



The Changing Organization of Work and the Safety and Health of Working People

Knowledge Gaps and Research Directions

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health



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Foreword

Throughout its thirty years as the Nation's primary research agency for worker safety and health, NIOSH has played a vital role in improving safety and health in the workplace. However, much remains to be done and new challenges are always on the horizon. This is certainly the case with the organization of work.

Since its inception, NIOSH has been committed to understanding and preventing hazards arising from the organization of work. In the 1970s, NIOSH was a partner in the Quality of Employment Surveys and initiated seminal epidemiologic studies on the effects of organization of work factors. Subsequently, NIOSH recognized stress at work as a leading safety and health problem and launched a series of initiatives to investigate and control this problem. Working with the American Psychological Association (APA), NIOSH has supported international conferences on work, stress, and health and postgraduate and graduate training programs combining organization of work with occupational safety and health at major universities. NIOSH also collaborated with the APA and other partners to establish the Journal of Occupational Health Psychology to explore these issues. But sweeping changes in the organization of work in recent years have increased the stakes and now call for bold new action.

In 1996, the National Occupational Research Agenda recognized organization of work as one of the 21 priority research topics for the next decade, and a multidisciplinary team of researchers and practitioners from government, industry, labor, and academia was assembled to craft the research agenda presented in this report. Simultaneously, a concerted effort was made to expand and strengthen both the extramural and intramural NIOSH programs in this area. We have increased extramural funding to universities for research on the organization of work and enhanced the visibility of "organizational science" within NIOSH.

We are confident that these measures will serve to energize urgently needed research on safety and health in the changing workplace. I commend to you the present report—not as a final definitive statement on research needs, but as a framework for a national agenda to

elevate organization of work research to a higher priority in occupational safety and health, to provide guideposts for research direction, and to develop partnerships in support of these pursuits.



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Abstract

Revolutionary changes in the organization of work have far outpaced our knowledge about the implications of these changes for the quality of working life and for safety and health on the job. This gap in knowledge is one of the 21 priority areas for research under the National Occupational Research Agenda (NORA)—a framework crafted by the National Institute for Occupational Safety and Health (NIOSH) and its partners to guide research into the next decade. This report was developed under NORA as the first attempt to develop a comprehensive research agenda for investigating and reducing occupational safety and health risks associated with the changing organization of work. Research and development needs identified in the agenda include (1) improved surveillance mechanisms to better track how the organization of work is changing, (2) accelerated research on safety and health implications of the changing organization of work, (3) increased research focus on organizational interventions to protect safety and health, and (4) steps to formalize and nurture organization of work as a distinctive field in occupational safety and health.

Executive Summary

Organizational practices have changed dramatically in the new economy. To compete more effectively, many companies have restructured themselves and downsized their workforces, increased their reliance on nontraditional employment practices that depend on temporary workers and contractor-supplied labor, and adopted more flexible and lean production technologies.

Fears have been raised that these trends are resulting in a variety of potentially stressful or hazardous circumstances, such as reduced job stability and increased workload demands. Data suggest, for example, that working time has increased dramatically in the last two decades for prime-age working couples, and that workers in the United States now log more hours on the job than their counterparts in most other countries. On the other hand, the increased flexibility, responsibility, and learning opportunities seen in many of today's jobs may hold potential for improved satisfaction and well-being in the workforce. In reality, however, the revolutionary changes occurring in today's workplace have far outpaced our understanding of their implications for work life quality and safety and health on the job.

This gap in knowledge about safety and health effects of the changing organization of work has been recognized as one of the 21 priority areas for research under the National Occupational Research Agenda (NORA). NORA represents a concerted

process by the National Institute for Occupational Safety and Health (NIOSH) and its partners to target and coordinate occupational safety and health research into the next decade. Approximately 500 individuals and organizations outside NIOSH contributed to NORA, including employers, employees, safety and health professionals, public agencies, and industry and labor organizations.

The present report was developed under NORA as the first attempt in the United States to develop a comprehensive research agenda to investigate and reduce occupational safety and health risks associated with the changing organization of work. Four areas of research and development are targeted in the agenda.

First, an urgent need exists to implement data collection efforts to better understand worker exposure to organizational risk factors for illness and injury, and how these exposures may be changing. Since the demise of the Quality of Employment Surveys of the 1960s and 1970s, there has been no way of determining how the demands of work may be changing, and how these demands vary from one industry, occupation, or population to another. In this regard, there is a special need for systematic data collection examining major trends in organizational practices (e.g., new production technologies such as lean production and flexible manufacturing) that appear to be spreading rapidly

through the economy and seem to have an important influence on job demands.

Second, much greater research attention needs to be given to the safety and health effects of prominent trends in the organization of work that have arisen in recent years. Process reengineering, organizational restructuring, and flexible staffing are prime examples of practices that are increasingly prevalent but insufficiently studied from an occupational safety and health perspective. For example, despite growing concern that inexperience resulting from variable and short-term job assignments may place temporary workers at increased risk for illness and injury, little data exist on safety and health outcomes among these workers.

This research on effects of new organizational practices cannot ignore the changing workforce, which is increasingly populated by women, ethnic minorities, and older workers. Women are disproportionately represented in jobs with restricted benefits and reduced flexibility, and they account for almost all of the growth in working hours. African-American women are twice as likely to be employed in temporary jobs than in traditional work arrangements, and (longer-tenured) older workers are at increased risk of displacement with greater earnings losses. Yet, the interplay of major demographic trends and the changing organization

of work has received little research attention in the United States.

Third, the need exists for intervention research targeting organizational practices and policies that may protect worker safety and health. Improved methods are needed to overcome the many obstacles confronting intervention research in workplaces, and a closer examination is needed of factors influencing the motivation and capacity of firms to implement organizational interventions to protect worker safety and health.

Finally, progress toward understanding and preventing safety and health risks posed by organizational factors will require a much stronger public health commitment to this field of study. Steps need to be taken to formalize and promote organization of work as a distinctive field of study within occupational safety and health, to develop the multidisciplinary training essential for research in this area, and to improve research funding opportunities. As prescribed by NORA, strategic alliances among key stakeholders will be fundamental to advances of this nature. Stakeholders include Federal agencies, industry and labor coalitions, and the many professional disciplines with interests in the organization of work (e.g., labor studies, economics, organizational behavior, occupational/public health, and the job stress field).

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1 Introduction

Changing Organization of Work

Advanced industrial countries such as the United States have witnessed sweeping changes in the organization of work that have been influenced by major economic, technological, legal, political, and other forces. Manufacturing jobs continue to decline, giving way to service and knowledge work. Liberalized trade regulations and new information and computer technologies have enabled more companies to operate globally, resulting in intensified price and product competition. In addition, product and service demands are shifting rapidly amid pressure for higher quality and customized products. In many countries, these trends are occurring against the backdrop of an aging and increasingly diverse workforce and tightening labor markets.

Organizational practices have changed dramatically in this new economy. To compete more effectively, many large companies have restructured themselves by downsizing their workforces and outsourcing all but core functions. At the same time, nontraditional employment practices that depend on temporary workers and contract labor have grown steadily. Organizations are also adopting new and flatter management structures that result in downward transfer of management responsibility and decentralized control, and they are implementing more flexible and lean production technologies such as just-in-time manufacturing. The rubric “high performance” work systems has

been used to describe and justify many of these organizational practices.

... revolutionary changes in the organization of work have far outpaced our understanding of their implications for work life quality and safety and health on the job.

For many workers, these trends have resulted in a variety of potentially stressful or hazardous circumstances, such as reduced job stability and increased workload. Data suggest, for example, that the average work year for prime-age working couples has increased by nearly 700 hours in the last two decades [Bluestone and Rose 1998; DOL 1999a] and that high levels of emotional exhaustion at the end of the workday are the norm for 25% to 30% of the workforce [Bond et al. 1997]. Alternatively, increased flexibility, responsibility, and learning opportunity in today’s workplace may offer workers greater potential for self-direction, skill development, and career growth, leading to reduced stress and increased satisfaction and well-being.

In reality, these revolutionary changes in the organization of work have far outpaced our understanding of their implications for work life quality and safety and health on the job. This gap in knowledge is the subject of discussion here.

Concept of Organization of Work

Although the expressions “work organization” or “organization of work” are increasingly used in discussions of worker safety and health, these expressions have not been formally defined, and literature on this topic is still meager in the occupational safety and health field. As used in this document, organization of work refers to the work process (the way jobs are designed and performed) and to the organizational practices (management

and production methods and accompanying human resource policies) that influence job design. Also included in this concept of organization of work are external factors, such as the legal and economic environment and technological factors that encourage or enable new organizational practices.

