AEFA has also provided information to managers about the processes they should follow to ensure employees receive training. However, several employees said workload demands and cubicle size affected their ability to implement certain ergonomic practices, such as taking breaks or putting their monitors in an appropriate location.

⁵⁴A corner work surface creates a diagonal surface on which employees can place their keyboards, providing employees additional comfort while using the computer and increased access to items on either side of it.

⁵⁵AEFA officials were not sure how to categorize these computer accessories. One official said they may be a “blend” of administrative and engineering controls. For purposes of presentation, we are categorizing these items as personal protective equipment because they are similar to padded gloves or wrist supports, in that they provide a barrier between the employee and the hazard.

Training and Education

Training is the cornerstone of AEFA's program. Part of the reason training plays such a major role in the program is that most of AEFA's headquarters employees work in an office environment and therefore face similar computer-related hazards. Office ergonomics training is taught by the ergonomics specialist for 1-1/2 hours every Thursday; this module has also been built into orientation training for selected employees. The training provides employees information on what they should do to make their workstation more comfortable, including how they should adjust their chairs and monitors, how they should use the phone, and the importance of reporting symptoms and pains early. During this training, employees are also measured so their workstations can be set up properly and are asked to fill out the discomfort survey as well as the feedback survey on the quality and effectiveness of the training. AEFA has also recently begun to provide training on proper lifting techniques to employees who face hazards associated with manual material handling.

To supplement this training, AEFA has provided written employee guidelines and a video, which cover much of the same information as is provided in the training. The ergonomics specialist also uses E-mail and other electronic media to send out messages about ergonomics and the availability of training.

Medical Management

AEFA's ergonomics program has established links with its medical management staff (in-house risk management officials as well as local health care providers) to ensure early reporting and prompt evaluation of injuries. Through the training and discomfort surveys discussed above, AEFA emphasizes the importance of early reporting. The risk management department, which is responsible for tracking workers' compensation costs, can also trigger a workstation evaluation by providing the First Report of Injury form to the ergonomics staff when reported injuries are believed to be due to ergonomic hazards.

To ensure prompt evaluation, AEFA has identified local health care providers with expertise in diagnosing and treating MSDs that employees can use if they desire.⁵⁶ AEFA has also encouraged these health care providers to visit the facility and become familiar with AEFA's operations to understand what AEFA employees do and how AEFA can accommodate any medical restrictions.

⁵⁶While employees in Minnesota are allowed to select their own health care providers, AEFA officials said that, in most cases, employees prefer to use the providers identified by AEFA because these providers are knowledgeable about MSDs and typically can better serve the employees.

AEFA also uses transitional or restricted-duty assignments to return employees to work as soon as appropriate and follows up on the employees' recovery once they return. AEFA has classified a number of jobs as "temporary modified duty" positions, and officials said they have had a positive experience with bringing previously injured employees back to work. If an employee has been out for 10 days, AEFA contacts the health care provider and suggests various light-duty jobs the employee might be able to do. Once the employee has returned to work, the ergonomics specialist conducts a workstation evaluation to ensure that work conditions support whatever restriction the employee may have. AEFA allows employees a 12-week transition period to ease back into the job requirements, during which time the ergonomics specialist conducts monthly follow-up. If it is determined that the employee cannot perform the job tasks anymore, AEFA works with the employee to find another job, within AEFA if possible.

Results and Issues Related to Program Performance

AEFA officials said they are pleased with the results of the program, which they believed has helped reduce workers' compensation costs for MSDs and improve employee productivity and morale. However, they raised several issues that complicated their ability to tie the results directly to program efforts and that therefore should be considered when reviewing these results.

Reductions in Workers' Compensation Costs Associated With MSDs

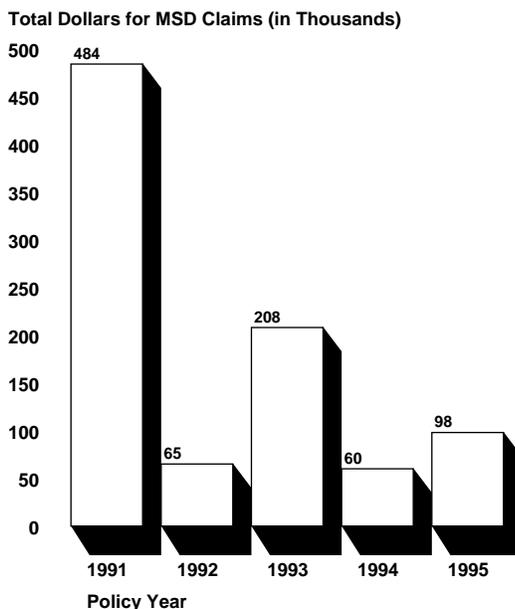
As shown in figure III.1, AEFA reduced its costs for MSD workers' compensation claims by about 80 percent (from about \$484,000 to about \$98,000) between 1992⁵⁷ and 1996. Because the program has to date focused on employees who use computers in an office environment, AEFA tracks MSDs by looking at "computer and mouse injuries" and other "repetitive motion injuries not related to computer use."⁵⁸ Additionally, the officials said the reduction in the average cost incurred for MSD claims (from about \$9,100 in 1992 to about \$1,700 in 1996, as shown in fig. 3) is an indication of AEFA's emphasis on early reporting and treatment of injuries before they become serious.

⁵⁷As more fully discussed in app. I, in most cases, we present data from the year before the full implementation of the ergonomics program through 1996 in order to show changes that occurred during the years of the program's operation. Since AEFA's program was fully implemented in 1993, we present data beginning in 1992.

⁵⁸The "other" repetitive motion injuries at this time do not include those associated with stress, strain, and lifting. Officials did not believe it was appropriate to include these injuries in their results data because the ergonomics program has only recently begun to focus on these hazards.

Appendix III
The Ergonomics Program at AEFA
Headquarters, Minneapolis, Minnesota

Figure III.1: Workers' Compensation Costs for MSDs at AEFA, 1992-96



Notes: AEFA's data system is based on "policy years." A policy year begins on Sept. 30 and ends on Sept. 29. In other words, policy year 1991 is the period from September 30, 1991, through Sept. 29, 1992. As a result, for this discussion, we refer to policy year 1991 as "1992," policy year 1992 as "1993," and so on.

Data include headquarters and field staff, since data are not available for headquarters employees only.

Source: AEFA's workers' compensation database.

AEFA officials said several factors have affected AEFA's ability to reduce costs further and account for some of the yearly fluctuations. For example, the spikes in workers' compensation costs for MSDs in 1994 and 1996 (that is, policy years 1993 and 1995) may be the result of the emphasis on closing open cases. Additionally, there is often a lag between the time an injury occurs and when the costs appear. Costs also are significantly affected by any big claim, as is evident in 1996 (policy year 1995), when several major cases required surgery. Additionally, AEFA officials said the increase in claims in the first year after the program was fully implemented may be at least partly attributed to increased employee awareness. AEFA has also experienced a significant increase in staffing levels since 1988 as well as increased workloads. Officials said that the

reductions AEFA has achieved should be considered in light of these factors.

AEFA officials also said there is some question about what types of injuries should be considered MSDs. As long as there is no agreed-upon definition, it is sometimes difficult to know what to track and how to distinguish MSDs from other injuries. Although ergonomics staff rely on their workers' compensation database rather than on the OSHA 200 log data, they said the database in the past has not allowed them to break out data by geographic location or department or to track lost workdays. Working with its insurer, AEFA enhanced the database so that, starting in 1997, it now provides this information.

Reductions in Injuries and Illnesses According to the OSHA 200 Log

As a financial institution, AEFA is not required to maintain the OSHA 200 log. However, AEFA's safety department does keep the OSHA 200 log voluntarily because AEFA is among the universe of employers included in BLS' Survey of Occupational Injuries and Illnesses, which collects data (from the OSHA 200 log) about workplace injuries and illnesses.⁵⁹ However, the ergonomics staff at AEFA did not use the OSHA 200 log to track program progress for several reasons. First, because the ergonomics staff were not responsible for monitoring the log, they were uncertain of how the data were input onto the log. Second, ergonomics staff believed it was more efficient to use the workers' compensation database, since it allowed ergonomics staff to track injuries, claims, and costs. Finally, the safety officials who maintained the log said there is confusion about how to categorize ergonomically related injuries; for example, back injuries are not typically coded under the repetitive trauma category.

Improvements in Productivity, Quality, and Morale

Facility management officials said the ergonomics program has contributed to increased productivity and quality of work as well as employee morale. AEFA's annual discomfort surveys have shown significant declines in the number of employees reporting discomfort in numerous body parts, including head, neck, back, shoulders, elbows, and wrists, between 1993 and 1996.⁶⁰ Furthermore, according to results from numerous feedback surveys filled out by employees who have attended

⁵⁹Because OSHA 200 data were not available before 1994 and the facility did not maintain the data necessary to calculate injury and illness incident rates, we did not include AEFA's OSHA 200 log data in this report.

⁶⁰For example, in 1993, about three-quarters of employees surveyed reported headaches and discomfort in the neck and back. In 1996, only about one-third of surveyed employees reported these symptoms.

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The Ergonomics Program at AEFA
Headquarters, Minneapolis, Minnesota

training since 1994, between 80 and 90 percent of employees believed that learning about ergonomics was an effective use of their time, and most indicated they planned to change some work habits on the basis of information received from the training.

Because AEFA has not, to date, tracked the direct effects of the program on productivity and quality, officials said it would be very difficult to pinpoint any changes that resulted directly from the ergonomics program. However, in an effort to establish whether discomfort affects employee productivity, AEFA has revised its discomfort survey to ask employees the extent to which they believe their discomfort affects their productivity. The ergonomics staff hopes to use these results in future assessments of the ergonomics program's effect on productivity.

The Ergonomics Program at AMP, Electronic Connectors Manufacturing Facility, Tower City, Pennsylvania

Background

AMP Incorporated, which began operation in 1941, is a manufacturer of electrical and electronic connection devices. AMP supplies connectors to a wide variety of industries, including automotive, computer and office equipment, and consumer and home electronics industries. AMP employs 40,800 employees in 212 facilities, with subsidiaries in 40 countries.

The Tower City facility, which began operation in 1972, stamps metals with mechanical presses to form electronic terminals and connectors. The majority of employees are die machinists and mechanics. The dies are metal blocks, shaped through a grinding process, that fit into the mechanical presses for use in stamping connectors into any one of a wide variety of forms, depending upon the particular application of that connector. Current employment at the Tower City facility is approximately 300. None of the workforce is unionized.

AMP's corporate culture allows for a decentralized approach that provides business groups⁶¹ and local facilities flexibility to organize safety and health activities in order to achieve production goals. As a result, a lot of variation in operations exists among facilities, and this is reflected in the ergonomics efforts. This variation in ergonomic programs across facilities is also attributed by AMP management to business conditions, which affect the level of investments for ergonomics, as for any other initiative, and to local cultural and regulatory conditions. For example, facilities located in states where some types of MSDs are not compensable may have less incentive to reduce these injuries.

Initiating the Ergonomics Program at Tower City

The ergonomics program at Tower City was fully implemented as of 1993, when the facility formed an ergonomics team. The team was formed in response to the global safety department's promotion of ergonomics efforts across the company out of its concern regarding rising workers' compensation costs for MSDs. The strategy of the global safety department was to promote and train local ergonomic task teams in each of AMP's facilities.

AMP's ergonomics efforts, including those at Tower City, appear to have been evolving since the late 1980s, when the global safety department began offering ergonomics training courses. Corporate productivity initiatives were also being launched, and business groups across AMP were

⁶¹AMP is organized by business groups. For example, the Tower City facility is part of the Consumer Products Business Group.

forming teams of employees to get them more involved in production activities and to identify production problems.

Structure and Core Elements of the Program at Tower City

The heart of the ergonomics program at Tower City is the value-added manufacturing (VAM) team for ergonomics.⁶² This team is composed of employees from a wide variety of departments—including tool and die making, maintenance, and packaging—and is led by an industrial engineer. The team is responsible for identifying problem jobs and developing controls.

The global safety department serves in a consulting capacity to the different teams and facilities across AMP for all safety and health issues, including ergonomics. The global safety department has a total of nine staff, six of whom are professional staff. In addition, the department provides training and administers the corporationwide safety audits of all facilities, of which an assessment of ergonomic activities is a small part. In addition to global safety staff, there are environmental safety and health coordinators across AMP who report to individual facilities and business groups as well as overseas operations.

Management Commitment

Management commitment to the ergonomics program at Tower City is demonstrated in a number of ways. Primary among them is the assignment of staff—to the ergonomics team—specifically to address ergonomic hazards.

Corporationwide accountability mechanisms are in place in the form of a safety audit, the recent integration of an overall safety goal into AMP's pay-for-performance system, and recommended criteria to help develop performance measures. An AMP-wide safety audit, the Safety Assessment of Facility Excellence (SAFE), helps ensure accountability for the ergonomics program, among other safety efforts, and can be used by facilities to conduct self-assessments of their safety programs. For example, SAFE includes questions on whether an ergonomics team has been established, routine workplace inspections for ergonomic opportunities are being conducted, and specific worksites where MSD risks or symptoms have been identified are being evaluated. Additionally, the 1997 overall safety goal of one accident involving lost or restricted days per 100 employees has been

⁶²The ergonomics VAM team is one of a total of 21 VAM teams and two product-focused teams at Tower City alone. These teams were formed to get employees more involved in production activities, and they operate similarly, using performance agreements as a way to track progress on projects the team decides to undertake.

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integrated into AMP's pay-for-performance system. This goal was based on the experiences of other employers in this industry who are members of the National Safety Council. Finally, suggested criteria or activities, some of which are ergonomic-specific, were recommended by the global safety department to the local facilities to help them develop pay-for-performance measures that are meaningful at the local level and that contribute toward this overall safety goal. An ergonomic criterion, for example, is whether or not ergonomic teams have been recruited and trained at each local facility to evaluate job tasks.

Ergonomic principles are also integrated into the purchasing of tools, equipment, and furniture and the design of new facilities. Tower City works closely with its suppliers to test and evaluate a variety of ergonomic tools and equipment before purchasing these items. For this purpose, Tower City has set up Ergonomic Prototype Work Centers in virtually every work area to test new products and controls, and to obtain employee acceptance of new controls. AMP's corporate facilities services center has developed a catalog of furniture that is modular and adjustable, and global safety has recommended that individual facilities order items from this catalog. In designing a new, larger facility in nearby Lickdale, Pennsylvania, where operations at Tower City and another facility will be combined, focus groups were formed to provide input so that ergonomic principles, among other design considerations, would be addressed.

Resources are also made available for the ergonomics program. The team leader said that most of the team's suggestions for controlling problem jobs are approved at the facility level and that a written justification and approval from a higher level of management are needed only when a capital investment of \$2,000 or more is involved (which is the case for all investments). When developing the cost justification, the ergonomics team routinely includes an estimate of the cost of MSDS should controls not be implemented.

AMP has a written program in the form of a section in its safety manual, although this document is not key to program operations at the facility level because facilities are given considerable flexibility to implement ergonomics programs as they see fit. This section in AMP's "124 Specification" identifies specific areas of responsibility to be assumed by local facilities and various departments to address ergonomic hazards. For example, local facilities are encouraged to perform routine, periodic workplace inspections for ergonomic hazards as part of the facilities' ongoing loss prevention efforts, and the facility services department is

responsible for the selection of adjustable office furniture. In addition, the global safety department is in the process of developing guidelines that include ergonomic activities to help local facilities develop or improve their safety programs.

Employee Involvement

The ergonomics VAM team drives the effort at the Tower City facility. About 12 employees (referred to as “associates”) serve as team members and are responsible for identifying and prioritizing problem jobs as well as developing controls for these jobs. Both the team leader, who is an industrial engineer, and the secretary of the VAM team are elected. One member of the ergonomics team is assigned to each project that the team, after prioritizing, agrees to take on. In this way, projects are “championed” by individual team members. The team meets biweekly during work hours because weekly meetings were found to be too time consuming.

Employees are involved in an ad hoc fashion as well. Any employee can choose to participate on the ergonomics team on a project-by-project basis if, for example, the team is trying to develop controls for that employee’s job. Many employees on problem jobs are interviewed by members of the team who are investigating the problem jobs, and these employees are the source of ideas for many of the controls developed.