Figure 1 depicts the multilevel concept of organization of work and illustrates the continuity between (1) broad economic and public policy and other forces at the national and international level,

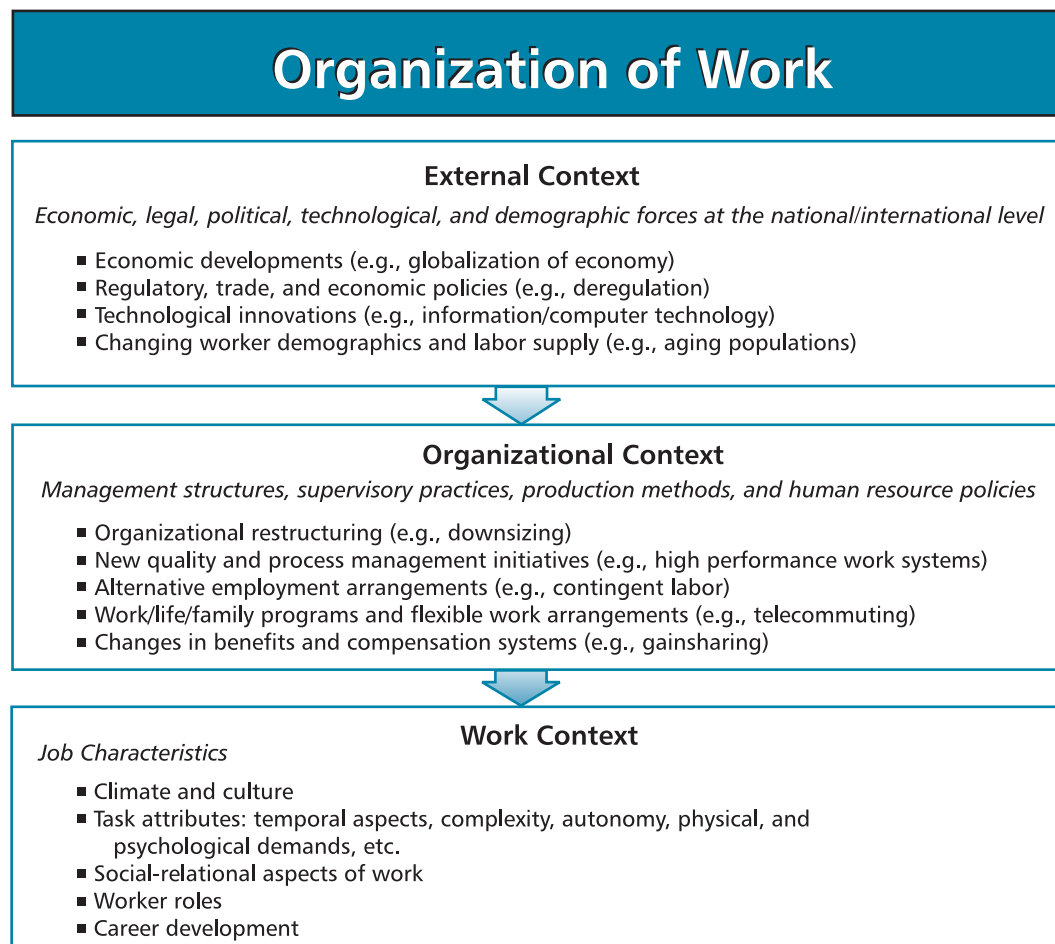


Figure 1. Organization of work.

(2) organization-level structures and processes, and (3) job demands and conditions in the workplace. For example, global economic pressures may lead to restructuring and downsizing by companies which, in turn, may increase workload demands and reduce job security for workers.

As explained, organization of work is identified most closely with the work process and with organizational factors influencing the work process. However, as illustrated conceptually in Figure 2, the present discussion adopts a broader formulation of the organization of work that incorporates both human resource practices and labor market characteristics. (Note that human resource practices and labor market characteristics are included among the organization of work factors in Figure 1.) In practice, these elements cannot be excluded from discussions of organization of work because they are commonly bundled together with work process innovations, or they may interact with new work processes to influence safety and health. For example, expanded employee training (a human resource function) is integral to the success of flexible production processes (an aspect of the work process). As an example of interplay between labor market and work process factors, studies imply that increasing job demands or longer work hours may pose disproportionate risk for women because they bear greater domestic responsibility and therefore experience greater total workload than do men [Alfredsson et al. 1985; Heyman 2000; UNDP 1995].

Organization of Work and Occupational Safety and Health

Organization of work has been a topic of interest for some time in specialized areas of occupational

safety and health, especially in the fields of job stress, industrial fatigue, and ergonomics. For example, extensive literature links job characteristics (e.g., low levels of control and work overload) to job stress and stress-mediated health outcomes such as cardiovascular disease and psychological disorders [Karasek and Theorell 1990; Sauter et al. 1998; Schnall et al. 2000].

However, there is growing appreciation that the organization of work has broad implications for the safety and health of workers—not just for stress and stress-related outcomes. The changing organization of work may also directly influence the level of exposure to physical hazards in the workplace. For example, workers with multiple jobs or extended work shifts might be at risk of exceeding permissible exposure concentrations to industrial

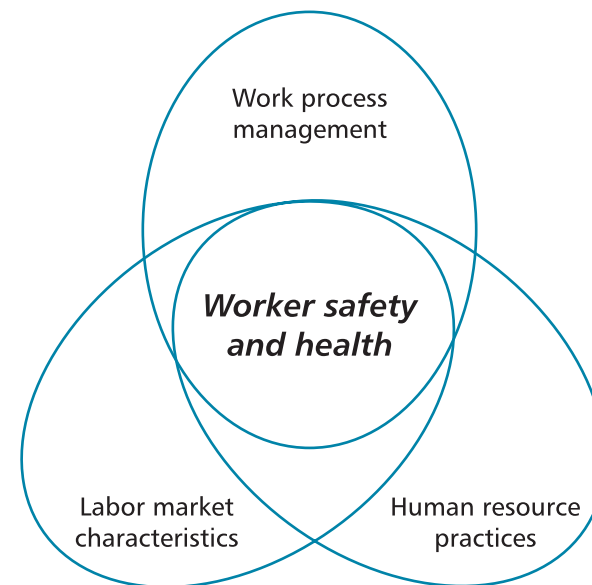


Figure 2. Topics encompassed by the organization of work.

chemicals. Long work hours and staff reductions may increase the risk of overexertion injury. Increased public contact and alternative work schedules (e.g., night work), which are common in the growing service sector, may expose workers to heightened risk of violence in their jobs.

In addition, worker safety and health might be threatened by more indirect effects of changing organizational practices. For example, worker access to occupational health services and programs might be adversely affected by organizational downsizing or by the growth of defined contribution or voucher-style health benefit programs. These multiple influences of organization of work on occupational safety and health are illustrated in Figure 3.

Little research, however, and few resources have been directed toward a fuller examination of the safety and health risks (or benefits) of the changing workplace. Indeed, researchers currently have only limited means to understand how the organization of work is changing, and studies linking organizational changes to safety and health outcomes have been slow to develop. Even more uncommon is research on organizational interventions to protect worker safety and health in the changing workplace.

The present report develops a scientific agenda to address occupational safety and health consequences of the changing organization of work. We begin by examining *surveillance systems* and suggesting improvements in these systems to better

track how the organization of work is changing. Second, innovative organizational practices in today's workplace are examined, and *safety and health effects research* is proposed to better understand the consequences of these practices. Third, limitations in research on ways to reorganize work to protect worker safety and health in the changing workplace are discussed, and steps to advance *intervention research* of this nature are proposed. Finally, *challenges confronting research* on all of these topics are discussed.

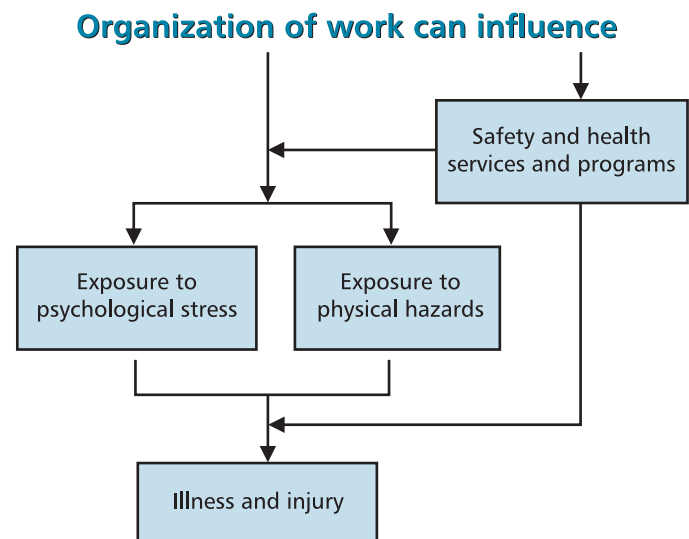


Figure 3. Pathways between organization of work and illness and injury.

2 Surveillance

Gaps in Surveillance of the Changing Organization of Work

Our capacity to track or describe changing patterns of work is very limited. Thus, we lack the means to determine whether organization of work factors that present known threats to worker safety and health are becoming more or less prevalent in the workplace; we are unable to identify emergent trends in the organization of work that may pose risk; and the distribution of organizational hazards across industry, occupation, worker demographic, and other relevant sectors cannot be known. These knowledge gaps stand as primary obstacles to interventions to protect workers from known organizational hazards and to the conduct of studies to better understand the safety and health effects of emergent and suspected organizational hazards.

Our capacity to track or describe changing patterns of work is very limited.