Procedures have been established so employees can directly access ergonomic services, although these procedures are very informal at this facility. Employees can request that the ergonomic team look at their job by raising their concerns with a member of the team, their representative on the local safety committee, their supervisor, or their human resources representative. This is done by word of mouth. Although an analysis of the job is not automatically triggered, the job or task is added to a list of problem jobs, which the team then prioritizes. (A discussion of prioritization appears below.) In addition, the ergonomics team leader “walks the floor,” so he is accessible to employees should they be experiencing discomfort. As evidence of employee interest, the team leader said many associates voice their ideas informally for how jobs might be controlled or changed to reduce exposure to ergonomic hazards. The facility also has a suggestion system that awards employees for suggestions regarding any aspect of the facility’s operations, including ergonomic improvements.

Identification of Problem Jobs

There are several ways in which the ergonomics team learns that a job might be a problem. The following methods for identifying problem jobs

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are incidence-based; that is, they are based on employee reports of injury or discomfort or employee requests for assistance:

- Information from incident reports, which are completed whenever an accident or “near miss” incident⁶³ has occurred or whenever an employee reports symptoms to a supervisor or the facility nurse (who is a member of the ergonomics team), is provided to the ergonomics team if ergonomic hazards appear to be involved.
- Periodic walk-through audits by AMP’s third-party insurance administrator alert the facility to opportunities to address ergonomic hazards. In some cases, insurance representatives may look specifically at those areas where workers’ compensation costs are high.
- Employees can bring up any discomfort they are experiencing with members of the ergonomics team, their representative on the local safety committee, their supervisor, or their human resources representative; ergonomics team members themselves identify problem jobs on the basis of symptoms they are experiencing or complaints they have heard from fellow employees. The suggestion system also may provide information on potential problem jobs. Requests to the ergonomics team to address a problem job can also come from management of the facility or business group, the departments, the local safety committee, or one of the other 17 VAM teams at Tower City.

Prioritization of problem jobs is done by the ergonomics team. Once the ergonomics team is alerted that a job may be a problem, the team prioritizes which jobs it will analyze. Each team member is asked to identify the two or three jobs he or she feels are most important to address. The problem jobs are then ranked on the basis of how many team members have identified them as important. Jobs in which MSDs have already occurred are typically given the highest priority. Because the team identifies its own priorities, this process also serves the purpose of keeping the team focused and interested. As indicated previously, individual team members are assigned to “champion” each selected project.

Analyzing Problem Jobs
and Developing Controls

Facility officials described their process for analyzing problem jobs and developing controls as “intentionally flexible” and “informal.” Analysis of a problem job might involve simply analyzing a particular job element or task that is thought to be the source of the problem. However, if a problem

⁶³A near miss incident is one in which significant property damage or serious injuries could have resulted.

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job is more complex or labor intensive, Tower City will undertake a more detailed job analysis.

Members of the team and management at the facility and corporate levels all emphasized that developing controls is not “rocket science” and that the answers typically come from employees on the production floor. The process of developing controls was described as “iterative” and involving “continuous improvement.” The ergonomics team leader said that its work is never done, because new problem jobs or tasks are always being identified and controls initially introduced for problem jobs are not always adequate. A mix of controls is employed, but many were described by facility officials as “low-tech” engineering controls.

Process Used to Analyze Jobs

To analyze a problem job, a one-page “Ergonomic Evaluation Form,” is administered to the employee on the problem job. The form is tailored to that specific job, and asks “yes/no” questions about the employee’s ease and comfort when performing certain job tasks. After reviewing this form, a member of the ergonomics team interviews the employee and observes the employee performing the job. This Ergonomic Evaluation Form was initially longer and more complex but was subsequently simplified to encourage employees to fill it out. As an incentive, those who fill out this form are provided the opportunity to test any new equipment or tools, and will be involved in the final decision about which equipment or tools to purchase. For jobs involving keyboarding, a one-page “yes/no” workstation checklist is used to record observations such as whether the chair and keyboard are adjusted properly, or whether there is adequate variety in tasks performed throughout the day.

If a problem job is more complex or labor intensive, Tower City will undertake a more detailed job analysis, which may involve videotaping the job and collecting more documentation. According to the ergonomics team leader, problem jobs are videotaped whenever possible because the team finds this helpful for identifying the ergonomic hazards of a job and possible controls. For example, the team has videotaped jobs in the re-reeling department, where connectors and terminals manufactured at this facility are wound onto reels for packaging and distribution; the packaging department, where boxes are stretch-wrapped for shipping; and the machine shop, where the grinding and milling of dies takes place.

Additional documentation is collected to develop controls for these problem jobs using the “Job/Task Evaluation” form. This form is several pages long and provides space to record more detailed observations about

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the adequacy of the workspace, environmental conditions, and hand tools as well as for comments regarding possible controls. A physical assessment survey may also be administered to capture frequency of discomfort in various body parts. This was done in the re-reeling department because that department historically had higher numbers of MSDS.

Tower City also used “process mapping” sometimes, which involves breaking down the steps of a job process and then, on the basis of that information, developing a new method of performing that same job that eliminates unnecessary steps. Although the focus of this type of job analysis is usually improving productivity, this analytical tool is recognized by the ergonomics team as helping the facility make important ergonomic improvements.

**Process Used to Develop
Controls**

The controls themselves are developed informally, through “brainstorming” by the ergonomics team members using the information collected from analyzing the job, interviewing employees, and suggestions from employees on the production floor.

Although the ergonomics team takes the lead in developing controls, it has access to in-house engineering support. For example, the team had developed a prototype cutoff device to reduce stress on employees from ripping paper placed between layers of connectors as they are wound onto reels. Because this device was found to be inadequate, the ergonomics team has requested assistance from the engineering group to develop a fully automated paper cutter.

Although Tower City officials said many controls were developed internally, there were instances in which outside resources were integral. For example, the Tower City facility arranges with vendors or suppliers to provide tools and equipment at no cost to the facility so the facility can test the product before making a purchase. Through its Ergonomic Prototype Work Centers, which are set up within each work area, these tools and equipment are then evaluated. By creating an Ergonomic Prototype Work Center in the tool and die work area, the ergonomics team enabled employees to experiment with different tools and different ways of arranging tools to eliminate awkward reaching. The facility now suspends the tools by magnetic strips in easy arm’s reach above the workstation. Also, tools are organized by specific jobs to make it easier for the employee to locate the appropriate tool. In addition, the ergonomics team also uses electronic media, including the Internet, to obtain

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information on ergonomics and available tools. The ergonomics team leader then distributes this information throughout the facility, both for education and awareness purposes as well as for ideas for controls. In select instances, the facility may also use the services of its third-party administrator's loss control engineers to help identify controls, such as in the re-reeling department (see app. II).

The ergonomics team tries to address in some way every job that has been identified as a problem job. According to AMP officials, small and focused efforts to develop and implement controls were important in achieving early successes and convincing employees and management alike that the ergonomics program was worthwhile. Some of the initial projects of this team involved little or no capital investment, were relatively easy to develop and implement, and were inherently good candidates for success.

The process of developing and implementing controls was described by facility officials as "iterative" and involving "continuous improvement." Controls initially introduced for problem jobs might not be adequate or may introduce new problems, such as slowing operations down, which underscores the importance of going back to monitor the job once the controls have been introduced to see if they are working and employees have accepted them. So, while controls already implemented have helped to reduce reports of MSDs in the re-reeling department, the ergonomics team continues to work to improve this job. For example, the introduction of vacuum lifts to lift boxes from the conveyor to a skid for packaging slowed the operator down while he or she manipulated the boxes so they were properly oriented before being placed on the skid. As a result, the ergonomics team is researching other, perhaps more efficient, possibilities for safe handling. The team also continues to identify other solutions to problem jobs and tasks, such as redesigning racks where reels are stored so that employees are not lifting the heavy reels as high.

This facility has instituted a formal follow-up process to determine whether or not controls introduced on problem jobs are working. The ergonomics team administers a postevaluation form, the same one-page form administered before controls were introduced, to document whether or not the ease and comfort of employees performing that job or job task have improved. Formal follow-up also occurs through performance agreements, which are drawn up for each major project undertaken by the ergonomics team and posted in a public area. These performance agreements require the team to document its desired and actual results for comparison, as well as its standards of performance or accountability. For

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example, one desired result was to establish a procedure for employees to obtain ergonomic chairs, with a performance standard of securing at least one chair per quarter. The ergonomics team documented the success of this project by developing criteria for individual employees to qualify for ergonomic seating, selecting a line of products, and establishing a system by which the team identifies seating requirements and counsels individual employees regarding appropriate ergonomic chairs. Sometimes the ergonomics team will also circulate a written comment sheet to employees to elicit feedback on the controls that have been introduced, as the team did for the re-reeling job.

In addition, informal follow-up occurs through ongoing review of medical reports and walk-throughs conducted by members of the ergonomics team to determine whether or not employees continue to experience problems in jobs where controls have been introduced.

Types of Controls Implemented

A mix of controls is employed, but many were described by facility officials as “low-tech” engineering controls. For example, this facility uses mechanical arms to maintain tension of electronic connectors as they are reeled and has modified the tool and die workstations so that tools are suspended within easy reach.

Sometimes administrative controls are used when engineering controls are difficult to implement or do not completely eliminate all ergonomic hazards. For example, in the re-reeling job, employees are rotated every 2 hours so they are not reeling the same product over long periods of time.

Training and Education

General awareness training is provided only to members of AMP’s local ergonomics task teams (including Tower City’s ergonomics team). This training consists of a half-day course offering a basic overview of ergonomic principles. Global safety conducts this course and also follows up to see how well the teams are implementing their programs.

Training provided to all employees is informal—through distribution of literature and promotion of the activities of the ergonomics team. Also, Tower City integrates ergonomics into ongoing worker training on all equipment. This is done by the facility’s equipment trainer, who serves as a member of the ergonomics team and is responsible for teaching all employees proper work practices and how to avoid ergonomic hazards. In addition, training is provided to each employee on a particular job when that job has been changed to reduce exposure to ergonomic hazards.

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Tower City emphasizes focused, specialized training for employees based on their respective roles in addressing these hazards. Training for engineers, supervisors, and members of the ergonomics team is offered through AMP's Engineering Education Program and conducted by global safety staff. The courses include an "Introduction to Ergonomics," which covers basic ergonomic design principles for machines, tooling, and workstations and the benefits of ergonomic design in relation to corporate strategic goals. An "Advanced Human Factors Workshop" offers in-depth discussion of human factors principles in design and task analysis. This course includes workshops in analyzing facility loss trends, conducting job analysis, implementing controls, and computing return on investment for management reports.

Global safety has recently started to offer training in behavior-based safety management at several facilities. This training is intended to help staff identify the root cause of behaviors that lead to accidents or contribute to MSDs. This training will also cover how to document savings from changing behaviors.

Because it has had a good business year, Tower City has been able to meet its targets for training this year. However, global safety staff have found training participation is affected by business conditions. In addition, sometimes it is difficult to justify training, including ergonomics training, during work hours. The result is that courses are often offered in the evenings, which can also limit participation.

Medical Management

Strong linkages between Tower City's ergonomics program and medical management staff have been established to ensure early reporting and prompt evaluation. An occupational nurse serves the Tower City facility and two other facilities. This nurse, along with other AMP nurses, reports to AMP's department responsible for all health services. The nurse and supervisors try to document whether the source or nature of injuries is ergonomic-related. The nurse completes a medical report for every accident for which medical treatment is required, and space is provided for descriptive information to capture whether the problem may be related to an ergonomic hazard. Incident reports are also completed by the direct supervisor and reviewed by several managers before being sent to global safety for analysis. Poor workstation design and incorrect use of equipment or tools are among the hazardous condition categories that can be indicated. These reports are regularly reviewed by the local safety

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committee and the ergonomics team, and the nurse, as a participant in both groups, calls attention to problems related to ergonomic hazards.

Although most of the care provided for MSDs is through referral to local health care providers, a list of several area physicians, known by AMP's insurance administrator to be knowledgeable about MSDs and familiar with AMP's operations, is provided to injured employees. The nurse works closely with these physicians when an employee is diagnosed with an MSD to develop appropriate treatment and to identify restricted- or light-duty jobs. Nurses and occupational therapists employed by the insurance administrator are also available to assist the facility nurse. These nurses will, on occasion, observe the employee doing the job in question to help the physician determine the exact nature of exposure. In addition, the facility nurse told us she conducts informal walk-throughs to increase her familiarity with the jobs and associated risks. Facility tours are also provided to physicians in the community.

Tower City has a return-to-work policy to reduce workers' compensation costs. Finding restricted- or transitional-duty jobs has not been difficult at this facility because there have never been many employees on this type of duty, according to facility officials. Only three staff are currently on restriction. In addition, Tower City can also bring employees in on half shifts or restricted hours, and there are many opportunities for temporary assignments because of the variety of jobs within each department. In fact, this facility has always been able to place an injured worker in a restricted job within his or her same department.⁶⁴

Results and Issues Related to Program Performance

AMP officials said they were generally satisfied with the results of Tower City's ergonomics program, which has sought to improve worker safety and health through reduced injury rates and lower workers' compensation costs. However, officials raised a number of issues associated with Tower City's ability to assess program performance. Global safety officials said that the identification of "metrics" by which to measure progress in safety and health has been a challenge for the company. This difficulty prompted this department to work to introduce safety goals into AMP's corporationwide pay-for-performance system and to solicit local facilities to help develop meaningful measures.

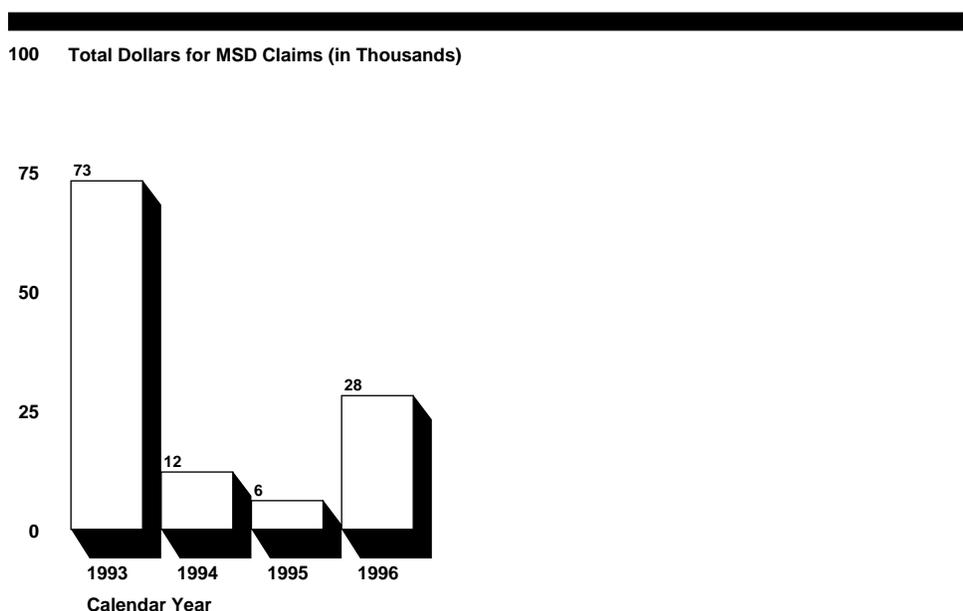
⁶⁴As a corporation, however, AMP has faced some problems finding light-duty work for all its injured employees and has faced some resistance from employees about its return-to-work emphasis.

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**Reductions in Workers’
Compensation Costs
Associated With MSDs**

Workers’ compensation data provide some evidence that the ergonomics efforts at Tower City are helping to reduce costs associated with MSDs. To capture MSDs, Tower City tracks sprains and strains in which the cause of the injury is lifting, repetitive motion, pushing, or pulling. As shown in figure IV.1, Tower City has achieved a reduction in workers’ compensation costs for MSDs from about \$73,000 in 1993⁶⁵ to about \$28,000 in 1996. Additionally, during this same time period, the average cost for each MSD claim declined from \$6,601 in 1993 to \$2,512 in 1996 (see fig. 3).

**Figure IV.1: Workers’ Compensation
Costs for MSDs at the AMP Facility,
1993-96**



Source: AMP’s workers’ compensation database.

While AMP officials believe these data suggest improvements at the facility, officials emphasized it would be difficult to attribute all improvements to the operation of the VAM team, given other contributing factors. First, there is a limited number of available years of workers’ compensation data available, and officials said it may take several years before real changes occur. Second, officials said there is often a lag in workers’ compensation

⁶⁵As discussed in app. I, we attempted to present data for the year prior to the program’s full implementation through 1996 for each facility. However, workers’ compensation data for 1992, the year prior to the program’s full implementation, were not comparable to data for later years. Therefore, we present data for the AMP facility for the years 1993 to 1996.