Unlike the European Union, which has undertaken cross-national surveys of working conditions (including the organization of work) at 5-year intervals, few mechanisms exist in the United States for recurrent or systematic investigation of the organizational aspects of working conditions. It is notable, however, that this type of information was once collected in the context of the Quality of

Employment Survey (QES) that was administered on three occasions during the period 1969–1977.

The Bureau of Labor Statistics (BLS) provides periodic updates on labor market conditions and other topics relevant to organization of work through mechanisms such as the Current Population Survey (CPS), a monthly sample survey of 50,000 households. Examples of information that is relevant to the organization of work and collected by BLS through the CPS and other surveys include data on occupational growth in different sectors of the economy, job displacement and layoffs, alternative employment arrangements (e.g., temporary help agency employment), multiple job holding, earnings and benefits, and hours of work and work schedules. Information about related topics is also provided by other Federal agencies (e.g., Census Bureau and Department of Transportation), private institutes (e.g., Economic Policy Institute, Families and Work Institute), trade associations (e.g., American Management Association), consulting firms (e.g., International Survey Research Corporation), and national and international human and labor rights organizations (e.g., International Labour Office).

Reports from these sources have yielded insights on changing patterns of work that may have implications for worker safety and health. For example, a sampling of findings by these groups suggests the following: (1) hours of work seem to be growing steadily across many occupations and worker populations [Bluestone and Rose 1998;

DOL 1999a; Rones et al. 1997]; (2) telecommuting and work at home are increasing steadily [Bureau of the Census 1998; International Telework Association and Council 2000]; (3) the rate of job growth in the temporary help industry appears to far exceed the rate of overall job growth [CRS 1999]; (4) job displacement due to organizational restructuring continues to grow [Hipple 1999]; and (5) job tenure has declined for many workers [BLS 2000; Neumark et al. 1997].

However, from an occupational health perspective, these data and data collection mechanisms leave much to be desired. Concerns include the fragmentary and discontinuous nature of surveys and variation in definition and measurement of working conditions in these surveys (resulting, for example, in widely discrepant assessments of the number of workers in the contingent workforce). Further, systematic data collection is lacking for major innovations in process management and associated human resource practices (e.g., lean production methods) that are spreading rapidly throughout the economy (see Mavrinac et al. [1995] for examples and discussion of these innovations).

In addition, at present no Federal or other systematic efforts exist to capture information about changes in specific job characteristics that are known risks for stress, illness, and injury. For example, since the demise of QES, there has been no way of determining whether job tasks are becoming increasingly or less repetitive, whether workloads are increasing or decreasing, whether workers have reduced or increased control in their jobs, etc., and how these trends vary from one industry/occupation or working population to another.

As a further limitation, present surveys addressing organization of work factors generally collect

little or no collateral data on exposure to other workplace hazards or on health outcomes, nor do they allow organization of work data to be linked readily to other exposure data or health data. Thus, these survey efforts cannot be exploited for health effects studies on the organization of work. On the other hand, health surveillance efforts (using workplace-centered data such as workers' compensation files and injury logs or general population surveys such as the National Health Interview Survey) usually lack sufficient job data to link safety and health outcomes to organization of work factors.

Surveillance Needs

An urgent need exists to implement data collection efforts to better understand worker exposure to organizational risk factors for illness and injury, and how these exposures may be changing. Specifically, these data collection efforts would be designed to

- describe changing exposure to organization of work factors that present known risks for illness and injury,
- detect emerging trends in the organization of work that pose uncertain or suspected risk, and
- describe the distribution of these exposures and trends within industry, occupation, demographic, and other relevant sectors.

In turn, this information would be used to justify and target interventions to reverse hazardous trends in the organization of work, and to identify and prioritize organization of work factors for further study of their safety and health effects.

The design, content, and operation of a national surveillance system for the organization of work is beyond the scope of the present exercise and should be relegated to a stakeholder panel. However, it is possible in the present context to outline important features of such a system.

Type of Information to be Collected

An organization of work surveillance strategy must at least assess organizational factors that have recognized associations with illness and injury or with psychological and physical stress at work. Good examples of these factors include job characteristics (i.e., Work Context factors in Figure 1), such as work roles and workload demands, degree of support and control afforded workers, job security, etc., that have been the subject of extensive study in the job stress and psychosocial epidemiology fields (see Kasl [1992] for a more expansive listing and discussion of these factors).

In addition, a surveillance strategy for the organization of work should include measuring broader organizational structures and practices (i.e., Organizational Context factors in Figure 1) that are presumed to influence job characteristics and risk of illness and injury, but whose effects may not be well understood. Alternative employment arrangements, organizational restructuring, and elements of high performance/lean production work systems (e.g., participative management strategies, just-in-time inventory control, multiskilling, job combination, and team work) are examples of organizational practices that would merit close attention in a contemporary organization of work surveillance system (see Mavrinac et al. [1995] for a more expansive listing and discussion of these practices).

Consistent with the causal model in Figure 3, surveillance of organization of work should extend also to collection of data on workplace safety and health programs that may offset adverse effects of organizational practices. Prime examples of such programs include occupational medicine services, employee assistance programs, safety training, and work-life programs.

Injury and illness information can also be useful in the context of organization of work surveillance. Although data on changing job characteristics and organizational practices alone can yield insights regarding risks of changing organization of work, such inferences would be strengthened if these data could be merged with health surveillance data (although merger of these different data sets often proves difficult). Alternately, some surveys of changing work experiences (e.g., the BLS National Longitudinal Survey) include injury and illness inventories and measures of psychological well-being, thereby enabling direct study of the relationship between organization of work exposures and health. Similarly, the former QES contained measures of perceived stress, job satisfaction, and work-family conflict.

From the standpoint of inferring illness and injury risk, collecting data on physical hazards (e.g., noise, ergonomic hazards) may also prove useful since exposure to these hazards can be influenced by the organization of work and may pose imminent threat to safety and health.

Approaches to Data Collection

Several strategies for improving surveillance of the organization of work can be proposed. The most desirable (and ambitious) approach would be to

develop a stand-alone nationally representative survey of the organization of work. Such a survey might be modeled after and expand upon the former QES. The QES captured much of the key surveillance data described previously and was administered on three separate occasions at 4-year intervals during the period 1969–1977. Preferably, followup administration of a core survey of this nature would occur at 3- to 5-year intervals, with supplements to assess emergent conditions of interest, such as the recent trend toward telecommuting and growth of work-life programs. Logically, primary responsibility for such a survey would reside with the National Institute for Occupational Safety and Health (NIOSH) and sister agencies, such as BLS, that have the charge and technical capacity for data collection of this nature.

Second, organization of work surveillance could benefit from efforts to promote access to existing public domain and proprietary data sources that pertain to the changing nature of work. These sources include diverse data sets on the conditions of work that are developed and maintained by government agencies such as BLS, national polling organizations such as the National Opinion Research Center, and trade and industry associations such as the American Management Association or the

Society for Human Resource Management. The University of Michigan Panel Study of Income Dynamics, for example, has proven to be useful for analysis of trends in hours of work. Nontraditional data sources such as organizational climate data that are collected periodically within specific organizations and industries may also hold value for surveillance purposes. Researchers also need to be vigilant to opportunities to influence these data sets by annexing items or suggesting content changes to surveys to improve their utility for surveillance purposes.

Finally, attention needs to be given to ways to improve methods and metrics for surveying the organization of work. A need exists for surveys and measures of job characteristics that economize on administration time, yet have acceptable psychometric qualities. A need also exists for development of improved methods for assessing organizational conditions (such as working hours) that have presented difficult measurement problems to researchers. Additionally, a need exists for improved standardization of content across surveys to enable comparison and aggregation of data. Resolution of these methodological and psychometric problems would serve to benefit health effects research on organization of work as well as surveillance.

3 Safety and Health Effects Research

Gaps in Research on Safety and Health Effects of the Changing Organization of Work

Several disciplines have contributed to a steady accumulation of research attesting to the importance of organization of work as a determinant of workplace safety and health. However, this area of study remains loosely organized and has been unable to keep pace with new organizational practices and safety and health concerns raised by these practices. This section provides examples of prominent trends in the organization of work (including human resource practices) that have arisen in recent years and highlights areas of uncertainty about their safety and health consequences. Workforce characteristics are treated as an additional and cross-cutting topic of research need because the effects of these trends cannot be fully understood without considering the changing makeup of the workforce.

Uncertain Effects of New Organizational Practices

Process reengineering, organizational restructuring, and flexible staffing are prime examples of practices that have swept through industry in recent years but have been insufficiently studied from an occupational safety and health perspective. In the following discussion these practices and other prominent developments (e.g., telecommuting and

work at home, and the trend toward longer work hours) are examined together with gaps in understanding how they may influence the jobs, safety, and health of workers.

Process reengineering, organizational restructuring, and flexible staffing are prime examples of practices that have swept through industry in recent years but have been insufficiently studied from an occupational safety and health perspective.