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data, and the injury may have occurred years before the costs show up in the data. This sometimes makes it difficult to interpret changes in workers' compensation costs.

Reductions in Injuries and Illnesses According to the OSHA 200 Log

Trends in overall injuries and illnesses from the OSHA 200 log are important because MSDS account for a significant portion of all injuries and illnesses at our case study facilities and because these data are what OSHA looks at when inspecting a facility. From 1993 through 1996, the facility's rate of injuries and illnesses for every 100 employees, known as the incidence rate, declined from 12.8 to 7.1 (see fig. 4). The incidence rate for 1995 of 5.4 is lower than the 1995 industry average of 7.1 for manufacturers of electronic connectors, according to the most recent available data. Additionally, Tower City reduced the number of lost days by 78 for every 100 employees from 1993 through 1996. In contrast, during the same period the number of restricted days increased by 21 for every 100 employees, which, in fact, may be the consequence of bringing more injured workers back to work (see fig. 2). However, the team generally does not use the OSHA 200 data to assess its progress, preferring instead to rely on the facility nurse to do so because she is knowledgeable about recording and interpreting the data.

Improvements in Productivity, Quality, and Morale

Tower City has also established a linkage between ergonomic investments and productivity or quality improvements. By examining production bottlenecks, this facility has identified ergonomic hazards that contribute to the production problem. The facility used an analytical tool called "process mapping," which involves describing each step of a job process and then, on the basis of that information, developing a new method of performing that same job process that eliminates unnecessary steps. Process mapping enables the facility to demonstrate how comparatively fewer steps (less time and shorter distances) are required to perform the same activity. For example, employees used to have to manually search through bins filled with numerous channels, or attachments, to locate, align, and fix a particular channel on a die to guide a newly manufactured terminal as it was re-reeled. Through process mapping, a new way of attaching the matching channel to the die earlier in the process was identified. In another application of process mapping, employees no longer have to crawl under the press to feed a vacuum hose to remove scrap material after connectors are stamped. A new extraction system has been installed underneath the press that automatically removes remnant or

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scrap metals. This improvement has also reduced the facility's scrap rate and improved the quality of recovered metals.

Worker morale has also improved, as reflected by employee interest and involvement in the activities of the ergonomics team. In general, the ergonomics program has been a vehicle to get employees more involved in how their jobs are performed, according to the team leader, as evidenced by employees' significant use of the "suggestion system."

The Ergonomics Program at Navistar, Springfield Assembly Facility, Springfield, Ohio

Background

Navistar International Transportation Corp. manufactures heavy- and medium-duty trucks, school buses, diesel engines, and service parts.⁶⁶ Navistar has 10 facilities in the United States, Canada, and Mexico, employing about 15,000 employees worldwide. The Springfield Assembly Facility assembles the heavy- and medium-duty trucks. Originally designed to produce pick-up trucks, the facility was built in 1967 and currently employs about 4,000 employees, most of whom work on the production floor assembling truck parts. About 80 percent of Navistar's workforce is unionized and under contract with the United Auto Workers (UAW). Some office employees and security personnel are also unionized at the local level.

The culture at Navistar has influenced the implementation of the ergonomics program. For example, the UAW bargaining agreement requires each facility to have an ergonomics program that includes employee involvement in the identification of hazards and selection of control methods; job analysis to identify ergonomic risk factors and target ergonomic interventions; training for employees; and active involvement of the medical department in the identification of problems, medical evaluation, treatment, rehabilitation, record keeping, and job placement of restricted workers, among other requirements.

Navistar's facilities have flexibility in how they carry out their ergonomics programs and achieve bargaining agreement requirements, safety and health standards, and injury reporting requirements. Thus, the programs differ somewhat from one facility to another. For example, only three of Navistar's facilities have full-time ergonomists to lead the ergonomics programs. Additionally, because of experiences during program evolution, the membership of the ergonomics committees may differ from one facility to the next.

Local facility conditions also affect program implementation. A key feature of Navistar's products is that they can be customized; this means that production lines and processes at the Springfield facility can change frequently. Additionally, because there is cyclical demand for any particular product, production line speeds can vary significantly. Both of these factors mean that jobs or job tasks may change every few months. This poses challenges for Springfield to identify particular problem jobs and ensure that controls are effective over the long term. Additionally, Springfield has hired relatively few new employees over the past 2

⁶⁶Until 1984, Navistar operated under the name International Harvester, manufacturing primarily agricultural equipment.

decades, and over the past several years its staffing level has remained fairly stable. As a result, the facility's workforce is composed largely of men whose average age is 50. While the collective experience of this workforce helps to prevent injuries, it also may be problematic, because as employees age they may be more susceptible to injury. In 1994, Springfield did hire about 500 new employees, a large number of whom were women, but they were subsequently laid off throughout 1995. Because these employees were new and perhaps not used to these physical requirements, Springfield suffered increased numbers of injuries while they were on board.

Initiating the Ergonomics Program at Springfield

The current ergonomics program at Springfield was fully implemented in 1994 with the hiring of the current ergonomist. However, Springfield's program has evolved over a decade of experimenting with a number of different ways to reduce ergonomic hazards and MSDs.

Springfield began to implement an ergonomics program as early as 1984, when the UAW required Navistar, in its collective bargaining agreement, to establish a pilot ergonomics program. Navistar corporate officials said there were other influences that contributed to their decision to implement an ergonomics program, including witnessing other employers in the auto industry being cited by OSHA for MSDs, and being encouraged by a consultant who demonstrated ergonomics' relationship to improved productivity and quality.

The pilot ergonomics program was based on local ergonomics committees. Composed of line employees, these committees were tasked with looking for problem jobs and developing controls. However, the employees on these committees often lacked knowledge of ergonomics, lacked the engineering resources necessary to implement suggested controls, and found it difficult to meet because of workload demands. Additionally, Springfield also found there were too many employees on its committee to make it effective. As a result, Navistar and the UAW decided to restructure committee membership so that the only required members would be the local union safety representative and a management safety representative, with other employees brought in as appropriate.

In 1991, Springfield decided to hire its first ergonomist to coordinate the ergonomics program. According to the facility manager, most of Springfield's injuries with lost workdays are caused by ergonomic hazards. However, because the ergonomist reported to the engineering department,

competing priorities often meant that ergonomics was not given the same priority as other engineering activities. Springfield subsequently decided to place the ergonomist in the safety department. According to Springfield officials, this organizational change was instrumental in ensuring the ergonomics program received the attention it deserves.

Structure and Core Elements of the Program at Springfield

Springfield's ergonomics program is led by a full-time ergonomist and a local UAW representative (who works on ergonomics about 3 days a week). The ergonomist reports to the environmental safety and health manager, who reports directly to the facility manager. Other departments are involved with the program, such as the workers' compensation branch (which tracks workers' compensation costs), the medical department (which treats injured employees), and the in-house engineering staff (which helps design and implement controls).

Management Commitment

Management commitment to the ergonomics program at Springfield is demonstrated in a number of ways. Springfield has a written document that lays out the various elements of its program, but this is not key to the daily operations of the program. Instead, officials said other, more tangible signs are better indications of management commitment.

Springfield has assigned staff—referring to the full-time ergonomist and UAW representative—to manage the program. Specifically, this ergonomics staff is responsible for identifying and analyzing problem jobs, leading efforts to develop controls for those jobs, and overseeing implementation of controls. Additionally, the ergonomist provides training to Springfield employees and develops ergonomic guidelines for them to follow.

Navistar has also integrated ergonomic principles into corporate accountability mechanisms. For instance, Springfield is given a cumulative percentage reduction goal for injuries and illnesses. The percentage reduction is based on the number of incidents, the frequency of those incidents, the number of incidents with lost time, and costs for workers' compensation.⁶⁷ Springfield also uses 5-year strategic business plans that lay out goals and timeframes for completion of those goals. Achieving these goals contributes to compensation decisions affecting managers. For the last 2 years, these strategic plans have included goals for the ergonomics program that have been developed by the ergonomist and the

⁶⁷A daily safety report tracks Springfield's progress in meeting its overall injury and illness goals. These data are provided to the facility and department managers daily and are posted publicly.

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UAW representative. The most recent plan calls for redesigning processes ergonomically to reduce injuries and costs associated with MSDS, training technical support staff on ergonomics, and reducing lost time days and dollars by bringing employees on workers' compensation or medical layoff back to work. Springfield officials said including ergonomic requirements in the strategic business plan has brought ergonomics to the forefront and represents a tangible sign of management commitment.

Ergonomic principles have also been incorporated into Navistar's yearly safety audits. For the first time, in 1996, Navistar conducted a safety audit at each of its facilities that scored each facility on various safety matters, including ergonomics.⁶⁸ Although the audit was predominantly compliance based (relating to, for example, record-keeping and maintenance issues), it also looked for evidence that an effective ergonomics program was in place—for example, that there was evidence of employee awareness about ergonomics, that processes were in place to evaluate repetitive trauma injuries, and that medical staff were involved in the program. The 1996 score will be used as a baseline to evaluate future performance, and Springfield's progress relative to this baseline score will be included in future years' injury and illness reduction goals. Springfield takes the results of this audit seriously; as a result of last year's audit, Springfield created a management-level ergonomics committee to spread awareness of the ergonomics program. This committee also helps to ensure management support for the program. The committee meets bimonthly and includes representatives from each of the departments of the facility (primarily department heads or their designees). The committee reviews the status, feasibility, and appropriateness of various controls that have been suggested or implemented.

The ergonomics staff also said that suggestions for ergonomic controls generally have been implemented, although recent budget restrictions have made it more difficult to justify all types of capital investments. However, if Springfield does not have the funds to obtain safety-related items, it can request that corporate Navistar pay for them. Cost justifications are typically required for ergonomic controls, as they are for all capital investments. To justify the purchase of the control, the ergonomist typically cites the costs of injuries or the potential costs of injuries if the control is not implemented. For example, in a cost justification for additional automatic lift tables (tables that keep supplies at an appropriate distance and level for employees by rising as the loads on them decrease), the ergonomist reported that these tables help to

⁶⁸Safety audits had been performed in prior years, but they had not scored the facilities.

reduce shoulder and back injuries, which have cost the facility well over \$200,000 a year in workers' compensation costs.

Employee Involvement

Navistar relies on committees to accomplish the employee involvement required by the collective bargaining agreement. Springfield's primary ergonomics committee for identifying problem jobs and developing controls is purposely fluid, based on Navistar's previous experience with large standing committees during program implementation. The only required members of this committee are the ergonomist and the UAW representative. Other employees (such as the employee doing the job, a line supervisor, an engineer, and the medical director) are pulled in on an ad hoc basis depending upon the particular job being studied and the expertise needed to develop a control. Officials said this type of committee works well because it is relatively small and focused on a particular job, so the analysis and control development can be done fairly quickly. Additionally, corporate officials said this approach allows Springfield to involve a large number of employees in identifying problem jobs and developing controls in a more efficient way than using a standing committee would allow.

In some cases, Springfield has formed special committees to address particularly difficult jobs. For example, the "pin job" is considered the most onerous job in the facility. On this job, the frame of the truck is lowered onto the axle. Employees have to "manhandle" the frame so it aligns with the axle, while simultaneously manually hammering in pins that attach the frame to the axle. This job requires significant force, vibration, and awkward postures. Because previously suggested long-term controls for this job would require significant changes in the production process or in the design of the product, Springfield officials said they have recently created a new committee and given it 6 months and an "unlimited" budget to assess the job and develop alternative types of controls.

Springfield has also established procedures that allow employees direct access to services. For example, employees can trigger a job analysis simply by submitting a "Request for Ergonomic Study" form to the ergonomist or UAW representative if they feel discomfort or just want to have an analysis performed. This one-page form elicits basic information about the employee involved (name, time of injury, or type of discomfort reported); the "ergonomic concern" being reported (that is, the action that has caused the injury, discomfort, or both); the area of the body affected;

and any suggestions the employee may have to alleviate the ergonomic concern. In 1996, the form was revised to also request information on ergonomic risk factors present on the job (repetition, force, awkward postures, vibration, and lifting). Once the ergonomist or UAW representative receives this form, the appropriate employees are convened to conduct a job analysis.

Identification of Problem Jobs

Springfield identifies problem jobs primarily on an incidence basis. In other words, Springfield's efforts most often are the result of job-related reports of injuries or discomfort to the medical department but can also result from employee requests for job analysis. Springfield has implemented a simple system by which jobs are identified for analysis. Facility officials emphasized that this process must be simple in order to encourage employees to report their injuries or discomfort early. When an employee reports an injury or discomfort to the medical department (Springfield has an on-site occupational health clinic), the medical director evaluates whether the injury or discomfort was caused by an ergonomic hazard, and, if so, completes a Request for Ergonomic Study and gives it to the ergonomist or UAW representative. As noted above, employees or supervisors can also complete this form if they or their employees are feeling discomfort that has not yet resulted in a visit to the medical department or if other conditions exist that lead them to believe there are potential problems with the job. Employees can also informally tell the ergonomist or UAW representative about a problem job during their frequent walk-throughs of the facility without using the form to generate a job analysis.

Springfield does not use a discomfort survey to identify potential problem jobs because the results are difficult to interpret, and a survey carried out by an intern several years ago identified those jobs that the ergonomics staff already knew were problematic. Officials said it is difficult to know whether the discomfort being experienced by employees on particular jobs is attributable to the employee's aging, or whether it is in fact due to a particular job. Even if it could be determined that the job was causing the discomfort, because the nature of jobs changes frequently, it would be difficult to tell whether the discomfort was the result of the job itself or of the interaction between the employee and the job.

Although Springfield has spent most of its time on incidence-based identification, the facility has recently started to identify problem jobs on a more proactive basis. The ergonomist asked all supervisors to identify

problem jobs on the basis of those staffed mostly by employees with low seniority and those with high turnover. In a unionized environment, as employees gain seniority, they can “bid off” of certain less desirable jobs and onto more desirable ones. This means that those jobs done by employees with the lowest level of seniority are probably jobs that most employees do not want to do—and the probable reason for this is that there are ergonomic hazards on these jobs. Officials said using these indicators may be more appropriate than using risk factors. Virtually any job in a manufacturing environment involves risk factors, they said, so it would be prohibitively time consuming and expensive to use risk factors as a basis to identify problem jobs.

Although the ergonomist and the UAW representative complete an analysis on every job for which they receive a Request for Ergonomic Study, they currently give the highest priority to those jobs on which injuries have already occurred or discomfort has already been reported to the medical department. The next highest priority is given to those jobs for which a large number of requests for job analysis have been submitted. At this time, the lowest priority is given to those jobs identified by supervisors on the basis of high turnover and low seniority. Aiding in this prioritization is a database developed by the ergonomist called the “Ergonomic Log Line Breakdown,” which tracks all requests for job analysis and provides information such as the employee who was involved, the time the injury occurred or discomfort was reported, the job the employee was working on, and the body part affected.

Analyzing Problem Jobs and Developing Controls

Springfield’s process for analyzing jobs and developing controls was described as simple, informal, and purposely not paper intensive. The ergonomist pointed out that a company is less likely to analyze a large number of jobs if there is a lot of paperwork to do for each job analyzed. She said Springfield analyzes about 250 jobs a year, which would not be possible if a lot of paperwork was required. Officials said this process relies heavily on the in-house resources at the facility, such as the employees doing the job and facilities engineering staff. In some cases, a detailed analysis is done if the job is particularly complex.

The ergonomics staff stressed that the process must be continuous, as it is not always feasible to correct all hazards on every job, especially the first time out. While some effort is always made to alleviate at least some of the hazards on the job, the process must ensure that the problem job is revisited as long as the problem continues to exist. Officials also said that

most of the controls that have been implemented have been administrative or “low-tech” engineering controls. For a description of controls developed to eliminate ergonomic hazards associated with windshield installation, see appendix II.

Process Used to Analyze Jobs

To analyze a job, the ergonomist or the UAW representative assembles a committee of individuals and watches an employee perform the job in question to get a good understanding of the job requirements and what may be causing the problem. In some cases, the analysis is based on the information already provided on the Request for Ergonomic Study form. Typically, the analysis does not involve breaking the job down into component parts, although the committee often studies problem areas, which are generally the “ergonomic concern” stated on the Request for Ergonomic Study form, such as lifting or reaching.

If necessary, a more detailed analysis is conducted. Jobs are not videotaped, because that would violate provisions of the bargaining agreement, but if the job is particularly complex, the analysis process is lengthy, or a large number of people are involved, Springfield may use an additional form called the “Ergonomic Assessment Form.” This two-page form elicits additional information, such as the type of work being done (for example, hand-intensive and manual materials handling), the risk factors present, and the tools and parts used. This form is used by a sister facility for all of its job analyses; however, according to the Springfield ergonomist, it is not reasonable for Springfield to use this form because of the number of jobs analyzed each year.

Process Used to Develop Controls

Once the committee has finished analyzing the job, it follows an informal process to develop controls. The officials told us no specific tools are used to develop controls. Instead, the process is fluid and varies depending upon the problem itself. In some cases, the employee, supervisor, or whoever submitted the Request for Ergonomic Study has already suggested a control based on his knowledge of the job. In other cases, the committee identifies other operations in the facility to determine whether their controls may be appropriate for this job. The officials said it is imperative that they “walk the floor” to understand what the jobs are and what types of controls may be effective. For example, for the cab part of the truck to be adequately attached to the frame, the cab must be positioned at a particular angle. To accomplish this, employees previously had to “jack up” the cab with a car-type jack numerous times a day and were experiencing back, shoulder, and other problems as a result. The UAW representative knew that employees on other production lines were using

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a hydraulic pump to lift up the cab and suggested to the employees working on this process that they look into whether this type of control would work. These employees are now using a hydraulic pump, and discomfort has been reduced.

For more complex situations, the committee presents the problem to the in-house engineers and asks them to develop controls. For example, on the radiator line, employees had to attach a metal casing (called a “horse collar”) to the radiator, which was suspended from an overhead line. Because the holes on the casing and the radiator were not lining up properly, employees had to manually pry the components with a screwdriver to adjust the holes before inserting the bolts. A number of employees were complaining of fatigue and pain from this job, and there were quality problems because the bolts were sometimes inserted incorrectly. In this case, the in-house engineers designed a U-shaped “spreader bar” that precisely aligns the holes in the radiator with those in the casing. The spreader bar has eliminated the physical strain of the employees and also improved the quality of the work.

Springfield officials said they used no specific threshold to determine whether and when a control should be put in place. In most cases, these are judgment calls based on several factors, such as the severity of the problem or hazard, the extent to which the problem can be fixed, and the time or resources needed to develop and implement controls. Because of the limited number of in-house engineers to design or implement controls, Springfield tries to prioritize controls on the basis of likely injuries and other costs if the job is not fixed.

Facility officials acknowledged that the program is never completed and the ergonomics staff is always on the lookout for improving existing controls. However, follow-up is typically informal, as there are insufficient time and resources to formally follow up on all jobs where controls have been implemented. However, the Ergonomic Log Line Breakdown can help the ergonomist determine whether jobs that have been analyzed continue to be the subject of requests for ergonomic study. If they are, the ergonomics staff will continue to revisit those jobs.

The iterative nature of the program is especially important because not every hazard on every job can be totally eliminated. Facility officials said a small number of jobs they have analyzed have not been able to be fixed, primarily because it would have been prohibitively expensive to do so, requiring a change in product or in the production process. However, even

in these cases, as with the pin job, Springfield has made repeated efforts to reduce exposure to hazards through other means. The establishment of the committee to develop controls for the pin job is the most recent example of this iterative process.

In some cases, it is difficult to implement controls immediately because of the complexity of the product, the customization of the product, or the facility layout. In these cases, changes must often be implemented when a production or schedule change takes place. This was the case with the change in how windshields are installed (see app. II). On the other hand, constantly making changes can make it difficult to know whether controls are working. Additionally, it is not always feasible or appropriate to take a control implemented on one job or workstation and implement it on all similar jobs or workstations. For example, Springfield currently has about 30,000 guns at the facility that are used to drill in bolts. Many of these guns are “impact” guns that have excessive vibration, but they are very powerful. As many of the impact guns wear out, Springfield is replacing them with “nutrunner” guns, which are less powerful but cause less vibration. Facility officials said it is not reasonable or feasible to expect Springfield to replace every impact gun immediately; moreover, in some cases, nutrunner guns are not an acceptable replacement for impact guns.

Types of Controls Implemented

Springfield has implemented a mix of controls, focusing on the most cost-effective controls in their efforts to at least partially address identified hazards on every job analyzed. The ergonomist estimates that only about 10 percent of the controls implemented have been engineering controls, and most of these have been considered “low tech,” because they have not been extremely costly or significantly changed the job. For example, Springfield has installed hoists to lift 120-pound fuel tanks and mechanical articulating arms to transport carburetors down an assembly line. These controls have eliminated the manual lifting and strain associated with handling these heavy objects. The facility has also installed automatic lift tables, which rise as the load lessens, to reduce reaching and bending by employees and has improved hand tools used to do the jobs. Springfield’s program also covers employees who work in an office environment. There, Springfield has provided ergonomic chairs, filters for computer screens, and articulating keyboard trays.

Most of the controls Springfield has implemented are administrative controls or personal protective equipment. Administrative controls have included training for office employees and a guideline for engineers to use when designing products. Padded gloves, elbow supports, and other

protective equipment are commonly used throughout the facility, especially in those cases, such as the pin job, where it has been difficult to address hazards through engineering controls.

Training and Education

To date, Springfield has not provided basic awareness training to employees but has instead provided general information about ergonomics informally through posters, word of mouth, and pamphlets. While Springfield would like to provide awareness training to all new employees and employees working on the production floor, there has been some difficulty taking employees off the floor during work hours for training.

Springfield has focused on providing targeted training to office employees and production supervisors. For example, the ergonomist provided training to office employees to help them understand how to arrange their workstations to be more comfortable. In 1997, the ergonomist began to teach a technical training class for supervisors and engineers. This class provides 4 hours of basic information on MSDs, as well as up to 4 hours of additional information for material handling analysts, supervisors, and all engineers.

Medical Management

Springfield's program has established strong linkages with its medical management staff to ensure early reporting and prompt evaluation. Springfield has a fully equipped on-site occupational health clinic that is able to treat most of the injuries experienced by Springfield employees, with rare referrals to local health care providers. The medical director told us that having a clinic on site means that employees are less likely to leave work for medical attention and that she is more involved with and aware of what the employees are doing, how the injury or discomfort occurred, and how similar problems can be avoided in the future. Other officials said having an in-house doctor and medical staff helps Navistar, which is self-insured, keep medical costs down.

The medical director is closely linked with the ergonomics program in several ways. Primarily, she can request a job analysis (through the Request for Ergonomic Study form) when an employee reports to the medical department discomfort or an injury that she believes was due to an ergonomic hazard. In fact, the recent change to this form to identify risk factors was initiated at the request of the medical director. Also, in many cases, the medical director participates on the ad hoc ergonomics committee, as well as on the management-level ergonomics committee,

and helps analyze and develop controls for problem jobs. Additionally, when there are questions about the premise of a workers' compensation claim, the medical director calls together the ergonomist and a representative from the workers' compensation branch to discuss the validity of the claim. This workers' compensation causation committee also helps to identify causes of injuries.

Springfield also uses restricted- and transitional-duty assignments in an effort to return injured employees to work. The medical director said this is key to a successful, cost-effective program. However, Springfield faces several challenges in this regard. For example, if an injured employee has been given a particular work restriction, the available job that accommodates that restriction may not be available to the employee because he or she does not have enough seniority to work on that job. In other cases, some of the jobs available to injured employees, such as sweeping, are not seen as being productive, so employees are reluctant to take these jobs.

Results and Issues Related to Program Performance

Navistar officials said they are generally satisfied with Springfield's ergonomics program's contribution to improved worker safety and health, reduced injury rates, and lower workers' compensation costs. Officials said they use a number of measures to look for results of the ergonomics program, since it is inappropriate to consider just one measure and exclude others. However, officials raised a number of issues that need to be considered when reviewing these results and that often complicate their ability to tie results directly to their efforts.

Reductions in Workers' Compensation Costs Associated With MSDs

As shown in figure V.1, Springfield reduced its costs for workers' compensation claims associated with MSDs⁶⁹ from almost \$1.4 million in 1993⁷⁰ to \$544,000 in 1996—a decline of over 60 percent. Additionally, during this same period, the average cost for each claim declined almost by half, from \$9,500 in 1993 to \$4,900 in 1996 (see fig. 3), which provides some evidence that the facility has been encouraging early reporting and

⁶⁹To capture MSDs, Springfield tracks the following injury categories: "repetitive trauma," "carpal tunnel syndrome," "thoracic outlet syndrome," "tendinitis," "epicondylitis," "torn rotator cuff," "torn meniscus," and "acute strains involving the back."

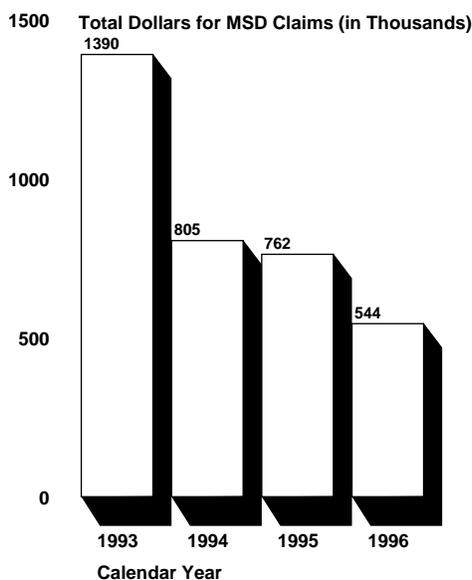
⁷⁰As discussed in app. I, the years of data provided for each facility differ depending upon when facility officials believe the current program was fully implemented. In most cases, we present data from the year prior to full implementation of the program through 1996 in order to show changes that occurred at the facility during the years of the ergonomics program's operation. For Springfield, since the current program was fully implemented in 1994, we present data beginning in 1993.

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providing early treatment. According to data provided by the ergonomist, Springfield also avoided about \$250,000 in workers' compensation costs between 1994 and 1996 as a result of reductions in carpal tunnel syndrome, repetitive trauma, and back injuries.

During this same period, total costs for workers' compensation declined by about 15 percent. But the facility did not achieve its overall safety percentage reduction goal in 1996 because of several large claims and the difficulty it experienced in returning injured employees to work.

Figure V.1: Workers' Compensation Costs for MSDs at the Navistar Facility, 1993-96



Source: Navistar's workers' compensation database.

Navistar officials said several factors need to be considered when looking at their experience with workers' compensation costs. First, there is uncertainty about what injuries should be considered MSDs. The ergonomist preferred to track injury categories directly tied to identifiable ergonomic hazards, such as lifting or repetition. On the other hand, corporate officials preferred to track all injuries to which ergonomic hazards may contribute.

Officials also said that hiring 500 new employees in 1994 and laying them off shortly thereafter contributed to increases in injuries, claims, and associated costs. New, inexperienced employees are more likely to become injured, and claims also tend to increase before a layoff because, if an employee can qualify for a medical restriction, he or she will be able to receive workers' compensation during a layoff. When the layoff ends, claims generally decrease. In 1995, Navistar did experience an increase in total workers' compensation claims, although this spike did not appear in costs associated with MSD claims.

Reductions in Injuries and Illnesses According to the OSHA 200 Log

Navistar also uses the OSHA 200 log to assess its performance in reducing injuries and illnesses on a facilitywide basis. Additionally, these data are used by OSHA in its inspection activities. According to these data for 1993 through 1996, Springfield reduced the number of injuries and illnesses for every 100 employees (referred to as the incidence rate) from 20.3 in 1993 to 14.2 in 1996 (see fig. 4). Additionally, in 1995, Springfield's incidence rate of 16.1 was significantly lower than the industry average of 22.5, based on the most recent available data, for other assemblers of truck and bus bodies. Springfield also reduced the number of lost and restricted days for every 100 employees by 122 days and 35 days, respectively (see fig. 2).

However, the ergonomics staff at Springfield said these data are not helpful for identifying or tracking reductions in MSDs. They said the OSHA log does not provide enough information to enable them to fully understand the circumstances surrounding an injury, or how it should be recorded. Officials also said injuries such as back injuries are recorded as acute, rather than as repetitive trauma, while in a manufacturing environment, most back injuries are the result of repeated lifting.

Improvements in Productivity, Quality, and Morale

Officials believed that, in many cases, ergonomic improvements had contributed to productivity, quality, and morale improvements. While the facility is not formally tracking productivity or quality improvements resulting from the program, the facility manager said the relationship between ergonomics and improving quality and performance cannot be denied. Additionally, the ergonomist reported that those departments with the most quality problems also tend to have the lowest seniority and most ergonomic problems. Officials cited examples, such as the redesign of the windshield installation process as discussed in appendix II, in which Navistar has been able to achieve quality as well as ergonomic improvements.

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However, corporate officials said it is difficult to distinguish the benefits gained by “ergonomic” investments from those resulting from efforts to increase productivity or reduce rework. Concerns were also raised that, in some cases, ergonomic controls may actually decrease productivity—for instance, when additional employees are assigned to do the same amount of work that one employee had been doing.

The Ergonomics Program at SOCHS, Lewiston, Maine

Background

The Sisters of Charity Health System is a for-profit health care provider located in Lewiston, Maine. It includes a not-for-profit 233-bed acute/behavioral medical care facility (St. Mary's Regional Medical Center) and a not-for-profit 280-bed long-term-care nursing facility (St. Marguerite d'Youville Pavilion).⁷¹ These two entities employ about half of SOCHS' workforce of 1,400 nonunion employees—522 employees work at the medical center and 253 work at the nursing home.

A number of local conditions set the stage for the implementation of the ergonomics program at the medical center and nursing home. In 1993, to prepare for managed care, SOCHS began to streamline management structures, improve client relations, and gain a better handle on costs by becoming self-insured.⁷² As a result, when OSHA invited the medical center and nursing home to participate in the Maine 200 program,⁷³ SOCHS agreed. SOCHS realized the ultimate goal of the program—to reduce injuries and illnesses through establishing a safety and health program—supported SOCHS' efforts to reduce costs and increase efficiency. OSHA's offer to provide assistance and the good relationship SOCHS had with OSHA were also factors in the decision.

SOCHS had been aware of its high workers' compensation costs because, when it became self-insured, it was required by the Bureau of Insurance to set aside considerable funds to develop a trust to cover future workers' compensation claims (the amount was based on historical claim experience). Additionally, SOCHS knew that a leading cause of lost time was back injuries of CNAs who did most of the patient handling at the nursing home. Also, employees working in the laboratory, medical records, registration, and other heavily computer- and phone-intensive operations at the medical center were suffering various hand and wrist injuries. The offer from OSHA provided additional incentive for SOCHS to address these injuries.

⁷¹SOCHS also has an independent living facility, community clinical services, and a food service facility.

⁷²This decision was also a reaction to the workers' compensation crisis Maine was experiencing at the time. Insurers were leaving the state, and employers were leaving because they were unable to find an insurer.

⁷³Under this program, OSHA targeted employers with high numbers of workers' compensation claims with lost workdays for 1991. OSHA offered employers the choice of working with it to reduce those injuries or being subject to an on-site inspection.

Initiating the Ergonomics Program at SOCHS

Officials told us the program was fully implemented in 1994 after they had undertaken a number of efforts in response to OSHA's September 1993 invitation to participate in the Maine 200 program. These efforts were generated by the requirements to participate in the program. To participate, the medical center and nursing home had to conduct a baseline hazard survey to identify existing hazards, set up an action plan that outlined the steps the facility would take to address identified hazards, and establish a comprehensive safety and health program that would seek to reduce injuries and the contributing hazards. The facilities were also required to report quarterly to OSHA on their progress and allow OSHA inspectors to conduct on-site monitoring visits. Along with its invitation, OSHA also provided SOCHS its Safety and Health Program Management Guidelines, which were to be the framework for SOCHS' safety and health program.

The first thing SOCHS did was contact a consultant who said that staff should be assigned to manage the program. Soon after, SOCHS hired a safety coordinator to establish a safety and health program. The consultant also suggested setting up a system to track injuries and workers' compensation costs. Because existing systems were inadequate, SOCHS hired a risk management coordinator to develop a database to track the number and type of employee injuries, the number of lost and restricted workdays, and related information. A second system was developed in conjunction with the third-party administrator to track costs of claims.

The safety coordinator conducted the required baseline hazard survey. On the basis of the survey results, SOCHS developed action plans that laid out how the medical center and nursing home would address the identified hazards and injuries. SOCHS also began to establish procedures to implement the elements of an effective safety and health program.