Reengineering of production processes

Beginning in the mid-1980s, organizations in the United States invested heavily in innovative production processes to foster improvements in quality and efficiency and increase their ability to respond rapidly to changing market demands. Various names have been given to these new work systems, including high performance and high involvement work systems, flexible workplace practices, total quality management (TQM), and lean production. Theoretically, and in contrast to mass production technologies and traditional command and control management systems, these types of work systems seek to capitalize on the ingenuity, creativity, and problem-solving ability of workers to make the production process more efficient. High performance or high involvement work systems profess to shift decision-making

authority downward to teams of workers who are trained to be proficient in a variety of tasks. TQM and lean production try to reduce production impediments by using process simplification to eliminate wasted time and motion, paring inventories through just-in-time methods, and by emphasizing continuous improvement. In principle, TQM and lean production give greater voice to workers to achieve these goals, but generally, this influence extends to problem solving at the point-of-production only. A hierarchical management structure may still be retained.

Aspects of high performance and lean production work practices seem to be spreading rapidly throughout the economy. Surveys suggest 30% to 50% of organizations with 50 or more workers engage in teamwork [Gittleman et al. 1998; Kaminski 2001; Osterman 1994], 25% of these organizations practice job rotation [Gittleman et al. 1998; Osterman 1994], and 25% to 50% employ TQM practices [Gittleman et al. 1998; Osterman 1994].

On the surface, these practices resemble positive principles of work organization (i.e., emphasizing worker autonomy, task variety, learning opportunities, etc.) that are highlighted in job enrichment theory and contemporary models of healthy work [Karasek and Theorell 1990]. Thus they would appear to hold promise for improvements in worker health and organizational performance. However, the limited research data on these practices are less encouraging, showing mixed effects on employee empowerment or control and raising fears of work intensification. Further, studies of lean production in the automotive industry demonstrate increased risk of musculoskeletal disorders although evidence of adverse outcomes in other industrial settings is more equivocal (see

Landbergis et al. [1999] and Smith [1997] for a summary of these concerns and findings).

Additional study is needed to permit generalizations regarding safety and health effects of these new work systems and to gain insights regarding circumstances under which they promote safe or unsafe and healthy or unhealthy work. Since, in practice, these work systems are seldom implemented in a standardized fashion, their effects on worker safety and health may depend on their specific characteristics and the implementation process.

Organizational Restructuring and Downsizing

Organizational downsizing reached record levels by the early 1990s, when a third or more of major organizations engaged in broad workforce reductions on a yearly basis [AMA 1997]. Although risk of job displacement receded steadily in subsequent years [AMA 2000; Hipple 1999], the present economic downturn has produced a new wave of workforce reductions as confirmed by BLS data showing a substantial increase in mass layoffs in 2001 [BLS 2001]. Also, the fraction of job loss due to structural reasons (abolishment of positions or shifts) has continued to grow over the last two decades and presently accounts for 25–30 percent of all job displacement [Hipple 1999]. The continuing risk of involuntary job displacement has coexisted with periods of brisk job creation that has resulted in high levels of turnover due to voluntary separations [BNA 2000]. This volatility in the recent job market poses a threat to stable and long-term relationships between employers and workers. Recent analyses indicate declining job stability from the 1980s to the 1990s for male workers and longer-tenured workers, and to the

early 1990s for African American workers [BLS 2000; Neumark et al. 1997].

These trends raise multiple questions and concerns that have received only sparse study. Too little is known about the safety and health risks to workers who face or survive episodes of downsizing, or the effects of downsizing and outsourcing on the capacity of organizations to provide occupational health services and programs for workers. Also, concern exists that high rates of job destruction and creation in an organization may threaten its ability to accumulate and store safety knowledge. High rates of job destruction and creation may also lead to high levels of stress from chronic employment uncertainty, particularly since the jobs created may not provide the same level of compensation and benefits nor the same quality of working conditions.

Flexible Staffing and Other Human Resource Innovations

Agency-supplied temporary workers and workers in other alternative employment arrangements (independent contractors, contractor-supplied labor, and on-call workers) constitute nearly 10% of the workforce according to data from the BLS CPS [DiNatale 2001]. Data from the BLS Current Employment Statistics Survey (CES) and other sources suggest, however, that the temporary help sector of the economy is larger than reflected in the CPS and has been growing steadily [Brogan 2001; CRS 1999; Franklin 1997; Houseman 1997]. According to the CES, for example, the total number of jobs in the temporary help industry multiplied 6-fold to nearly 3 million during the period 1982–1998, whereas total employment during this period grew about 40% [CRS 1999; GAO 2000].

Flexible employment practices seem to result from strategic efforts by organizations to adjust staffing in response to fluctuating market demands, seasonal needs, and absent permanent workers. At the same time, labor costs are contained by relying on a contingent workforce to whom the organization has minimal or no obligation for long-term employment, benefits, training, or responsibilities under labor law [CRS 1999; DOL 1999b; Houseman 1997; Jorgensen 1999; Peck and Theodore 1998]. Increased labor supply from youth, women, and aging workers (who may not always desire long-term employment relationships) may also contribute to the upward trend in temporary employment.

Little is known, however, about the impact of flexible employment practices on worker safety and health, and a host of concerns have been raised. Proponents of alternative employment arrangements point to flexible scheduling (that can lead to improved work-life balance) and avenues to permanent employment as potential benefits for workers. Critics charge, however, that flexible employment practices are leading to a downward restructuring of the labor market that evades legal and contractual obligations to workers and exposes them to financial and health risks. In this regard, statistics show that most agency-supplied temporary workers do not prefer temporary employment, and they are less likely than traditional workers to receive health or pension benefits [DiNatale 2001; Houseman 1997]. Concern also exists that organizations may shift hazardous jobs and tasks to members of the alternative workforce, that these workers may be less likely to recognize and report hazards and injuries, and that they may be at increased risk of stress owing to precarious employment.

However, speculation far outstrips the empirical data on all of these concerns. For example, despite the strong growth in temporary employment since the mid-1980s, empirical study of safety and health experiences among temporary workers is scarce.

Other human resource programs have emerged in recent years and may ease or exacerbate risk of stress, illness, and injury among workers. Examples include incentive pay systems (e.g., gainsharing), defined contribution and self-managed health benefits, work-life programs (e.g., flexible work arrangements, dependent care programs, concierge benefits), and absenteeism policies that penalize workers for taking any type of leave. However, like flexible staffing arrangements, the implications of these practices for worker safety and health have received little investigation.

Long hours of work

American workers are spending more and more time on the job. Especially dramatic is the steady increase in working hours for women and prime-age working couples, the latter contributing nearly four additional months of annual work time since the 1970s [Bluestone and Rose 1998; DOL 1999a]. Average annual working hours in the United States presently exceed the average for Japan and all of Western Europe, except for the Czech Republic and Hungary [ILO 1999]. Evidence of risk to safety and health from long hours of work is found in the research literature [Hanecke et al. 1998; Rosa 1995; Spurgeon et al. 1997]. In a recent study of German workers, an exponential increase in injury risk was observed beyond the 9th hour of work [Hanecke et al. 1998]. However, the body of research literature on safety and health effects of long work hours is surprisingly small. Furthermore, little

is known about the interaction of long work hours with demanding work schedules (nightwork, shiftwork, etc.), with different job characteristics and exposures, with the intensification of work, and with mandatory and unplanned overtime.

Other key developments—new technology, telecommuting, and home work

Although home work is not new, increasing numbers of people are working from home or virtual workplaces, aided by new computer and communications technologies. Extrapolation from various surveys suggests that the number of telecommuters has increased dramatically to 16 million workers or more during the decade of the 1990s [DOT 1993; International Telework Association and Council 2000; Kensington Technology Group 1998], although these numbers underestimate the prevalence of work at home in general [Edwards and Field-Hendrey 1996]. This trend toward a seamless work-life paradigm revisits questions about safety and health in home work. On one hand, home work and telecommuting arrangements may reduce stress and injury risk by harmonizing work and family demands and minimizing daily commutes. Balanced against these presumed benefits are risks from loss of safety oversight, introduction of occupational hazards into the home environment, blurring of work and family roles, and isolation from peers yet feeling constantly tethered to the workplace.

Organization of Work and the Changing Profile of the Workforce

Researchers acknowledge that the occupational safety and health field, including the job stress literature, has not given due attention to the special

circumstances and risks encountered by women [Stellman 1999] and by racial and other minority populations in the workforce [Frumkin and Pransky 1999]. Present trends in the organization of work and employment create an even more acute need to attend to these populations. For example, evidence shows that (1) women are disproportionately represented in the growing service sector [DOL 2001a] and in less favorable jobs (lower pay with restricted benefits and flexibility) [Beers 2000; DOL 2001b; Heyman 2000]; (2) they account for almost all of the recent growth in working hours [Bluestone and Rose 1998; DOL 1999a]; and, (3) as their presence in the workplace has increased, their risk of job displacement has surpassed the risk for men [Hipple 1999]. Also, the growing pool of agency-supplied temporary labor is disproportionately young, female, and African-American. African-American women, for example, constitute 21% of the workforce provided by temporary help firms—nearly twice their representation in the traditional workforce [DiNatale 2001].

Nonetheless, few studies have investigated the implications of the changing organization of work for the safety and health of women and minority populations. To what extent do these employment circumstances expose women and minorities to hazardous work and the stresses of marginal employment? To what extent do their jobs provide otherwise unavailable access to the benefits of employment? What are the net effects on worker safety and health?

Changes in organization of work also interact with the aging of the workforce to raise questions regarding safety and health risk. The population of workers 55 and older is projected to grow much faster than the population of workers aged 25–54 [Fullerton 1999] and, among longer-tenured

... few studies have investigated the implications of the changing organization of work for the safety and health of women and minority populations.

workers (3 or more years tenure), this older group is at higher risk for displacement with greater earnings losses [Helwig 2001; Hipple 1999]. Researchers have not investigated the safety and health implications of these and other circumstances among older workers. It is unclear, for example, whether evolving organizational practices (such as long work hours and new production methods involving teamwork, continuous improvement and learning, etc.) create special risks and safety and health training needs for aging workers. In this regard, concern exists that lean production practices may be leading to reduced availability of lighter duty jobs for older workers [Lewchuk and Robertson 1996]. Such risks could be exacerbated in workplaces that are disproportionately populated by older workers as a result of seniority systems.

Safety and Health Effects Research Needs

Our limited understanding of risks posed by today's turbulent work environment illustrates the need for a more expansive program of research on this topic. In particular, research is needed to better understand how emerging trends in organizational practices influence job demands, employee development, hazard exposures, health services, worker behaviors, work-family balance, and other conditions that may influence risk of stress, illness, and injury in the workforce. In this section we provide some examples of specific research needs

targeting the effects of new organizational practices on job conditions and, in turn, on the safety and health of workers. The section begins, however, with a discussion of broader directives for safety and health research on the changing organization of work.

Of primary significance, evidence points to both positive and negative effects of changing organizational practices [Berg 1999; Jackson and Martin 1996; Jackson and Mullarkey 2000; Kaminski 2001; Landsbergis et al. 1999; Smith 1997; Sprigg et al. 2000]. These mixed findings suggest that an important focus of research should be the clarification of circumstances (for whom and under what conditions) in which these practices protect workers or place them at increased risk.

Also, research on effects of changing organizational practices should include a wide range of outcomes, including safety risks and associated injuries. Safety outcomes have been particularly neglected in prior research. Additional outcomes (such as disability, health care and employee assistance program utilization, socioeconomic costs, and work-family conflict) should be studied in order to portray more fully the burden of illness and injury associated with organizational stressors.

Finally, research on safety and health effects of organizational factors needs to overcome methodological difficulties that are common, but certainly not unique, to this field of study. Most widely recognized is the need for increased use of prospective study designs to overcome limitations in causal inference with cross-sectional studies. Exposure assessment presents special challenges in this field of study. To begin with, improved standardization of exposure measures and methods is needed to enable comparisons across studies. Multimethod estimates of exposure are needed to help improve

validity and overcome the risk of contamination of questionnaire or other self-report exposure measures by present health status or other factors. A particular need exists for methods to assess more reliably organizational practices (e.g., quality improvement) that are commonly measured only at the organizational level through key informants. At the same time, a need exists for economy in exposure assessment strategies so organizational practices can be assessed efficiently in large-scale epidemiologic studies. Finally, more work is needed to develop job exposure matrixes to obtain meaningful estimates of exposures to organization of work factors among today's workers whose careers are increasingly punctuated by job transitions.

New Organizational Practices, Workplace Effects, and Risk of Illness and Injury

Emerging evidence and accounts by workers and managers suggest effects of new organizational practices on job conditions and exposures that may influence the risk of stress, illness, and injury. Examples of these effects that need further study include the following:

Work pressures and demands

■ Evidence points to a steady increase in workload over the last two decades [Bond et al. 1997]. Research is needed to investigate organizational practices that may contribute to the intensification of work and to examine the implications for worker safety and health. Examples of such practices include the spread of high performance/lean production work systems and teamwork structures that may lead to work intensification through processes such as the following:

1. Increased worker responsibility and accountability for production management and meeting production goals.
2. Increased vigilance (process monitoring) and problem solving demands.
3. Increased electronic monitoring.
4. Increased peer-monitoring and competition within teams.
5. Increased role demands or conflict (owing to multiple roles and blurring of manager and worker roles).
6. Demand for flexibility and continuous change.
7. Speedup and reduction in idle time.

Other potential sources of work intensification in need of study include overwork motivated by (a) the trend toward putting increasing amounts of pay at risk (pay for performance), (b) vulnerability to labor market risks (e.g., low pay, risk of job loss) among temporary workers, or (c) fear of displacement resulting from organizational restructuring and downsizing. Additionally, better understanding is needed of the risks and effects of work overload resulting from staffing reductions following organizational downsizing. At the same time, research is needed to investigate whether increased levels of worker control and learning provided by new work systems can offset adverse effects of intensified demands in today's workplace.

■ Research is needed to investigate factors that may contribute to lengthening of work hours (e.g., substitution of overtime for new employment, communication technologies and organizational practices that make work impervious to time and

geographical boundaries) and risks of injury and illness brought about by the demands and fatigue of long work hours. Particularly pressing is the need for research on the following:

1. Effects of modest increases in working hours.
2. How effects of long work hours might be modified by alternative work schedules and work-rest regimens, and varying domestic demands.
3. Task-specific effects of long work hours (e.g., effects of long work hours for physically demanding tasks and other hazardous exposures).
4. The effects of unplanned and mandatory overtime.

Studies need to develop improved methods for measurement of working hours, give much more attention to safety outcomes, and focus on populations most likely to work long hours.

Worker empowerment and development

■ Research is needed to better understand how new work systems affect workers' capacity to influence job conditions and opportunities for learning and growth and, in turn, the impact on safety and health in the workplace. Increased worker control and learning opportunities are recognized in the job stress literature as powerful antidotes to stress and illness. But concern exists that various worker participatory or involvement strategies may often be more ceremonial than substantive, having little meaningful influence on worker empowerment—or perhaps

even eroding workers' means to influence job conditions through more traditional labor-management mechanisms such as collective bargaining. Concern also exists that cross-functional teamwork and job enlargement strategies may in some instances multiply the number of tasks workers perform with little net effect on worker competencies.

Occupational health services and programs

■ Research is needed to better understand how occupational health services and programs, including worker safety training, and access to these services and programs are affected under organizational restructuring and downsizing. Some indication exists, for example, that utilization of employee assistance programs may drop significantly when these programs are outsourced to off-site vendors [Collins 1999]. Additionally, information is needed on the effects of loss of health benefits among the substantial proportion of displaced workers who become re-employed but experience loss of health insurance and wage reductions.

■ Only a fraction of temporary workers and other members of the alternative workforce enjoy access to company-provided health benefits, and access to occupational health services and programs has not been studied among these workers. Research is needed to better understand gaps in the delivery of occupational health services to these workers. Additionally, research should examine the safety and health implications of the emerging trend toward defined contribution and self-managed health benefit programs that may limit health services available to members of the traditional workforce.

Worker safety knowledge and behavior

■ Research is needed to investigate effects of changes in the organization of work on the fund of safety knowledge available to workers and organizations. Examples of relevant questions for investigation include the following:

1. Are downsizing and employment volatility creating safety and health risks by depleting institutional knowledge of safety and health practices through loss of experienced workers and managers—or, correspondingly, is high labor turnover interfering with workers' ability to acquire safety skills and knowledge?
2. To what extent is job combination, even among seasoned workers, adding tasks for which workers lack safety knowledge?
3. To what extent do temporary workers face increased risk of illness and injury from inexperience or insufficient safety training owing to variable and short-tenure job placements?

Evidence of substantially increased injury incidence among inexperienced workers [BLS 1999; CDC 2001; Goodman and Garber 1988] adds urgency to the need for studies addressing these questions. Studies of workers with new jobs and tasks need to investigate not only risks posed to themselves, but to their peers as well.

■ Studies are needed to examine the effects of new work systems and work intensification on the time and opportunity to exercise safe work practices.

■ Research is needed to investigate whether perceptions of insecure employment among contingent workers or traditional workers at risk of displacement discourages the reporting of hazards, injuries, and illnesses or the utilization of health care.

Hazard exposures

■ Research is needed to assess whether alternative employment arrangements, such as temporary and contract work, result in differential work assignments involving elevated exposures to occupational hazards. Similarly, research is needed to investigate whether job insecurity might motivate workers to accept more hazardous job duties.

■ Little evidence exists of organizational investment in safety training and assessment of working conditions for home workers and telecommuters. Research is needed to better characterize hazardous exposures attendant to homework, including telecommuting by white-collar and knowledge workers.

Work-life balance

■ Accelerated research is needed on effects of telecommuting and other organizational practices that meld work and family life, considering both the benefits presumed to result from increased flexibility and control over family obligations and risks from insufficient separation of work and family. Specific attention needs to be given to the risk of stress and family dysfunction from spillover of work demands into the family environment for telecommuters and home workers, and to technologies and organizational policies that promote or discourage intrusion of work into personal

spaces. Similarly, study is needed of the sources and effects of work disruption and potential safety and health risks resulting from conditions in the homes of telecommuters and home workers.