Structure and Core Elements of the Program at SOCHS

SOCHS' ergonomics program is led by several officials located in the human resources department—the director of risk management and safety, the safety coordinator, and the risk management coordinator. A doctor and an ergonomist/nurse with the on-site occupational health clinic (called WorkMed) dedicate most of their time to conducting workstation evaluations, helping to develop controls, and treating injured employees. Other in-house resources, such as engineering staff, also work with these staff to develop controls.

Officials said that when MSDs constitute the majority of injuries and illnesses, they are a priority under SOCHS' safety and health program. When other injuries (such as slips and falls on icy parking lots or injuries from combative patients) constitute a majority of the injuries, then they are a priority.

Management Commitment

Management commitment to the ergonomics program at SOCHS is demonstrated in a number of ways. SOCHS does not have a formal ergonomics document for either the medical center or the nursing home, but officials told us the quarterly reports to OSHA that chart the facilities' progress in meeting goals and information provided in meetings and training for senior management and supervisors are the best indicators of the daily operations of the program.

SOCHS officials said there must be a point person responsible for making sure things get done and that person must have the resources to deal with problems. Because of this view, SOCHS has assigned staff to be responsible for the program. Key are the director of risk management and safety, the safety coordinator, and the risk management coordinator. These employees are responsible for addressing hazards, providing training, and tracking injuries and costs.

Additionally, SOCHS has integrated ergonomic principles into the purchase and design of equipment. For example, WorkMed must certify that all new office construction incorporates ergonomic furniture and design. WorkMed has helped design new office space in the medical records department and the emergency registration area at the medical center, as well as in other areas. Additionally, the nursing home recently bought new medical carts to eliminate identified ergonomic hazards. Medical carts are used to store residents' medications and are wheeled around the nursing home when medications are dispersed. Several shorter employees had suffered wrist injuries resulting from having to reach into awkward positions to get the medications. Because the ergonomics staff notified the nursing home administration about this hazard, the nursing home looked for and purchased shorter carts that had side drawers that could hold medications and accommodate these shorter employees.

SOCHS has also made financial resources available to the program. For example, early on, SOCHS spent \$60,000 on 14 automatic lifts for the nursing home and has since purchased another as a "spare." Officials said making such a significant investment early in the program required a "leap of faith"

that it would pay off, because there were no real data to support such an investment. Ergonomics staff noted, however, that this investment needs to be considered in light of the cost of just one back injury, which could cost more than \$60,000. Additionally, officials said suggestions for ergonomic controls are typically implemented; in fact, in 1997, the director of risk management and safety was given additional funding for ergonomic controls that were not accounted for in departmental budgets.

SOCHS has also ensured management support for the program in several ways. For example, if managers do not address identified hazards and employee complaints promptly, the safety coordinator has the authority to take action against these managers.

Employee Involvement

SOCHS relies on a number of committees to identify hazards, including ergonomic hazards.⁷⁴ These committees do not identify problem jobs or develop controls; instead, according to SOCHS management, these committees work to provide a heightened awareness of safety and ergonomic principles throughout SOCHS by keeping an eye on overall workplace conditions and notifying the ergonomics staff when they see items that need to be addressed. The committees meet once a month during work hours and draw membership from hourly as well as managerial employees and, in some cases, doctors. Management reviews the minutes from these committee meetings.

Recently, an ergonomics task force was formed.⁷⁵ The task force has about nine volunteer employees, and the safety coordinator, the director of risk management and safety, doctors, and officials from purchasing and engineering provide guidance to the task force. The ultimate goals of the task force are to help develop priorities for hazards that need to be addressed and to help employees address those hazards that may not be serious enough to merit a workstation evaluation by WorkMed.

SOCHS has also established procedures that provide employees direct access to services. For example, if employees want a workstation evaluation, they can simply call WorkMed to request one. Officials also emphasized the value of employee input during these evaluations and said many of the controls come from employees.

⁷⁴The medical center and the nursing home each has its own safety committee. Subcommittees of these safety committees address specific hazards, such as needlesticks or combative patients.

⁷⁵This task force is actually a subcommittee of the medical center safety committee, but employees who work at the nursing home are also members.

Identification of Problem Jobs

SOCHS identifies problem jobs primarily on an incidence basis. In other words, most of SOCHS' efforts result from a report of injury or discomfort or from employee requests for assistance because of other reasons.⁷⁶

SOCHS has established a simple system by which problem jobs are identified. If an "incident" occurs (at SOCHS this means an injury or feeling of discomfort), the employee and supervisor are required to complete separate "Report of Employee Incident" forms within 24 hours.⁷⁷ The employee's form elicits information about the employee involved (such as, age, sex, and position); the incident (location, time, date, witnesses, explanation of what the employee was doing at the time of the incident, and the body part affected); and steps taken after the incident occurred (whether first aid was provided or referral to WorkMed was made). The supervisor's form elicits information about the length of time the employee has been doing this task or job, what may have contributed to the incident, corrective actions the supervisor has taken for the affected employee (which must be taken within 72 hours), and actions the supervisor is taking to prevent a similar incident in the future. This form is then forwarded to WorkMed, which performs a physical examination of the employee. After the examination, WorkMed determines whether the injury or reported discomfort is due to ergonomic hazards (such as experiencing shoulder pain from prolonged use of microscopes) and, if so, WorkMed performs a workstation evaluation.⁷⁸ Workstation evaluations can also be triggered simply by a phone call to WorkMed if the employee does not need a physical examination.

Although SOCHS devotes most of its time to workstation evaluations resulting from complaints of discomfort or employee requests for assistance, SOCHS also identifies problem jobs on the basis of potential risks. For example, when an employee relocates or changes jobs, WorkMed is required to conduct a workstation evaluation to ensure that the employee's new workstation is set up correctly and that the employee is aware of potential hazards on his or her new job. Additionally, when entire departments are relocating or when new construction is taking

⁷⁶SOCHS' baseline survey required by Maine 200 participation did not identify a significant number of ergonomic hazards.

⁷⁷This form is also filled out if there is a "near miss"—that is, when an incident has not occurred but might have. In such cases, the safety coordinator determines whether an evaluation or job analysis is necessary.

⁷⁸If WorkMed decides the injury has occurred because employees were not following safety guidelines (for example, a CNA suffers a back injury as a result of not using automatic lifts to transfer residents) or because of other factors (a fall due to an icy parking lot), WorkMed refers the matter to the safety coordinator on the assumption that it can be addressed without a workstation evaluation.

place, WorkMed provides guidance on appropriate workstation and equipment design and must certify that design is ergonomic before final approval.

Analyzing Problem Jobs and Developing Controls

SOCHS officials said the process it uses to analyze problem jobs is simple. In fact, it stressed that, in most cases, it conducts workstation evaluations—making physical changes to an individual’s workstation to make the job more efficient and the employee more comfortable—rather than job analyses—evaluating whether tasks of a job or operation should be changed. Although there have been times where SOCHS has done job analyses, officials said it is not always practical or necessary to conduct a detailed job analysis in order to reduce hazards. The safety coordinator said that if a job was causing problems for more than one employee, he might undertake a job analysis to break down the job into tasks and make recommendations to change some of those tasks. However, he has not done this recently, because he can often make changes without having to do such detailed analysis.

SOCHS officials described their process for developing controls for problem jobs as informal. They emphasized the importance of using in-house resources to develop controls because employees know the job process and often can provide the best information on how the workstation can be improved. The officials also noted that the process is a continuous one. There is no specific threshold for when and whether a control should be implemented, and something can always be done to reduce a hazard or respond to the cause of the injury. Officials said a large number of the controls that have been implemented have concerned better work practices, while others have been “low-tech” engineering controls that have not drastically changed the job or operation.

Process Used to Analyze Jobs

When WorkMed officials conduct evaluations,⁷⁹ they spend about an hour watching the employees perform the job and taking physical measurements of the current workstation design (desk height, monitor placement, and chair height) and the employee as he or she relates to the workstation (appropriate elbow height when seated, for example). WorkMed may also assess the general workplace conditions, such as light and noise levels, but it does not follow a particular format for these evaluations. Because WorkMed is not technically a component of SOCHS, it

⁷⁹On a few occasions, workstation evaluations have been performed by a private consultant because there was some question about the validity of the results of the evaluations WorkMed had done.

charges SOCHS for these evaluations. Since 1995, SOCHS has spent about \$10,000 for evaluations at the nursing home and the medical center.

Although SOCHS does not typically videotape jobs, it may perform detailed analyses of jobs. For example, in the surgical area at the medical center, one job requires a secretary to input a significant number of medical charges into a computer. This is an extremely stressful job, because if items are omitted or input incorrectly, the medical center loses revenue. The secretary is required to perform several other tasks simultaneously, which contributes to the overall difficulty of the job. In doing its analysis of this job, SOCHS evaluated not only the physical characteristics of the workstation (work surface and chair height), but also the environment (noise and other distracting influences) and the numerous additional required tasks to determine whether any of these tasks could be eliminated or altered to reduce the stress of the position and increase the efficiency of the data input process.

Process Used to Develop Controls

Once the WorkMed staff have completed the workstation evaluation, they work with the employee who performs the job, in-house engineering staff, or others to “brainstorm” possible suggestions for eliminating the identified hazard. Officials said that often the employees themselves have suggestions for what controls to make. WorkMed officials said that when developing controls, they try to do those things that are easy to accomplish or fairly inexpensive. Additionally, for the duration of its participation in the Maine 200, SOCHS obtained ideas for controls from the compliance officer who had been assigned to it. Because of her familiarity with SOCHS and because she also had been assigned to similar employers in the health care industry, she was able to suggest ideas for controls that had worked for other employers.

WorkMed incorporates these suggestions into its evaluation summary—a two- to three-page memorandum that is provided to the director of risk management and the employee’s supervisor. The director of risk management evaluates the suggestions; determines how much implementing them will cost; and forwards them, along with their costs, to the cognizant department head for review and approval. For example, WorkMed recently suggested controls to alleviate employee discomfort in the shoulders and neck from excessive phone use, and back and arm discomfort from inappropriate computer workstation design in the medical center’s reception area. WorkMed suggested buying headsets for the employees; putting monitors on articulating risers so they could be placed at appropriate heights for numerous users; and buying ergonomic

chairs, among other suggested controls. These controls will cost about \$4,000.

In many cases, controls have been developed by in-house engineering staff. For example, an in-house engineer created an adjustable, slanted wooden surface that can be used as a mouse pad. A patent is currently pending on this item. In another instance, in-house engineers designed a wood computer monitor riser that elevates monitors to the appropriate height.

Facility officials agreed that analyzing problem jobs and developing controls must be a long-term effort, and the key is to look for continuous improvement. Accordingly, WorkMed or the ergonomics staff follows up after a workstation evaluation is performed if problems persist.

Officials also mentioned that not all problems can be fixed immediately, since the ability to implement controls is often dependent upon available resources. For example, the ideal way to adequately address the hazards on the surgical secretary job mentioned above would be to implement a computer system that would allow employees to input the medical charges as they are accrued, thereby reducing the amount of keying required by the secretary. However, this type of computer system could cost over \$200,000. Until the facility is able to afford this control or comes up with another alternative, SOCHS is trying other methods, such as rotating workers through the position on a part-time basis, in order to relieve the pressure of this job.

Types of Controls Implemented

SOCHS has implemented a mix of controls equally distributed between engineering controls (such as buying equipment), which alleviate or reduce hazards, and administrative controls, which encourage proper work techniques. Officials said that most of both types of controls have been inexpensive.

Perhaps the single greatest identifiable investment made by SOCHS on engineering controls has been for automatic lifts for the nursing home, which cost about \$60,000 (see the detailed discussion about these lifts in app. II). SOCHS has instituted a variety of other types of engineering controls in the laboratory area at the medical center. Employees who work in this area use computers, phones, and microscopes extensively. Because of the former configuration of lab counters and chairs, employees often had to use awkward postures to input data or use the microscopes. As a result, employees were experiencing shoulder, neck, and hand

discomfort, as well as some injuries. SOCHS lowered the countertops, bought adjustable ergonomic chairs, placed the monitors on articulating monitor risers to accommodate multiple users, raised the microscopes, and put glare screens on the computers. In the laundry room area, SOCHS has also placed false bottoms in laundry bins that rise as the load becomes lighter so employee bending and reaching are minimized.

SOCHS has also used administrative controls. For example, smaller laundry bags that hold only a limited amount of laundry are now used so employees' lifting requirements are lessened. SOCHS has also purchased antifatigue mats for its employees who stand while working. SOCHS has also offered body mechanics training and increased staffing to better manage high workloads in some work areas. WorkMed officials emphasized that quite often controls involve telling employees how to use better work practices. For example, recently a laboratory employee was experiencing a great deal of wrist pain resulting from the practice of dropping liquid from an eyedropper into a test tube. After watching the employee perform the job, it was found that she was flicking her wrist back after she dropped the liquid in the test tube. In this case, the control was a recommendation that she not flick her wrist. In the medical center's medical records area, employees were also experiencing wrist and hand pain from shoving copies of patient records onto shelves. In response, SOCHS instituted work policies that employees are supposed to follow for handling these records: They are supposed to leave space between each of the records to avoid using a pinch grip to pull out or push in the records.

Training and Education

SOCHS has provided general ergonomics training as a part of mandatory safety training. The class is offered twice a month for 4-1/2 hours at a time, about 3 hours of which focus on body mechanics (for example, correct positioning for various activities, such as lifting) and proper use of video display terminals. If employees do not attend this training, they will not receive their performance ratings.⁸⁰ SOCHS officials said this training is required by several OSHA standards, Maine's accreditation committee for health care organizations,⁸¹ and a state law that requires training for employees who work in front of video display terminals for at least 4 hours a day. Other general awareness education for ergonomics has been provided through an employee newsletter and advice from a "safety mascot."

⁸⁰With the exception of new employees, employees can take a test that allows them to opt out of this training for 1 year.

⁸¹Health care organizations must be licensed by this committee to operate in Maine.

The officials said that it is not feasible to require employees to attend training for more than 4 hours at a time or more than once a year. In the past, they said, they were unable to get people to stay in training when it was longer. Additionally, so much training is already required for health care organizations that any additional training must be reasonable and directly related to employees' tasks.

Given these concerns, SOCHS provides specialized ergonomics training for employees on the basis of the risks they are exposed to and their job requirements. For example, newly hired CNAs and other staff are given training on how to use the automatic lifts. The ergonomics committee leaders have also received training on how to identify and prioritize hazards. SOCHS also provides back training to all new employees working in areas where a significant amount of lifting takes place. For the last 4 years, supervisors have also received training on the procedures they must follow to investigate accidents and ensure injured workers are provided treatment, as well as how to identify hazards.

Medical Management

The ergonomics program has strong links with medical management staff to ensure early reporting and prompt evaluation. The officials emphasized that having WorkMed, the on-site occupational health clinic, has helped SOCHS encourage employees and managers to report all incidents early. This is done through the Report of Employee Incident form as well as by employees' directly contacting WorkMed for an evaluation. WorkMed is generally able to treat all injured employees.⁸² Because WorkMed conducts workstation evaluations, it is also able to suggest controls to reduce hazards and injuries and work with the engineering and facilities staff to apply ergonomic principles to equipment purchase and design.

SOCHS has also used restricted- and transitional-duty assignments in an effort to return injured employees to work. Officials said this was a major emphasis for them, since the large number of workers' compensation claims with lost workdays was a basis for their inclusion in Maine 200. In fact, when SOCHS began this program, a number of employees were out on disability, and SOCHS immediately tried to get them back to work on restricted duty. To control the number of days employees are out, officials maintain contact with injured employees, and the risk management

⁸²WorkMed also provides other personnel services, such as drug testing and preplacement evaluations of prospective employees to determine whether they have any preexisting conditions or injuries that may affect their ability to perform the required tasks. WorkMed provides services to about 300 other employers in addition to SOCHS employees.

coordinator sends calendars to cognizant supervisors to help them track the number of days their employees are out or on restricted duty.

WorkMed follows up with these employees once they are back at work. After each physical examination it performs, WorkMed determines whether an employee needs any type of restriction. If so, WorkMed completes a “Patient Instruction Form,” which documents the recommended treatment for the injury or reported discomfort and highlights the activities the employee can do and for how long. Through the workstation evaluations, WorkMed ensures that the employee’s workstation supports these restrictions.

Officials said that because SOCHS is so large, finding these types of jobs for injured employees is not difficult. The medical center has developed several light-duty positions, such as answering the telephone for lifeline calls or doing research on the library computer. The nursing home has established an area in its laundry room where employees can be assigned during recovery time. The officials said the individual departments carry the charges for these jobs, so they have an incentive to return employees to full performance as soon as possible. Despite this, officials did say that some employees in the system were so badly restricted that ensuring that they are productive has been difficult.