■ Work-life programs and family-friendly policies to reduce work-life conflict have spread rapidly throughout industry, but empirical study of their health-related effects is sparse. Research is needed to investigate the effects of these programs and program attributes on preventing work-family conflict and stress among workers.

Other effects—access to legal protection and organizational supports

■ Many workers who do not participate in the traditional (full-time, direct hire) workforce fall outside the boundaries of a myriad of statutes and policies to protect the rights and welfare of workers, including protection from discrimination, rights to overtime pay and minimum pay, rights to collective bargaining, etc. Research is needed to understand the impact of these limitations on the safety and health of workers who participate in alternative employment arrangements. Many of these workers also do not receive comparable pay, fringe benefits, and access to the career ladders and organizational resources available to members of the traditional workforce. Research needs to begin to explore how these constraints may play out over the long term to affect the well-being of workers.

■ As the social contract between employers and employees changes, workers are increasingly required to assume greater personal responsibility for their continuity of employment. Research needs to examine how these new demands may

influence stress and well-being in today's workforce.

■ Research is also needed on the potential stresses among home workers and telecommuters created by nonstandard work schedules, role conflicts, and the possible loss of identity, security, status, and support from peers and supervisors that may result from inability to participate in the social environment of the organization.

Effects in Worker Subpopulations: Women, Ethnic and Racial Minorities, and Aging Workers

Research needs to examine much more vigorously the effects of organizational stressors, such as harassment and job discrimination, that are highly specific to women and ethnic and racial minorities. Studies are also needed to better understand how employment arrangements more common among women and certain minority groups in today's economy (e.g., service work, temporary employment, home work) may disproportionately expose them to occupational risks, such as reduced health benefits and job insecurity. At the same time, studies need to investigate possible protective effects of these employment arrangements that may derive from increased access to employment, or the flexibility needed to balance work and personal or family demands more effectively.

Research is also needed to investigate whether the adjustments, learning demands, and workload pressures that may be created by new work systems and rapid technological advances place older workers at heightened risk of stress, illness, and injury. Studies of new job demands among older workers also need to examine the contribution of factors such as unavailability of light-duty work and increased probability of displacement to risk of stress, illness, and injury among these individuals.

Effects in High-Risk Sectors

An especially urgent need exists for research attention to industry sectors and occupations that have been subjected to sweeping organizational changes in recent years. For example, efforts toward cost containment in the health care sector have resulted in dramatic organizational changes involving staff reductions and a changing skill mix, long hours of work and mandatory overtime, and new work role demands as health care delivery shifts from a fee-for-service inpatient model to an outpatient managed care model. Although considerable attention has focused on the adverse effects of these widespread and abrupt changes in work practices on patient care [Aiken et al. 2001; Kohn et al. 2001], the effects of these changes on the safety and health of health care workers have received little study.

4 Intervention Research

Gaps in Research on Organization of Work Interventions to Protect Safety and Health

The scientific literature provides relatively few examples of occupational safety and health interventions that feature the reorganization of work. One exception is a fairly small body of research on reducing job stress that looks at effects of interventions such as work rescheduling, workload reduction, role clarification, and the redesign of jobs to improve worker decision-making and autonomy (see Parkes and Sparkes [1998] for a review of this literature). This research base is substantially enlarged if the broad literature is considered on sociotechnical design that examines effects of organizational interventions on related outcomes such as employee satisfaction and morale [Ilgen 1990; Locke and Schweiger 1979; Schneider 1985]. Additionally, studies of occupational safety programs are found in the safety literature [Cohen and Colligan 1998; Hugentobler et al. 1990; OSHA 1998] although classifying many of these programs as organization of work interventions may be inappropriate.

Review of this intervention research literature leads to several broad conclusions. First, as noted, the body of literature on interventions to change aspects of job design or organizational practices to reduce exposures to job hazards is small. In the job stress arena, this research base is much smaller than

the body of research on individual-level intervention strategies, such as stress management and health promotion, that seek to improve the capacity of workers to withstand demanding or hazardous job situations [Murphy 1996].

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Second, the extent to which many of these organization of work interventions improved worker safety and health is questionable. Small, inconsistent, and short-term effects of interventions are commonly reported, although these problems are more often found in the health literature than in the safety intervention literature. In their recent review of job stress intervention studies, Parkes and Sparkes [1998] concluded that “. . . the studies do not present a convincing picture of the value of organizational interventions designed to reduce work stress . . . and tend to be difficult to interpret, causally ambiguous, inconsistent, based on small samples, and/or statistically nonsignificant”. These conclusions were particularly true of participatory action research interventions; of the five such studies reviewed, not one demonstrated strong and favorable results.

Third, the organization of work intervention literature is beset by various methodological problems, especially the absence of strong study designs involving randomized trials, making evaluation and attribution of outcomes difficult. As discussed in a recent commentary on research on prevention of occupational injuries [Rosenstock and Thacker 2000], such methodological shortcomings are pervasive in the occupational safety and health intervention literature.

On the other hand, strong designs are sometimes not feasible in intervention research because of practical, ethical, legal, or other constraints. For example, organizations are changing so quickly in response to technological innovations and market conditions, it is often difficult to achieve the degree of stability needed to maintain control groups essential to experimental evaluation of interventions. At a more theoretical level, it has also been argued that organizations cannot be readily changed or improved by attempts to systematically manipulate their individual parts, and thus conventional scientific approaches may not be faithful to the true dynamics of the organizational change process [Colarelli 1998]. These circumstances represent substantial obstacles to rigorous study designs in intervention research and have led to the adoption of quasi-experimental methods in some cases and to the use of action research methods in others.

Finally, in addition to gaps in intervention effectiveness research, little is known about implementing interventions within organizations. Evidence suggests that benchmarking and other practices that are not necessarily evidence-based play an important role in adopting and diffusing organizational interventions (in contrast to the public health model, which proceeds methodically from

problem identification to intervention and evaluation). However, these practices are not well understood. Absence of better information about the decision processes underlying organizational interventions thus becomes an important impediment to promoting safety and health interventions for workers.

Intervention Research Needs

To close these gaps in research on organization of work interventions, advances are needed along several fronts: (1) a substantial increase in research is needed on organizational practices and policies that may serve to protect worker safety and health; (2) methodological advances in intervention research are needed in support of these studies; and (3) a closer examination is needed of factors that influence the implementation of interventions within organizations.

Effects of Protective Practices and Policies

Three categories of intervention research needs are most evident. First, intervention research is needed that develops remedies to hazards identified in health effects studies of the changing organization of work. Naturally, this research should target those organizational changes that create the highest apparent risk for stress, illness, and injury. In this regard, studies of the safety and health benefits of interventions targeting practices such as organizational restructuring/downsizing, long hours of work, and work intensification could be recommended.

Second, a need exists to more aggressively investigate the effects of organizational interventions already occurring in the workplace (i.e., natural experiments) to protect the well-being of workers.

For example, work-life programs and family friendly policies such as flexitime and flexiplace are becoming increasingly common in the modern workplace, presenting opportunities for research to investigate effects of these types of interventions on worker safety and health. This type of research may be more properly called program evaluation.

Finally, increased research attention needs to be given to the effects of legislation and public policy that influences the organization of work. One example of such legislation is the Family Medical Leave Act (FMLA), which ensures the right for leave time for critical family medical reasons. It can be anticipated that the FMLA would reduce stress associated with added workload burdens, job insecurity, or work-family conflict that may otherwise result from the need to provide family medical care. However, empirical study of the FMLA or other social policy impacting the workplace is scarce.

All these types of intervention studies should include effectiveness measures for a wide range of cost factors such as illness, injury and disability rates, health care utilization, absenteeism and lost time, etc., in addition to measures of health and well-being that are more commonly collected in research on the organization of work (e.g., self-reports of health status, job satisfaction). Such measures will help to better understand the intervention impact on injury and disease burden sustained both by workers and the organization.

Along this line, a new concept of organizational effectiveness (sometimes dubbed “organizational health”) links organizational practices that protect worker safety and health with high levels of organizational functioning—a variant on the theme “safety pays”. Safety and health studies of

Advances in knowledge of organizational interventions to protect worker safety and health will require improvements in intervention research practices.

organizational interventions that examine a broad range of organizational outcomes may identify practices that are conducive to both improved worker safety and health and improved organizational effectiveness, thereby building a stronger case for worker protection through job redesign.

As a practical matter, advances in organization of work intervention research would benefit from improved resources and training. A need exists for developing and compiling information about the science of intervention research, and for increased exposure of researchers to this information in their graduate training to improve their capacity for intervention research. In this regard, it is notable that the topic of intervention effectiveness has been recognized as a research priority under NORA, and a team of specialists from NIOSH and outside interest groups have undertaken an evaluation of knowledge on this topic similar to the present exercise for organization of work [Goldenhar et al. 2001].

Improvements in Intervention Research Methods

Advances in knowledge of organizational interventions to protect worker safety and health will require improvements in intervention research practices. There are two major issues here. First, a need exists for improved guidance, and possibly a new paradigm, for designing and conducting research on organizational interventions. Stated in

the most general terms, approaches need to be articulated that build on the strengths and minimize the limitations of various contrasting methods (e.g., case studies and action research versus experimental designs, qualitative versus quantitative methods) and allow for expeditious conduct of interventions in an organizational context. Responding to this need, Zwerling et al. [1997] suggested that a sensible and economical approach to conducting intervention effectiveness studies begins with qualitative methods and quasi-experimental designs to explore the feasibility of interventions, holding randomized controlled trials in reserve for testing and validating the most promising approaches.

Second, intervention research needs to be more theory driven to learn why and under what circumstances organization of work interventions succeed. In their recent report, the NORA intervention effectiveness team noted that too often investigators do not adequately describe the intervention or address the issue of why or how an intervention is expected to bring about improvement in the safety and health of workers [Goldenhar et al. 2001]. Well designed, theory-driven intervention research increases the likelihood that an intervention will ultimately be effective because it leads to a better understanding of how the intervention works and allows for generalization and tailoring of the intervention to multiple situations.

Until recently, theory-driven models for occupational safety and health interventions were not common in the published literature. However, Cohen et al. [1997] developed a model for reducing work-related musculoskeletal disorders that prescribed a seven-step process beginning with problem identification and leading ultimately to the design of new work practices (intervention).

Melhorn et al. [1999] used this model to establish an occupational intervention program for musculoskeletal disorders and reported substantial savings in worker compensation costs. Israel et al. [1996] presented a conceptual framework for interventions to reduce stress at work that was based on a comprehensive model of stress and health. Such models provide guidance for each step in the intervention process (design, implementation, and evaluation). As a side note, both of the above-mentioned models emphasize the need for management commitment and employee involvement in the intervention design process.

Implementing Interventions

More information is needed about critical factors and conditions that motivate organization of work interventions to protect worker safety and health. Experience suggests that decisions for organizational change are often driven by industry opinion leaders, by authority figures in organizations who are convinced about the efficacy of new organizational practices, by best practices, or by industry norms (benchmarking). However, these decision processes are not well understood or appreciated in the scientific community.

More information is needed about critical factors and conditions that motivate organization of work interventions to protect worker safety and health.

Ethnographic study of organizations to better understand the processes that govern intervention decisions could lead to development of products

to help motivate and support interventions. Examples of these products might include (1) casebooks on successful interventions to help organizations select, guide, and evaluate interventions; (2) design and promulgation of best practices based on accumulated findings from intervention research; and (3) forums on organization of work and

health that are keyed to practitioners (in contrast to researchers) and highlight information about interventions and intervention effectiveness. Study of these decision processes could also lead to improved designs for intervention research (e.g., help to identify organizationally relevant measures of intervention effectiveness).

5 Challenges Confronting Research Progress

In 1965, the National Advisory Environmental Health Committee issued a landmark report to the Surgeon General of the U.S. Public Health Service that foresaw many of the changes in the organization of work that are at the center of attention in the present discussion: new work processes, the growth in alternative employment relationships, increasing participation of women and ethnic and racial minorities in the workforce, etc. [DHEW 1966]. The report expressed apprehension that these changes posed new and unexplored threats to worker safety and health and singled out psychological stress as a special concern. However, three decades have passed and many of these issues still await systematic investigation. What circumstances have stood in the way of more aggressive study of the safety and health consequences of the changing organization of work?

To begin with, the subject of organization of work and health has yet to become a cohesive field of study. Numerous disciplines have contributed research on this topic, including labor studies, economics, organizational behavior, public and occupational health, and the job stress field. Presently, little interface exists among these disciplines, and differences exist in methods and endpoints of study. Historically, for example, the job stress field has looked at individual and job characteristics in relation to individual-level measures of health (e.g., illness symptoms), whereas economic and organizational behavior research has focused more on organizational parameters in relation to productivity

and other measures of organizational effectiveness. For these reasons, knowledge of occupational safety and health effects of the changing organization of work is often fragmented.

Progress toward understanding and preventing safety and health risks posed by organization of work factors requires a much stronger public health commitment to nurturing this field of study.

Further, perhaps in part because organization of work and health is not yet an established or widely recognized field of study, research in this field has not enjoyed the funding opportunities afforded to more traditional topics in occupational safety and health. Also, it seems that progress has suffered from too little interchange between the research community and the labor and business communities. As a result, researchers are often slow to recognize changing conditions of work and the risks they may pose, and research opportunities and access to study sites and populations are often unavailable.

Progress toward understanding and preventing safety and health risks posed by organization of work factors requires a much stronger public health commitment to nurturing this field of study. The topic of organization of work needs to be elevated to a higher level of visibility in the occupational safety and health field, and increased commitment

to funding for this type of research is needed. Strategic alliances among stakeholder organizations (Federal agencies, industrial and labor coalitions, professional societies, and academic researchers) will be essential to leverage these outcomes. Such alliances will also facilitate research by enabling access to study populations, data sources, and in-kind support for research.

Equally important, steps need to be taken within the academic community and professional organizations to nurture and formalize the subject of organization of work and health as a distinct field of study, and to provide the multidisciplinary training to ensure that students are prepared for research on organization of work and health. Such

training would combine methods and content from the fields of occupational health, epidemiology, psychology, management, industrial relations, and other relevant disciplines. Supporting this training need, the Institute of Medicine [2000] has recently issued a recommendation for increased training of occupational safety and health professionals in the organization of work (see Sauter and Hurrell [1999] for descriptions of prototype training programs of this nature).

Satisfaction of these needs for recognition, resources, and capacity building stands as an important prerequisite for research to narrow the gap in understanding ways to protect safety and health in today's rapidly evolving workplace.

References

- Aiken LH, Clarke SP, Sloane DM, Sochalski JA, Busse R, Clark H, Govannetti P, Hunt J, Rafferty AM, Shamian J [2001]. Nurses' reports on hospital care in five countries. *Health Affairs*, May/June, pp. 43–53.
- Alfredsson L, Spetz C-L, Theorell T [1985]. Type of occupation and near-future hospitalization for myocardial infarction and some other diagnoses. *Int J Epidemiol* 14(3):378–388.
- AMA [1997]. 1997 AMA survey. Corporate job creation, job elimination, and downsizing. New York: American Management Association.
- AMA [2000]. 2000 American Management Association survey staffing and structure. New York: American Management Association.
- Beers TM [2000]. Flexible schedules and shift work: Replacing the 9-to-5 workday? *Mon Labor Rev* 123(6):33–40.
- Berg P [1999]. The effects of high performance work practices on job satisfaction in the United States steel industry. *Ind Relat* 54(1):111–135.
- BLS [1999]. Lost-work time injuries and illnesses: characteristics and resulting time away from work, 1999. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, News USDL No. 01-71.
- BLS [2000]. Labor force statistics from the current population survey: employee tenure summary: employee tenure in 2000.[<http://statsblsgov/newsrelease/tenurenr0htm>]. Date accessed: August 2, 2001.
- BLS [2001]. Extended mass layoffs in the first quarter of 2001 News. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics.
- Bluestone B, Rose S [1998]. Public policy brief: the unmeasured labor force: the growth in work hours. Blithewood, Annandale-on-Hudson, NY: The Jerome Levy Economics Institute of Bard College, Bard Publications Office, No. 39.
- BNA [2000]. BNA Job Absence and Turnover Report 2000, 1st Qtr. Washington, DC: Bureau of National Affairs.
- Bond JT, Galinsky E, Swanberg JE [1997]. The 1997 national study of the changing workforce. New York: Families and Work Institute.
- Brogan TW [2001]. Scaling new heights: ASA's annual analysis of the staffing industry. *Staffing Success*, May/June, pp. 26–39.
- Bureau of the Census [1998]. Census brief: increase in at-home workers reverses earlier trend. Washington, DC: U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, Report No. CENBR/98–2.
- CDC (Centers for Disease Control and Prevention) [2001]. Nonfatal occupational injuries and

- illnesses treated in hospital emergency departments—United States, 1998. *MMWR* 50(16):313–316.
- Cohen AL, Colligan MJ [1998]. Assessing occupational safety and health training: a literature review. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health DHHS (NIOSH) Publication No. 98–145.
- Cohen AL, Gjessing CC, Fine LJ, Bernard BP, McGlothlin JD [1997]. Elements of ergonomics programs: A primer based on workplace evaluations of musculoskeletal disorders. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 97–117.
- Colarelli SM [1998]. Psychological interventions in organizations: an evolutionary perspective. *Am Psychol* 53(9):1044–1056.
- Collins K [1999]. Constructive confrontation. Are EAPs obsolete? *Employee Assistance Professionals Association* 29(6):32–33.
- CRS [1999]. CRS report for Congress: temporary workers as member of the contingent labor force. Washington, DC: The Library of Congress, Congressional Research Service, Order Code No. RL30072.
- DHEW [1966]. Protecting the health of eighty million Americans: a national goal for occupational health. Washington, DC: U.S. Department of Health, Education, and Welfare, Public Health Service, Bureau of Disease Prevention and Environmental Control, National Center for Urban and Industrial Health.
- DiNatale M [2001]. Characteristics of and preference for alternative work arrangements, 1999. *Mon Labor Rev* 124(3):28–49.
- DOL [1999a]. Report on the American workforce. Washington, DC: U.S. Department of Labor.
- DOL [1999b]. Future work: Trends and challenges for work in the 21st century. Washington, DC: U.S. Department of Labor.
- DOL [2001a]. Current population survey. Employment and earnings. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics 48(1):212–217.
- DOL [2001b]. 20 Leading occupations of employed women: 2000 annual averages. http://www.dol.gov/dol/wb/public/wb_pubs/20lead2000htm. Date accessed: June 4, 2001.
- DOT [1993]. Transportation implications of telecommuting. Washington, DC: U.S. Department of Transportation, Bureau of Transportation Statistics.
- Edwards LN, Field-Hendrey E [1996]. Home-based workers: data from the 1990 census of population. *Mon Labor Rev* 119(11):26–34.
- Franklin JC [1997]. Employment outlook: 1996–2001. Industry output and employment projections to 2006. *Mon Labor Rev* 120[11]:39–57.
- Frumkin H, Pransky G [1999]. Special populations in occupational health. *Occup Med: State Art Rev* 14(3):479–484.