Results and Issues Related to Program Performance

SOCHS officials said they were generally satisfied with the results of their program because of (1) the reductions in injuries and their associated workers’ compensation costs and (2) an improved safety and health record, as evidenced by both facilities’ “graduation” from Maine 200 in 1996. Eligibility for graduation from the Maine 200 program was determined by OSHA on the basis of the extent to which it believed the facilities had implemented the goals of the Safety and Health Program Management Guidelines,⁸³ not on whether the facilities met specific targeted reductions in injuries, claims, or costs. After working with SOCHS for this 2-year period, reviewing SOCHS’ quarterly progress reports, and conducting several on-site monitoring visits, OSHA determined that SOCHS had made sufficient progress in implementing its safety and health program. Despite this success, officials said a number of factors needed to

⁸³The specific requirements included clearly identifying the people assigned to safety and health responsibilities, providing for employee involvement in safety and health matters, developing a system for investigating all accidents to identify all contributing causes, having a plan to encourage employees to report hazards to management as soon as possible to enable management to address such hazards promptly, developing a comprehensive training program, and having a job hazard analysis program or its equivalent to analyze every job in the facility.

be considered when reviewing these results that often complicated their ability to tie results directly to their efforts.

**Reductions in Workers’
Compensation Costs
Associated With MSDs**

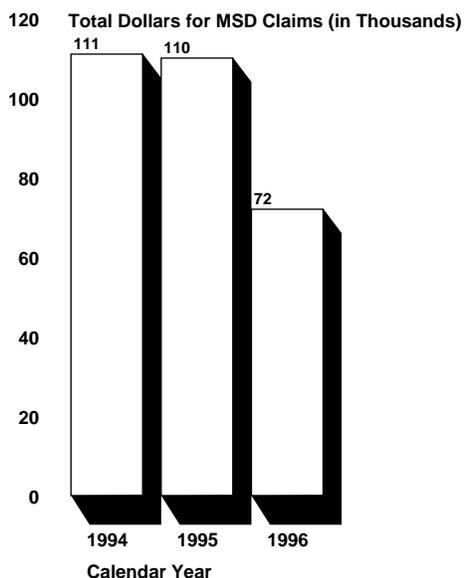
As figure VI.I shows, the medical center and nursing home together reduced workers’ compensation costs for MSDs by about 35 percent between 1994 and 1996⁸⁴ (from \$100,000 to about \$70,000). To capture MSDs, SOCHS tracks “cumulative trauma disorders” (for example, “carpal tunnel syndrome” and “overuse syndrome”); “tendinitis”; “epicondylitis”; and “back injuries.”⁸⁵ However, the average cost for MSD workers’ compensation claims for both facilities combined increased slightly, from about \$2,500 in 1994 to over \$3,000 in 1996 (see fig. 3).

⁸⁴As discussed in app. I, the years of data provided for each facility differ depending upon when facility officials believe the current program was fully implemented. In most cases, we present data from the year prior to the full implementation of the program through 1996 in order to show changes that occurred at the facility during the years of the ergonomics program’s operation. For SOCHS, since the program was fully implemented in 1994, we ordinarily would present data beginning in 1993. However, SOCHS data for 1993 are not comparable with those of later years because SOCHS became self-insured in Oct. 1993. As a result, workers’ compensation data presented are for 1994-96.

⁸⁵Officials said that not all back injuries are necessarily due to ergonomic hazards. To determine whether back injuries are due to ergonomic hazards, it would be necessary to review the conditions surrounding the incident.

Appendix VI
The Ergonomics Program at SOCHS,
Lewiston, Maine

Figure VI.1: Workers' Compensation Costs for MSDs at SOCHS' Medical Center and Nursing Home, 1994-96



Note: Workers' compensation data were not available for 1993, the year before the full implementation of the program, because SOCHS was insured through a carrier for most of the year and only has information on premiums paid. As a result, this figure uses 1994 as the base year for presentation of data.

Source: SOCHS' workers' compensation database.

SOCHS officials said other evidence of success has been the reduction in the amount needed to fund SOCHS' workers' compensation trust. After the first year of being self-insured, SOCHS has been allowed to set aside decreasing amounts of funds and can now set aside funds as it believes are necessary. If the trust becomes larger than SOCHS believes is required, it can withdraw any excess funds. In 1996, SOCHS withdrew \$800,000.

Nonetheless, the officials said a number of issues need to be considered when evaluating these data. First, when SOCHS implemented its program, officials found the existing systems were inadequate to track injury and claim experience, so SOCHS developed two databases—one based on the Report of Employee Incident form and the other based on workers' compensation claim experience.⁸⁶ These databases help SOCHS officials monitor injuries and claims, but officials said they do not typically isolate

⁸⁶This database is operated by SOCHS' third-party administrator.

injuries that would be categorized as MSDs because SOCHS has sought to reduce all types of injuries and their associated costs. Officials said it could be difficult to isolate MSDs from other injuries, since doing so would require that all Report of Employee Incident forms be reviewed to fully understand the circumstances of the incidents and, thereby, determine whether the injuries resulted from ergonomic hazards.

Officials also said costs can be significantly affected by one or two large claims. For example, in 1996, the medical center had a total of 179 lost workdays, 157 of which resulted from one claim. Thus, this one claim was in large part responsible for the increase in average MSD cost discussed above. Officials also said the number of incidents is likely to increase because early reporting is being encouraged.

Moreover, officials said it was difficult to know how much of a reduction in injuries, illnesses, and associated costs is appropriate. They agreed that it was appropriate for OSHA not to impose specific performance goals, such as a certain percentage reduction in workers' compensation costs, given the newness of the program. The officials said program results must be viewed over the long term, because they believed the key was to look for a process that improves from year to year.

Reductions in Injuries and Illnesses According to the OSHA 200 Log

The OSHA 200 log data are instructive because they illustrate a facility's general experience with injuries and illnesses, and these data are used by OSHA in its inspection efforts. According to data for the medical center and nursing home combined for 1993 through 1996,⁸⁷ the number of injuries and illnesses for every 100 employees (the incidence rate) declined from 14.7 to 12.3 (see fig. 4). The experience between the two was uneven, however, with the nursing home experiencing an increase in injuries and illnesses over this period. But the significant reductions at the medical center enabled SOCHS, as a whole, to realize a reduction in the incidence rate. And, for 1995, the last year for which industry comparison data are available, the nursing home's incidence rate of 17.3 was lower than the industry average for nursing and personal care facilities of 18.2, and the medical center rate of 8.6 was below the industry average for hospitals of 10.1. Additionally, while the facilities together were able to reduce the number of lost workdays for every 100 employees by 35, the number of restricted days for every 100 employees for both facilities combined actually increased by 45 (see fig. 2).

⁸⁷OSHA 200 log data were available for 1993, the year before the full implementation of SOCHS' program. Because so few years of data were available for workers' compensation costs for MSDs, we decided to use 1993 for the base year for presentation of OSHA 200 data.

The officials said reduction of lost workdays was important for them because the medical center and the nursing home were selected for inclusion in the Maine 200 program because of their large number of claims with lost days. As a result, officials said the increase in the number of restricted days reflects their efforts to keep injured employees at work on restricted work assignments or to return employees to work as soon as possible. Also, as evidence of its return-to-work policy, last year, SOCHS did not have to pay any workers' compensation for nursing home employees' salary or benefits while they were out of work.⁸⁸

Officials said they do not primarily use the OSHA 200 log to track program progress. In fact, they said they had to develop other systems when they first began the program because the OSHA 200 log data were piecemeal and, in some cases, inaccurate. Moreover, officials said OSHA 200 did not allow for sufficient information to be entered about the cause of the injury or illness.

Improvements in Productivity, Quality, and Morale

SOCHS officials believed that their emphasis on ergonomics, and safety and health in general, had contributed to an improved work environment, but evidence of this was largely anecdotal. Officials believed that the program had contributed to reduced turnover and absenteeism, and the better work environment has meant that SOCHS can attract the best employees away from competitors. In some cases, ergonomic improvements have also contributed to increased efficiency and effectiveness; for example, some of the equipment redesigns have eliminated duplication in the processes SOCHS uses to enter data. Officials also said that employee morale has improved, as evidenced by employees' appreciation and use of the automatic lifts. In response to employees' demands, SOCHS is now buying additional automatic lifts for use in other areas. This is significant, given that there was some resistance when the lifts were first instituted.

⁸⁸In Maine, employees must use their own accrued leave for the first 4 days they are out for any injury; the next 4 days are covered under a short-term disability fund. As a result, workers' compensation is not triggered until the ninth day, or after 56 hours. Because no injured employees at the nursing home were out for more than 8 days in 1996, SOCHS did not have to expend any workers' compensation costs on salary or benefits.

The Ergonomics Program at TI, Defense Systems and Electronics Group Headquarters, Lewisville, Texas

Background

Texas Instruments, which began operation in 1951, is a manufacturer of semiconductor devices; electronic sensors; and radar, navigation, and missile guidance systems. TI has about 55,000 employees worldwide in about 150 locations.

The Lewisville, Texas, facility of TI, which began operation in 1978, serves as the headquarters of the Defense Systems and Electronics Group (Systems Group) for TI. The Systems Group, which includes Lewisville and four other nearby facilities, produces the “smarts,” or electronics, for weaponry. About 2,800 employees are employed at Lewisville, with engineers composing about two-thirds of the staff. Other occupations at Lewisville include electrical assemblers, machinists, manufacturing aides, and equipment technicians. None of the workforce is unionized.

TI’s corporate culture, which reflects quality management principles, affects TI’s ergonomics efforts. Beginning in the early 1990s, TI adopted a team-based organizational structure. Many different teams have been formed at the facility level, the Systems Group level, and the corporate level to address a wide range of production and other issues, including safety and health. TI drives its activities by setting corporationwide goals and providing considerable flexibility at the various levels of the organization to achieve these goals. The overall goals and targets are set through a negotiation process between corporate management and these teams. As consistent with quality management principles, TI has encouraged the diffusion of best practices across sites. The Systems Group Ergonomics Council was formed in 1993 to facilitate sharing of information across the Systems Group. Also, a Global Ergonomic Leadership Team was formed at the corporate level to build a corporate communication strategy. TI also participates in an informal consortium of Texas companies called the North Texas Ergonomics Consortium.

The industry type and product line also affect TI’s ergonomics efforts. The Lewisville facility was described as a “lean and agile” operation that undergoes rapid changes in production activity. For example, as production in some work areas is “ramping up,” in others, it is “ramping down.” A recent consolidation resulted in some staff and operations from other facilities being transferred to Lewisville. These constant changes can be challenging to teams trying to reduce ergonomic hazards. In addition, the federal government is a major customer for the products at Lewisville, which places some constraints on the flexibility the facility has to modify its production practices. Also, because of Lewisville’s dependence on federal contract dollars, the facility underwent some downsizing between

1992, when it had about 3,700 employees, and 1996, when approximately 2,800 employees were employed at this facility.

Initiating the Ergonomics Program at Lewisville

The ergonomics program at Lewisville was fully implemented in 1992, the year after workers' compensation costs for MSDs exceeded \$2 million, causing considerable alarm among facility management. TI's ergonomics efforts, including those at Lewisville, appear to have evolved, however, with some activities dating back to the 1980s.

An extensive ergonomics awareness training effort was initiated by the site safety engineer at Lewisville in the 1980s. The next site safety engineer, who still holds this position, specializes in ergonomics. In 1989, an ergonomics thrust was proposed by the Lewisville Site Safety Council. Special corrective action teams (CAT) were formed to address specific ergonomic problems, such as replacing worn hand tools and redesigning totes for material handling that would cause less strain. Although the individual CATs attacked some special problems, each was dissolved once a solution was proposed.

In 1991, a standing ergonomics team, Lewisville's ergonomics team, was formed, and a second wave of ergonomics training was initiated throughout the manufacturing work areas. "ERGO Days"—special days on which participatory, educational displays were set up throughout the facility to foster awareness of ergonomic issues and during which employees' personal workstation measurements were taken—were begun in 1992. The ergonomics team also conducted incident evaluations when injuries occurred and started an effort to adjust administrative workstations. However, because the team was staffed by Lewisville employees who volunteered to do this in addition to their other duties, it was limited in what it could accomplish. In some cases, considerable delays occurred between when an injury was reported and when team members could find time to conduct an evaluation.

When a full-time ergonomics specialist position was created in 1995, the ergonomics team began to address the MSD problem more aggressively, according to the current team leader. A facility team of program managers—referred to as the Site Safety Quality Improvement Team (QIT)—had agreed to create this position because the ergonomics team had successfully argued that its inability to follow through on reports of injuries was a barrier to the facility's reaching its safety and health goals.

In 1996, the ergonomics team was reorganized to include a cross section of facility employees.

Structure and Core Elements of the Program at Lewisville

The heart of the ergonomics program at Lewisville is its ergonomics team, to which the full-time ergonomics specialist and the site safety engineer provide support. Other teams formed for broader objectives within the Lewisville facility, across the entire Systems Group, and throughout the corporation provide guidance and direction to the ergonomics team. These teams, including the Site Safety QIT, which is composed of program managers, communicate focus and strategy to the Lewisville Site Safety Council, of which the ergonomics team is a subteam.

The Systems Group Ergonomics Council communicates focus and overall direction on ergonomic activities across the Systems Group. It reports upward to two teams that support numerous ergonomic activities and also operate across the Systems Group: the Systems Group Environmental, Safety, and Health Leadership Team and the Systems Group Human Resources Leadership Team. These teams in turn feed into the Systems Group Leadership Team. At the corporate level, there are the Corporate Environmental Safety and Health Leadership Team and its subteam specific to ergonomics, the Global Ergonomics Leadership Team, which was formed just a year ago. The activities of the Global Ergonomics Leadership Team include building a better communication strategy that is truly global (since TI has facilities worldwide). Also at the corporate level is the staff office for Corporate Environmental Safety and Health.

Management Commitment

Management commitment to the ergonomics program at Lewisville is demonstrated in a number of ways. Primary among them is the assignment of staff, including the ergonomics team and a full-time ergonomics specialist hired in 1995 to help the team achieve its objectives. The site safety engineer said that the facility probably waited “too long” to hire the ergonomics specialist, which delayed implementation of the ergonomics program since neither the members of the ergonomics team nor the site safety engineer could respond quickly enough to problems.

Corporationwide accountability mechanisms are reflected in the corporate strategic goal, which all facilities are expected to contribute toward achieving. This overall goal is to eliminate all preventable occupational and nonoccupational injuries and illnesses by the year 2005. To do so, since 1996, facilities have strived for a 20-percent reduction from the

previous year in the injury and illness incident rate and the lost or restricted day rate. In addition, a corporationwide audit is conducted by the Corporate Environmental Safety and Health office at each facility once every 3 years. Through these audits, TI tries to ensure that each facility is following practices consistent with the company's Ergonomic Process Management Standard, which lays out minimum requirements for the core elements of an ergonomics program that each facility must meet. Each facility also conducts a self-audit every year using these same guidelines.

Ergonomic principles are also integrated into purchasing and design. For example, a future project of the ergonomics team, the Integrated Product Development Process, will involve working with facilities staff, product designers, and assemblers to see how ergonomics can be better integrated into product development. In addition, the ergonomics team, working with other teams across the Systems Group, has undertaken various projects for the design or purchase of ergonomic tools. For example, another facility within the Systems Group has developed an Ergonomic Hand Tool Catalog from which employees from any Systems Group facility can select tools that meet preset standards and that have been widely tested within the facility itself.⁸⁹

Resources are also made available for the ergonomics program. Suggestions for controlling problem jobs that are submitted by the ergonomics team are typically accepted by facility management. Because the cost center managers are also members of the Site Safety QRT (which can approve most expenditures directly), formal cost justifications are rarely required for capital investments to control ergonomic hazards. A written cost justification is required only if a control costs more than \$1,500. In fact, any of these larger capital investments must also be approved by the site safety engineer to ensure that no safety or health (including ergonomic) concerns are associated with it.

The facility has also established mechanisms for ensuring that middle management support is sustained. The Site Safety QRT is composed of program managers who provide overall focus and strategy to the ergonomics team and also approve most capital investments to improve ergonomic conditions. Also, in recognition of the importance of middle management buy-in, two "Ergonomic Management Seminars" were sponsored in 1996. Some of the managers had been skeptical of the need for the ergonomics program, perhaps since they had never experienced an

⁸⁹A manager at this other facility made money available out of his own budget to purchase tools, thereby expanding the hand tool effort there. Less money is available at Lewisville for purchasing these tools.