- Fullerton HN [1999]. Labor force projections to 2008: steady growth and changing composition. *Mon Labor Rev* 122(11):19–32.
- GAO [2000]. Contingent workers: incomes and benefits lag behind those of rest of workforce. Washington, DC: U.S. General Accounting Office, Report No. GAO/HEHS-00-76.
- Gittleman M, Horrigan M, Joyce M [1998]. “Flexible” workplace practices: evidence from a nationally representative survey. *Ind Labor Relations Rev* 52(1):99–113.
- Goldenhar LM, LaMontagne AD, Katz T, Heaney C, Landsbergis P [2001]. The intervention research process in occupational safety and health: an overview from the NORA Intervention Effectiveness Research Team. *J Occup Environ Med* 43(7):616–622.
- Goodman PS, Garber S [1988]. Absenteeism and accidents in dangerous environment: empirical analysis of underground coal mines. *J Appl Psychol* 73(1):81–86.
- Hänecke K, Tiedemann S, Nachreiner F, Grzech-Śukao H [1998]. Accident risk as a function of hour at work and time of day as determined from accident data and exposure models for the German working population. *Scand J Work Environ Health* 24(3):43–48.
- Helwig RT [2001]. Worker displacement in a strong labor market. *Mon Labor Rev* 24(6):13–28.
- Heyman J [2000]. *The widening gap: why America’s working families are in jeopardy and what can be done about it*. New York: Basic Books, Inc.
- Hipple S [1999]. Worker displacement in the mid-1990s. *Mon Labor Rev* 122 (7):15–32.
- Houseman SN [1997]. Temporary, part-time, and contract employment in the United States: New evidence from an employer. Kalamazoo, MI: WE Upjohn Institute for Employment Research. Unpublished report.
- Hugentobler MK, Robins TG, Schurman SJ [1990]. How unions can improve outcomes of joint health and safety training programs. *Labor Studies J* 15:16–38.
- Ilgen DR [1990]. Health issues at work: opportunities for industrial/organizational psychology. *Am Psychol* 45(2):273–283.
- ILO [1999]. *Key indicators of the labour market 1999*. Geneva: International Labour Office.
- Institute of Medicine [2000]. *Safe work in the 21st century: education and training needs for the next decade’s occupational safety and health personnel*. Washington, DC: National Academy Press.
- International Telework Association and Council [2000]. *Telework America (TWA) 2000: Research results: Executive Summary*. http://www.telecommute.org/twa2000/research_results_summary.shtml. Date accessed: August 2, 2001.
- Israel BA, Baker AE, Goldenhar LM, Heaney CA, Schurman SJ [1996]. Occupational stress, safety, and health: conceptual framework and principles for effective prevention interventions. *J Occup Health Psychol* 1(3):261–286.

- Jackson PR, Martin R [1996]. Impact of just-in-time on job content, employee attitudes and well-being: A longitudinal study. *Ergonomics* 39(1):1-16.
- Jackson PR, Mullarkey S [2000]. Lean production teams and health in garment manufacture. *J Occup Health Psychol* 5(2):231-245.
- Jorgensen HJ [1999]. When good jobs go bad: young adults and temporary work in the new economy. Washington, DC: 2030 Center.
- Kaminski M [2001]. Unintended consequences: organizational practices and their impact on workplace safety and productivity. *J Occup Health Psychol* 6(2):127-138.
- Karasek R, Theorell T [1990]. *Healthy work: stress, productivity, and the reconstruction of working life*. New York: Basic Books, Inc.
- Kasl SV [1992]. Surveillance of psychological disorders in the workplace. In: Keita GP, Sauter SL, eds. *Work and well-being*. Washington, DC: American Psychological Association, pp. 73-95.
- Kensington Technology Group [1998]. The workplace turns to telecommuting to drive productivity. www.kensington.com/about/press/nsow2.html. Date accessed: June 17, 2001.
- Kohn LT, Corrigan JM, Donaldson MS, eds. [2001]. *To err is human: building a safer health system*. Washington, DC: National Academy Press.
- Landsbergis PA, Cahill J, Schnall P [1999]. The impact of lean production and worker health. *J Occup Health Psychol* 4(2):108-130.
- Lewchuk W, Robertson D [1996]. Working conditions under lean production: A worker-based benchmarking study. *Asia Pacific Bus Rev* 2:60-81.
- Locke EA, Schweiger DM [1979]. Participation in decision-making: one more look. *Res Organiz Behav* 1:265-239.
- Mavrincac SC, Jones NR, Meyer MW [1995]. *Competitive renewal through workplace innovation: the financial and nonfinancial returns to innovative workplace practices*. Cambridge, MA: Ernst & Young LLP
- Melhorn JM, Wikinson L, Gardner P, Horst WD, Silkey B [1999]. An outcomes study of an occupational medicine intervention program for the reduction of musculoskeletal disorders and cumulative trauma disorders in the workplace. *J Occup Environ Med* 41(10):833-844.
- Murphy LR [1996]. Stress management in work settings: a critical review of the health effects. *Am J Health Promo* 11:112-135.
- Neumark D, Polsky D, Hansen D [1997]. *Has job stability declined yet? New evidence for the 1990's*. Cambridge, MA: National Bureau of Economic Research, Working Paper No. 6330.
- OSHA [1998]. *Review of the literature on safety incentives*. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.
- Osterman P [1994]. How common is workplace transformation and who adopts it? *Ind Labor Relations Rev* 47(2):173-188.
- Parkes KR, Sparkes TJ [1998]. *Organizational interventions to reduce work stress: Are they effective? A review of the literature*. Oxford, U.K.:

- University of Oxford, Health and Safety Executive, Contract Research Report No. 193/1998.
- Peck J, Theodore N [1998]. The business of contingent work: growth and restructuring in Chicago's temporary employment industry. *Work, Employ Soc* 12(4):665–674.
- Rones PL, Ilg RE, Gardner JM [1997]. Trends in hours of work since the mid-1970s. *Mon Labor Rev* 120(4):3–13.
- Rosa RR [1995]. Extended workshifts and excessive fatigue. *J Sleep Res* 4(Suppl 2):51–56.
- Rosenstock L, Thacker SB [2000]. Toward a safe workplace: the role of systematic reviews *Am J Prev Med* 18(4S):4–5.
- Sauter SL, Hurrell JJ, Jr. [1999]. Occupational health psychology: origins, content, and direction. *Prof Psychol: Res Prac* 30(2):17–122.
- Sauter SL, Murphy LR, Hurrell JJ, Jr., Levi L [1998]. Psychosocial and organizational factors. In: Stellman JM, ed. *ILO Encyclopedia of Occupational Health and Safety*. 4th ed. Vol. 2. Geneva: International Labour Office, pp. 34.2–34.3.
- Schnall PL, Belkic K, Landsbergis P, Baker D, eds. [2000]. The workplace and cardiovascular Disease. *Occup Med: State Art Rev* 15:(1)7–68.
- Schneider B [1985]. Organizational behavior. *Ann Rev Psychol* 36:573–611.
- Smith V [1997]. New forms of work organization. *Ann Rev Sociol* 23:315–339.
- Sprigg CA, Jackson PR, Parker SK [2000]. Production team-working: the importance of interdependence and autonomy for employee strain and satisfaction. *Human Relations* 53(11):1519–1543.
- Spurgeon A, Harrington J, Cooper CL [1997]. Health and safety problems associated with long working hours: A review of the current position. *Occup Environ Med* 54(6):367–375.
- Stellman JM [1999]. Women workers: The social construction of a special population. *Occup Med: State Art Rev* 14(3):559–580.
- UNDP [1995]. *Human Development Report, 1995*. NY: Oxford University Press, United Nations Development Programme.
- Zwerling C, Daltroy LH, Fine LJ, Johnston JJ, Melius J, Silverstein BA [1997]. Design and conduct of occupational injury intervention studies: a review of evaluation strategies. *Am J Ind Med* 32:164–179.