MSD—and they may be less likely to, since their job responsibilities tend not to pose the same risks. Yet the ergonomics team considered buy-in from these middle managers critical, since they often controlled the cost centers toward which any ergonomic investments would be charged. These management seminars demonstrated how ergonomic losses affect the bottom line by discussing the cost of injuries and the impact of MSDs on productivity.

TI's Ergonomic Site Policies and Procedures lays out specific responsibilities of various teams and facility staff for implementing the core elements of the ergonomics program. For example, this document requires the Site Safety QRT to continue to demonstrate visible support for the ergonomics program. Similarly, production engineering department staff are required to document ergonomic analysis for all future workstations and serve as ergonomic incident investigators for work areas they support. But this document is not viewed by corporate or facility staff as key to program operations, and team members said they rarely refer to it.⁹⁰

Employee Involvement

Employee involvement is illustrated by the central role the ergonomics team plays in all ergonomic activities at the facility. This team is composed of a cross section of staff from the engineering, warehouse, space planning, and medical departments as well as from TI's fitness club. There are more engineers on Lewisville's ergonomics team than there are on some other TI ergonomics teams, which, according to the team leader, reflects Lewisville's emphasis on developing controls specifically tailored to the needs of individual production units. In addition, the team leader is also a manager in the production engineering department. The team oversees the ergonomic program and the activities of the ergonomics specialist, and can make capital requests. Participation on the team is voluntary and involves a 2-hour meeting every 2 weeks and perhaps 1 hour of "homework" every week. However, it is the ergonomics specialist who is responsible for the day-to-day activities of identifying problem jobs and developing controls.

Employees are involved in an ad hoc fashion as well. They are encouraged to go directly to the ergonomics specialist or production engineering department to identify potential controls for their own jobs when they believe ergonomic hazards exist. Solutions or controls proposed by the

⁹⁰A corporate safety official said this document is based on OSHA's 1990 voluntary guidelines for the meatpacking industry.

ergonomics specialist or the ergonomics team are also critiqued by assembly and other employees who work on the problem job.

Procedures have been established so that employees can directly access ergonomic services. An employee can request an administrative or manufacturing workstation evaluation either in person, by phone, or via electronic message. The employee is then automatically visited by the ergonomics specialist, who administers a one-page “Ergonomics Evaluation Report” (one version for administrative workstations and another version for manufacturing workstations). Once measurements are taken by the ergonomics specialist, they are entered into a database so that any workstation the employee moves to within this or another TI facility is properly adjusted to meet that employee’s personal requirements.

Lewisville also conducts a number of awareness campaigns, including its “wing-by-wing” measurement campaign, in which employees are measured and their workstations adjusted. This is particularly helpful for employees who may be experiencing problems but have not yet requested services. As part of this campaign, ergonomic accessories are suggested to individual employees and ordered, and the ergonomics team works with cost center managers to purchase equipment or anything else that the employee needs. In addition, Lewisville offers a wide range of training and awareness activities, which are catalysts for effective participatory ergonomics, according to the facility’s ergonomics training coordinator. (These training and awareness activities are described below).

Identification of Problem Jobs

There are several ways in which the ergonomics team and the ergonomics specialist learn that a job might be a problem. Incidence-based methods for identifying problem jobs, that is, methods that rely on employee reports of injury or discomfort or employee requests for assistance, follow:

- When an accident occurs or an employee reports an injury or illness to the health center, the supervisor or “safety starpoint”⁹¹ must investigate the incident and complete an “Injury/Illness Investigation Report.” This report, which is submitted to the Accident Review Board of the safety department, is intended to identify root cause in order to prevent another employee from being injured in the same way. The employee is evaluated and treated at the health center. If the injury involves “body stress” or

⁹¹A safety starpoint is an employee within each work team who is responsible for helping with accident or incident evaluations and disseminating information regarding safety, which includes providing safety training, to members of the team.

“repetitive motion,” the ergonomics specialist is notified and is required to conduct a job or worksite analysis within 3 working days.

- Any employee who is experiencing discomfort can request either an administrative or manufacturing workstation evaluation simply by sending an electronic message to the ergonomics specialist.
- Jobs in all “at-risk” job classifications—that is, jobs with a high number of recordable injuries or illnesses—are identified through a review of the injury and illness data in the facility’s workers’ compensation database. Among the at-risk jobs identified were production helper, optical fabricator, parts finisher, and electrical assembler.⁹²

The following methods for identifying problem jobs on a proactive basis—to avoid injuries on jobs at which there was evidence that hazards existed—were used:

- A “wing-by-wing” measurement campaign was instituted to measure employees and adjust their workstations as a way of identifying employees who might be experiencing problems. This campaign offers one-on-one educational opportunities to employees who otherwise may not have sought out help, according to a member of the Site Safety QIT.
- An administrative workstation adjustment campaign was implemented in recognition of the facility’s need to shift its focus from hazards at the manufacturing workstation—many of which the company had already addressed—to potential hazards at administrative workstations. Many employees at Lewisville use both types of workstations.⁹³

Prioritizing problem jobs is done by the ergonomics team on the basis of jobs, or job classifications, where injuries have already occurred. In other words, the ergonomics team has focused first on jobs in which an employee, who has reported to the health center, is found to have an MSD or related symptoms. A second priority has been addressing at-risk job classifications with the help of a consultant.

Analyzing Problem Jobs and Developing Controls

Facility officials described analyzing problem jobs and developing controls as generally an “informal” process. The ergonomics specialist referred to

⁹²The analysis of all at-risk jobs, which involved examining at least several jobs within each of these job classifications and developing specific training for employees in these work areas, is 95-percent complete. However, controls have not necessarily been fully implemented in all of these job classifications, according to the team leader.

⁹³Lewisville had a target of measuring employees and adjusting the workstations of 90 percent of administrative staff by 1996. While the 1996 goal was missed, Lewisville had measured and adjusted the workstations of 72 percent of administrative staff as of March 1997.

many of his activities as workstation evaluations as opposed to job analyses because these activities focused on increasing the employee's comfort in relation to his or her workstation but did not involve major changes to the job or operations. Sometimes, however, more detailed analysis is conducted, particularly for at-risk jobs, and this facility has used the services of a consultant to help develop controls.

The ergonomics specialist said that developing controls is an "iterative" process, but that typically something can be done to reduce ergonomic hazards, even if it is just talking to the employee to identify work practices that may be contributing to the problem. Many of the controls implemented could be described as "low-tech" engineering controls, such as purchasing adjustable-height workstations and "ergoscopes" (ergonomic microscopes) to improve employees' comfort while they manually touch up or rework circuit boards. So even though some jobs required more detailed job analyses, the controls implemented were still relatively simple.

Process Used to Analyze Jobs

To analyze a problem job, the ergonomics specialist administers the one-page Ergonomics Evaluation Report whenever an employee requests that his or her workstation be evaluated. The employee can make the request to the ergonomics specialist by electronic message or face to face, since the ergonomics specialist often walks the floor of the facility so that he is accessible to all staff. Both the administrative and manufacturing workstation versions of the form ask for personal measurements and workstation descriptions and provide space for short- and long-term recommendations; the manufacturing workstation form also asks for risk factors. Once the employee measurements are taken, they are entered into a database so that any workstation the employee moves to within this or another TI facility can be properly adjusted to his or her personal requirements.

If an injury is reported to the health center, more information is collected by the health center staff and the ergonomics specialist. The "Ergonomic Evaluation Questionnaire" is several pages long and captures information on the frequency of tool or equipment use, the types of tasks performed, characteristics of the workstation if a computer is used, the types of physical activities the worker performs, the type of pain experienced, and activities outside of work that may be contributing to the problem. All of this information is provided by either the employee or the ergonomics specialist. Health center staff complete the part of the questionnaire that

asks for the employee's basic medical history, results of various ergonomic-related medical tests, and nursing interventions or treatment.

For the more extreme at-risk jobs, this facility provides a more detailed job analysis, which involves videotaping the job and collecting additional documentation. For example, the ergonomics specialist worked with a consultant to analyze and develop controls for the manual electronic assembly job, the job classification in which workers have experienced the highest injury rates. This job was videotaped in order to identify the source of the problem. However, the controls ultimately developed for such jobs are not necessarily complex even if they required more detailed analysis (see app. II). In addition, the consultant made a number of recommendations regarding Lewisville's manufacturing and warehousing operations. Because recommendations for these controls came from the consultant, the ergonomics team found it was easier to get management buy-in for necessary job changes.

Process Used to Develop Controls

Controls are typically developed informally by the ergonomics specialist, who "brainstorms" with other staff. First, the ergonomics specialist discusses the problem with the employee and the employee team assigned to the job. The ergonomics specialist also consults with the line supervisor (who is also the cost center manager for that particular work area) to get additional ideas for controls as well as buy-in for any changes to a problem job. The cost center manager can typically approve any capital expenditures within that work area.

Lewisville makes significant use of its in-house resources in developing controls. The ergonomics team comprises mostly engineers, which, according to the team leader, reflects an emphasis on developing controls specifically tailored to the needs of individual production units. Staff from the production engineering department are brought in to consult on more complex or technical jobs. Although the ergonomics team is not responsible for actually developing controls for specific problem jobs, the team does contribute to the selection of equipment, including personal protective equipment, and makes suggestions about workstation design and job rotation. Individual team members might be called in to advise on how to control a specific problem job. The ergonomics team is now trying to capture information on best practices and make this accessible to all employees and facilities through an Internet home page created for ergonomics issues.

Once problem jobs are identified, no specific threshold is used to determine whether or not a control must be put in place. The ergonomics specialist explained that some action is typically taken for each and every job where there is a problem. In fact, the ergonomics specialist said there is value even in just talking to the employee on the problem job because the ergonomics specialist can sometimes identify bad work practices that are contributing toward his or her discomfort.

To ensure that controls are effective over the long term, the facility also has developed a database that contains the results of administrative workstation evaluations. This information is used when an administrative employee relocates (which happens frequently) to ensure that the employee's new workstation is set up right the first time.

The process is really "never finished" and involves continuous monitoring, according to the team leader and the ergonomics specialist. Regular walk-throughs of the facility are conducted by the ergonomics specialist to enhance awareness and increase accessibility of ergonomic assistance to employees. Both the health center staff and the ergonomics specialist follow up on employees who have reported injuries or symptoms to the health center. Employees on the job, and other assembly and engineering staff, also provide feedback on how well controls are working.

Illustrating the iterative nature of developing controls, when an adjustable-height workstation design was tested on the production floor, employee feedback revealed that this design was unstable and allowed products to fall off. Using this feedback and working with a vendor, the ergonomics team and specialist developed a new design. The result was an adjustable table, referred to as "Big Joe," which was essentially a fork lift with its wheels removed. This design proved to be much more stable.

In some cases, the ergonomic hazard cannot be totally eliminated. One job that has been difficult for Lewisville to control involves the need for employees to fit wire harnesses into small openings of a potting mold in order to protect connectors from vibration inside the missile. This job requires considerable force, since the hand must be used as a clamp to fit the wiring into place. While the ergonomics specialist has experimented by having employees use pliers and different connectors and has asked tooling engineers to look at the job, no satisfactory engineering control has yet been developed.

Lewisville has discovered that sometimes minor changes in product design can have a major impact on reducing ergonomic hazards. An example of this involved the task of painting the inside of a particular type of missile. Employees were getting injured and experiencing discomfort from twisting and turning their wrists to paint in this confined space. After discussing the problem with the government contracting officers, Lewisville officials learned that the customer did not really need this product to be painted—that this had been required by military specifications that were now outdated. As a result of these discussions, this task was eliminated, significantly reducing the ergonomic hazards associated with the job.

Investments in technological advances in the electronics industry that have improved productivity or product quality have also led to ergonomic improvements—even though this was not necessarily the objective of these investments. By automating many of the steps in circuit board assembly over the last decade, Lewisville has eliminated much of the manual assembly work and, thereby, the associated ergonomic risks. For example, a stainless steel stencil is now laser-etched onto the board, an automated squeegee applies the paste to the board, and the boards are then fed into a machine that loads components via feeder reels and chip shooters. In these highly automated work areas, there are few ergonomic hazards.

Types of Controls Implemented

A mix of controls is employed. However, priority is given to engineering controls over administrative controls, which are viewed as an “interim solution.” Many of the engineering solutions, however, are relatively simple or “low-tech,” involving, for example, modifications to workstations so they are more comfortable for the user. These low-tech engineering solutions include installation of adjustable-height workstations, replacing older microscopes with more comfortable “ergoscopes,” placing padding along the edges of the workstation, and raising the circuit boards with foam for hand-intensive work. Hoists are used to load multiple circuit boards (which can weigh up to 60 pounds) into a vapor system machine to be primed and coated.

Many of the “low-tech” controls are also low cost. Average cost estimates developed by the ergonomics team for the Site Safety QIR are \$15 to \$20 for changes to administrative workstations and \$50 to \$1,000 for changes to manufacturing workstations. Only if a special tool is required (which is not often, according to the ergonomics team leader) to address a problem at a manufacturing workstation are costs significantly greater. Virtually every

workstation improvement can be made without going through the facility's capital approval cycle, which is required for investments over \$1,500.

"High-tech" engineering controls, however, are sometimes necessary. For example, the production engineering department developed a laser welder to eliminate some of the hand soldering required in the production of microwave circuit boards. Removing the coating around components to fix a faulty circuit board has also been automated with the use of a "microblaster." Before the microblaster, workers had to pick off the coating using tweezers.

Administrative controls are also used, particularly when it is not economical or feasible to implement engineering controls. For example, Lewisville is currently "ramping down" its production of one type of missile. Therefore, job rotation is being used on problem jobs related to the production of this missile to minimize employees' exposure to hazards.

Another type of administrative control used at Lewisville is its "stretch program." Currently, employees in most of the work areas take 10- to 15-minute stretch breaks twice a day. The purpose of the stretch breaks is to reduce both the physical and psychosocial stress of repetitive work and exposure to other ergonomic hazards. In addition, stretch breaks have sometimes led to employees' asking to have an ergonomics team member look at a work process or workstation and help them find a more comfortable solution, although, according to the ergonomics training coordinator, some managers at first felt that the stretch program was "a waste of time." However, since implementing this program, participants have reported that they feel better and are less fatigued, and some of the managers who were previously skeptical have been pleased by these results. One at-risk work area—where the majority of all injuries and illnesses at the facility had previously been recorded—found that MSDS dropped dramatically after instituting stretch breaks, which has contributed to an improved injury and illness incidence rate for the facility as a whole.

Training and Education

All employees at the Lewisville facility are required to take a general ergonomics awareness course. Each employee must take at least 1 hour of this training every 3 years.⁹⁴ Although training staff had initially proposed that this course be longer and offered annually, facility management was

⁹⁴TI as a company places a heavy emphasis on training, according to the ergonomics training coordinator. All employees are required to take 40 hours of educational training each year. Ergonomics training can be applied toward this 40-hour requirement.

concerned that this was too much of a time commitment. As a result, the awareness training requirement was reduced.

Lewisville also offers a wide range of both general awareness activities and targeted ergonomics training. “ERGO Days,” for example, is an annual 3-day event sponsored by the ergonomics team. Team members develop participatory, educational displays set up throughout the facility featuring best ergonomic practices for work and the home, computer accessories, tool demonstrations, and ergonomic workstation adjustments. Similarly, the “wing-by-wing” measurement campaign and the administrative workstation adjustment campaign spread awareness and include a one-on-one educational component. The ergonomics team also sponsors hand tool demonstrations for engineers, technicians, assemblers, and purchasers. These demonstrations are educational in nature in that they discuss, for example, the importance of replacing worn tools. In addition, Lewisville staff can access an Internet ergonomics home page. Finally, the Lewisville facility publishes an environmental, safety, and health newsletter that often features articles about ergonomics.

Training opportunities provided to employees are (1) site specific, so instruction is relevant to the employee (for example, photos and videotapes of work areas are taken to facilitate class discussion, and training is conducted within a team’s work area); (2) interactive and often team based, with emphasis on problem solving and practical solutions (the courses focus on problems employees are experiencing on their jobs, sometimes without disruption to the production cycle); and (3) results oriented, in that training staff and management plan courses together, so specific goals and expectations are agreed upon.

Courses offered at Lewisville include “Ergonomics for Computer Users” for all employees (including assembly workers if they also use computers) and “Ergonomic Audit for Computer Users” for all employees who spend more than 4 hours per day using a computer. The course “Factory Ergonomics Awareness” is designed to teach individuals how to identify and correct ergonomically unsound workplace conditions and activities. This course encourages the actual development and implementation of controls, with examples taken from participants’ own work areas. At least 95 percent of staff have taken this class. “Advanced Ergonomics for Electronic Assemblers” is specifically tailored to employees who work in this at-risk job classification, and team-based instruction is used.⁹⁵

⁹⁵One problem with team-based instruction, however, is the constantly changing composition of teams. This means that, particularly when a new team member is added, follow-up is needed to see if the training is being applied, according to the ergonomic training coordinator.

Assembly teams are taught how to identify risks and to be self directed in addressing problems. “Advanced Ergonomics for Teams that Handle Materials” is another team-based course for an at-risk job classification, which includes on-the-job training as well as classroom training. In this course, the ergonomic specialist helps the team identify a problem and develop and implement controls. A “Back Injury Prevention” course is offered to all personnel who lift as part of their jobs.

Medical Management

Strong links between Lewisville’s ergonomics program and medical management staff have been established to ensure early reporting and prompt evaluation. Lewisville (like every other facility within the Systems Group) has a health center staffed by two contract nurses. A senior nurse serves all four facilities within the Systems Group. Additional medical management staff include the disability coordinator (who is also a nurse) and the lost-time intervention manager. Medical management staff participate on all facility teams for safety, ergonomics, and lost-time intervention. These links were established because medical management staff recognized that, to have an impact on reducing injury and illness rates and their associated economic costs, they needed to participate on various teams to provide input into the facility’s ergonomic activities.

The medical management process was described as follows. First, the employee reports to the health center and a physical assessment is made and a medical history is taken. If symptoms or diagnosis of an MSD is involved, the employee is asked to fill out a portion of the Ergonomic Evaluation Questionnaire, which is then sent to the ergonomics specialist. In addition, an Injury/Illness Investigation Report is prepared for the Accident Review Board of the safety department. The ergonomics specialist is supposed to respond within 3 workdays by conducting a job analysis. Follow-up on the employee is done by medical management staff every week, and if there is no improvement, the health center recommends the employee see a doctor.

The disability coordinator is responsible for developing a relationship with local health care providers and a list of doctors who are conservative in their treatment approach, are familiar with the work at Lewisville, and understand the facility’s return-to-work program. Because state law precludes the health center from recommending a specific doctor, a list of doctors is provided to employees only if they request it. TI also has a list of preferred providers for hand surgeries if such treatment is called for. Identifying doctors and developing relationships with them have been

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challenging tasks at Lewisville, given the multitude of doctors in the surrounding Dallas metropolitan area. If the employee is out for 6 days or more, a special evaluation of the job is performed to help the doctor determine how the injured employee should be accommodated. If a determination is made that this MSD is a workers' compensation case, regular follow-up is conducted by health center staff and the ergonomics specialist.

Lewisville also uses its lost-time intervention program to return employees to transitional or restricted-duty work. This is key to cost savings, according to the manager of this program, because the company is insured through a third-party administrator, and TI pays out of pocket if an employee stays at home. In addition to cost savings, Lewisville's return-to-work program also offers other benefits, according to medical management staff: communication between the employee and the facility is maintained, and the employee feels more valued, which can accelerate the healing process.

Under Lewisville's return-to-work program, the lost-time intervention manager and other medical management staff begin to track employees who are absent from work because of an injury or illness, whether or not it was related to work. These employees are encouraged to return to work. The lost-time intervention manager assists the medical management staff to communicate with the doctor, the workers' compensation office, and the insurance office, as necessary. In 1995 alone, Lewisville's return-to-work activities resulted in 81 employees coming back to work. A corporate safety official said that before implementing this program, employees could easily become "lost in the system." Once they are back at work, employees' conditions are monitored. Typically, injured employees can be accommodated within their home work area on a restricted basis. Several things have been done to facilitate these placements, including developing a database of available jobs for workers on restriction and creating a special account that covers the payroll costs of employees on light duty (so the costs are not charged to that home work area's budget). If the limitations are permanent and prohibit the employee from performing essential job functions with reasonable accommodation, the employee is referred to the TI placement center for job search and other placement assistance. Since 1995, a total of only four employees from the several facilities composing the Systems Group have been transferred to TI's placement center because they could not be accommodated.

Results and Issues Related to Program Performance

Corporate safety and health officials at TI strongly believed in the success of Lewisville's ergonomics program, citing the reductions in injuries, illnesses, and associated costs. In fact, because the program has already achieved major reductions in injuries and illnesses, officials have now set their sights on improving productivity and other performance-related goals. Officials said Lewisville has also begun to measure its progress in implementing particular initiatives and awards bonuses to members of the ergonomics team—which can total \$300 to \$500 a person—on the basis of progress achieved. For example, the facility uses a “productivity matrix,” which assigns points on the basis of the accomplishment of particular tasks for individual ergonomic projects, to assess its progress on its administrative workstation adjustment campaign. Lewisville also tracks the progress toward other targets, such as implementing at least 10 special projects (“ERGO Days” was one of these), developing an action plan to respond to the corporationwide safety audit within 5 days, and providing 1 hour of awareness training to 90 percent of the employees at the facility. Using the productivity matrix, Lewisville compares its performance with that of other facilities across TI and other companies participating in the North Texas Ergonomics Consortium.

Corporate safety officials said that TI is probably in a better position than most companies to measure its progress in reducing MSDs because it is a “data-rich” company. Nonetheless, officials mentioned several factors that affected their ability to measure program performance.

Reductions in Workers' Compensation Costs Associated With MSDs

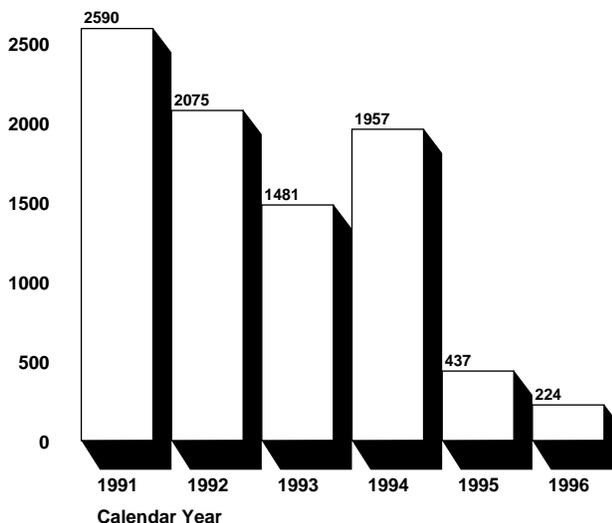
Workers' compensation data provide evidence that the ergonomic efforts at Lewisville are helping to reduce costs associated with MSDs. To capture MSDs, Lewisville tracks “repetitive motion” and “body stress.” “Body stress” includes all strains and sprains and actually represents two categories from the workers' compensation database: “strains and sprains associated with manual material handling” and “all other strains and sprains.” As figure VII.1 shows, Lewisville achieved a 91-percent reduction in workers' compensation costs for MSDs—from \$2.6 million in 1991⁹⁶ to \$224,000 in 1996. Additionally, the average cost for each MSD claim declined from \$21,946 in 1991 to \$5,322 in 1996 (see fig. 3).

⁹⁶As more fully discussed in app. I, we attempted to present data for the year before the program's full implementation through 1996 for each of the facilities. For Lewisville, since the program was fully implemented in 1992, we present data beginning in 1991.

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Figure VII.1: Workers' Compensation Costs for MSDs at the TI Facility, 1991-96

3000 Total Dollars for MSD Claims (in Thousands)



Source: TI's workers' compensation database.

Corporate officials said that increased awareness of ergonomics can lead to higher reporting of MSDs and, consequently, higher workers' compensation claims and costs. The officials said the high cost of MSDs in 1991 can be attributed to the efforts the facility made to increase awareness in the late 1980s; similarly, the spike in 1994 can be attributed to heavy awareness training in the early 1990s, as well as a notification sent to all employees in 1993 of a possible program shutdown due to cutbacks in federal contracts (the shutdown was ultimately averted). Officials said employees are more likely to report injuries before a shutdown in order that they might collect workers' compensation benefits should they be laid off.

Officials also said they could not estimate total program costs or determine whether the reductions in MSD costs and other outcomes exceeded program expenditures. A facility official said it would be difficult to distinguish between those investments made for ergonomic reasons and those made for other purposes, such as to enhance productivity.

Reductions in Injuries and Illnesses According to the OSHA 200 Log

Trends in overall injuries and illnesses reported in the OSHA 200 log are important because MSDS account for a significant portion of all injuries and illnesses at our case study facilities and because these data are what OSHA looks at when inspecting a facility. Furthermore, OSHA 200 data are key to how TI measures safety and health performance. In fact, using OSHA 200 data, Lewisville was able to demonstrate that it had achieved in 1996 its yearly target of a 20-percent reduction in the overall incidence rate and the lost or restricted workday rate. Meeting this goal contributed to the corporationwide goal of eliminating all preventable occupational and nonoccupational injuries and illnesses by the year 2005.

The facility's incidence rate—the number of injuries and illnesses per 100 employees—for all injuries and illnesses recorded in its OSHA 200 log declined from 5.5 in 1991 to 1.5 in 1996 (see fig. 4). The 1995 incidence rate of about 2.1 was below the industry average of 3.8 for other manufacturers of semiconductors and related devices in 1995, the most recent year for which these data are available. Additionally, between 1991 and 1996, Lewisville reduced the number of lost and restricted days for every 100 employees by 66 days and 15 days, respectively (see fig. 2).

While TI relies on OSHA 200 log data to track corporate performance in safety and health, facility officials said it is important that the right OSHA data be tracked. For example, officials said it is more meaningful to track whether or not an injury or illness involved any lost or restricted days in the first place than to track the actual number of lost and restricted days.⁹⁷

Improvements in Productivity, Quality, and Morale

Corporate and facility officials told us that, since Lewisville has already achieved major reductions in injury and illness rates, the facility is looking for new ways to measure progress made in productivity. However, they also said they are just beginning to consider how productivity gains through ergonomic improvements might be documented.⁹⁸ These officials believe that productivity gains will be more difficult to demonstrate than injury and illness reduction, because most of the “low-hanging fruit” (that

⁹⁷This explains why the lost and restricted day case rates are not tracked at TI facilities. The site safety engineer said the numbers of lost and restricted days were not as meaningful: They do not directly correlate with the severity of the injury or illness because workers' compensation laws can make it difficult to bring employees back to work once they are out.

⁹⁸TI is also piloting “nonoccupational” safety and health projects to reduce injuries and illnesses caused by activities employees do off the job. Corporate safety officials believe that these injuries and illnesses contribute to significant productivity losses.

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is, problem jobs that are easier to identify and control) has already been addressed at Lewisville.⁹⁹

Currently, Lewisville is piloting productivity studies. For example, the ergonomics team will be examining production bottlenecks to which ergonomic hazards might be contributing. The team refers to these efforts as its Continuous Flow Manufacturing Program. Recent efforts to improve hand tools are part of this initiative. In addition, the Systems Group Ergonomics Council recommended that Lewisville and other Systems Group facilities and their respective ergonomics teams begin to compare the productivity of operations at workstations that have adjustable-height equipment with the productivity of operations at workstations that do not have this equipment.¹⁰⁰ Productivity changes will be measured in terms of cycle time, output, and ergonomic gains. In addition, to document any productivity changes, the ergonomics specialist plans to videotape these jobs before and after the introduction of the adjustable-height workstations.

Evidence regarding morale improvement was largely anecdotal. However, corporate and facility staff emphasized that the ergonomics efforts at TI were consistent with quality management principles and that employee participation and empowerment are key to employee satisfaction. Medical management staff said that medical management and return-to-work efforts have benefited morale because they help demonstrate to employees that they are valued.

⁹⁹Another factor that makes productivity difficult to track, according to the team leader, is that, because of its varied product line, TI tracks on-time delivery to contract and not to units produced per hour per day. In addition, absenteeism is not a very useful measure, since TI offers employees a special time-off policy.

¹⁰⁰By installing an electric motor on workstation tables that were already being used at Lewisville, the facility made its own adjustable-height workstations without having to purchase new ones. Part of the table was also cut out so the employee could get closer to the microscope and other tools and materials on the table.

Comments From the Department of Labor

U.S. Department of Labor

Assistant Secretary for
Occupational Safety and Health
Washington, D.C. 20210



AUG 4 1997

Carlotta C. Joyner
Director
Education and Employment Issues
General Accounting Office
Washington, D.C. 20548

Dear Ms. Joyner:

I want to thank the General Accounting Office (GAO) for the opportunity to comment on the report "Worker Protection: Voluntary Private Sector Ergonomics Programs Yield Positive Results."

On the whole, OSHA believes the report, although limited in scope, represents a valuable contribution to the extensive literature on the benefits of ergonomic programs and reinforces conclusions found elsewhere in the literature. The GAO study helps to explain ergonomics in the simplest possible way: by showing that ergonomic interventions in the workplace significantly reduce work-related injuries and illnesses. The report shows that simple, inexpensive ergonomics programs can achieve impressive results in reducing musculoskeletal disorders (MSDs) and that this, in turn, leads to significant reductions in workers' compensation expenses.

GAO's finding that the five companies included in its study achieved from 36 to 91 percent reductions in their workers' compensation costs for MSDs as a result of these programs is impressive. It is also noteworthy that all of these programs included core elements similar to those OSHA has recognized as fundamental to ergonomics programs: management commitment; employee participation; identification of problem jobs; analysis and improvements for problem jobs; training and education; and medical management. The report clearly shows that major declines in the number and cost of MSDs can be achieved through simple, inexpensive, "low tech" interventions.

The report is consistent with OSHA's ergonomic programs experience. As early as 1989, OSHA articulated possible approaches to prevent MSDs, including the core elements of an effective ergonomics program. Since that time ergonomic programs have been widely adopted. At a conference sponsored by OSHA and NIOSH (January 1997), companies from around the country and across a variety of industries concluded that ergonomic programs yield positive results. In a period of industry downsizing and stiff global competition, companies find that maintaining an ergonomics program is integral to their overall success.

GAO notes that its report is limited because it only covers five large firms that have recently implemented ergonomics programs. All the firms studied identified problem jobs based on whether there had been work-related MSDs or other "incidents" in that job. There is broad agreement that such an incident-based approach is the quickest and easiest way to identify problem jobs.

Nonetheless, many other firms have adopted a more proactive approach that includes a hazard or job analysis to identify problem jobs where no injury or illness has yet occurred. While the study describes the potential benefits of some incident-based approaches, it is unfortunate that it cannot be used to draw any conclusions about the relative advantages of more proactive approaches. This is particularly true because the usefulness of incident-based approaches in identifying problem jobs varies significantly between small and large firms. Incident-based approaches work best where dozens or even hundreds of workers have similar jobs, as is the case in the companies included in the GAO study. Unfortunately, incident-based approaches are unlikely to work as effectively where there are a small number of workers in a given job, as is typical of many small and medium-sized firms.

There are myriad federal and state OSHA programs that address ergonomic issues. The GAO report attempted to describe some of OSHA's past, current and planned initiatives which directly or indirectly serve to reduce work-related MSDs. However, because of the limited scope of the study, which was concerned with the success of private sector voluntary programs, GAO was not able to fully and adequately describe state and Federal OSHA activities, policies, and programs. To do these efforts full justice could easily warrant a study in itself.

The weight of the evidence from the GAO report and other documents supports the need to prevent musculoskeletal disorders and the efficacy of controls. It is our sincere hope that this report will allow OSHA to continue the process of protecting America's workers from the debilitating effects of musculoskeletal disorders. On the issue of musculoskeletal disorders, NIOSH, employers and OSHA agree that there are serious health problems and simple solutions. The Agency welcomes the results of the GAO study as further evidence that the effectiveness of ergonomic programs is proven and not experimental.

Sincerely,



Greg Watchman
Acting Assistant Secretary

GAO Contacts and Acknowledgments

GAO Contacts

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Staff Acknowledgments

Other significant contributors to this report included Robert Crystal, Senior Attorney, who reviewed the legal implications of our findings; Benjamin Ross, Evaluator, who obtained information from state-operated programs on efforts to encourage employers to reduce MSDs; George Erhart, Senior Evaluator, who helped conduct and analyze the results of the case studies; Ann McDermott, who developed the graphics used in this report; Nancy Crothers, who edited and processed this report; and Bill Tacy, Special Assistant to the Director, Office of Security and Safety, and Joe Kile, Supervisory Economist, who contributed valuable comments and feedback during the planning and implementation of this review.

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