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Emerging Participatory Approaches to Ergonomic Interventions in the Construction Industry

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The Central Artery/Third Harbor Tunnel (CA/T) construction project in Boston is the largest and most costly highway construction project ever undertaken in the United States. The Construction Occupational Health Project (COHP) of the Work Environment Department at the University of Massachusetts—Lowell was established to conduct exposure assessment and to develop, introduce, and evaluate interventions in the areas of ergonomics and industrial hygiene on the CA/T project. For both political and practical reasons, COHP is using a participatory approach to intervention in the construction industry. The research process is employing participation at all the levels of the construction hierarchy in the form of various advisory groups. These advisory groups have been formed from existing joint labor–management advisory committees and are presently engaged in two participatory intervention activities: (1) evaluations of intervention ideas, and (2) comparisons of safety systems.

KEY WORDS: participatory research, construction, ergonomics, occupational health, disease prevention

INTRODUCTION

The Construction Occupational Health Project (COHP) of the Work Environment Department at the University of Massachusetts—Lowell was established to take advantage of the research and intervention possibilities presented by the massive Central Artery/Third Harbor Tunnel (CA/T) construction project in Boston. The COHP is part of a national effort to conduct research to better understand the health risks for workers in the construction industry and to reduce exposure to those risks. This effort is being coordinated by the Center to Protect Workers' Rights (CPWR), the health and safety arm of the Building Trades Department of the AFL/CIO. The CA/T project, scheduled to be completed in 2004, has a projected cost of $7 billion, making it the largest and most costly highway construction project ever undertaken in the United States. It provides a unique opportunity to study the health effects of construction work and to develop, introduce and evaluate interventions to mediate those effects. The COHP is working with unions and contractors on the CA/T to conduct exposure assessment and to design participatory approaches to intervention in the areas of ergonomics and industrial hygiene. This paper focuses primarily on participatory approaches to ergonomic intervention though many of the techniques and methods presented could be used to introduce interventions for industrial hygiene exposures.

HISTORY OF THE COHP

One of the primary objectives of the COHP is to quantify exposures on the CA/T that may present a health hazard. The PATH (Posture, Activities, Tools, and Handling) method, a flexible and mobile work sampling-based approach, has been developed for characterizing ergonomic exposures to construction workers. It is currently being used in the field to quantify the ergonomic hazards of the major

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construction trades involved in the CA/T project [Buchholz et al., 1995]. A central feature of the PATH method is that it is customized for each combination of trade and construction operation. The customization stage requires extensive observation in the field and interaction with workers and other personnel on-site, such as engineers and safety management. Data gathered using the PATH method are being used for intervention in two ways: (1) to quantify exposures in order to guide the development of engineering and organizational interventions, and (2) to measure the effectiveness of interventions by quantifying hazards both pre- and post-implementation.

Concurrent with the development and piloting of PATH, wide access has been gained to the CA/T. Research is currently being conducted with the cooperation of the project-wide management company, six union locals, five general contractors, and numerous subcontractors. With an effective pre- and post-intervention measurement tool and access to more than 1,000 workers, all the major contractors and, at any given time, approximately $200 million worth of construction work, the stage is set for introducing interventions and evaluating them.

PARTICIPATORY APPROACHES TO INTERVENTION

Arguments for and against participatory approaches to intervention range from the political to the pragmatic. There is general agreement that direct participation in the research by subjects causes a loss of objectivity and may induce bias into the results. It is less organized and complicated to design and conduct research in concert with outsiders who lack expertise in scientific methods and have subjective, vested interests in the direction and the results of the research. COHP has elected to undertake these more challenging participatory methods based on a political analysis that greater control of the workplace by workers is a precondition to making fundamental improvements in the work environment and the health of workers [Levenstein et al., 1994]. Recently this perspective has been buttressed by analyses of the effects of rapid technological change in the workplace and the need to direct occupational health efforts to the locus of that change, where the workers work [Loewenson et al., 1994].

Supporting this more general analysis, there is a compelling body of literature which contends that the successful introduction of ergonomic interventions into the workplace is preconditioned on participation by the affected workers. Noro and Imada [1991] argue that a participatory approach is efficient, inclusive of the end-users of the interventions and increases the likelihood of successful implementation. Gjessing et al. [1994], drawing on the participatory ergonomics programs in the meatpacking industry, claim that worker involvement results in enhanced motivation and problem-solving capability, greater acceptance of change and an increased body of relevant knowledge on which to draw. Schurman et al. [1994], reporting on the UAW-GM Ergonomics Pilot Program, recall great frustration at the monumental task undertaken, but their first recommendation to future researchers on ergonomics in the workplace is: "employ a participatory action research methodology." In his proposals to "devolve ergonomics," Wilson [1994], says that, to be successfully applied, "ergonomics must be seen not only as data and criteria and methods, but as the structures and programmes for the application of these." He charges that ergonomics must be "spread and embedded."

In addition to these political and practical justifications for a participatory approach to ergonomics research, several characteristics of the construction industry make a participatory approach to intervention not just an appropriate choice but perhaps the only effective method.

1. Extreme variability in ergonomic exposures is partly the result of the mobility of workers and the fluid nature of construction worksites. Worker mobility is manifested not only by the movement of workers within construction sites, but also by the movement of the workforce from site to site and from employer to employer. An average construction worker may have five or more employers per year [CPWR, 1993]. The fluid nature of construction confounds ergonomic research by the fact that construction workers regularly construct and deconstruct their workstations. The integration of the experience and knowledge of the actors is essential to successful intervention.
2. Many contractors are on the economic margin and are resistant to change. In addition, while contractors often have the power and opportunity to implement control measures as equipment replacement occurs or as new jobs begin, they need cultural and economic incentives to motivate innovation. These cultural and economic incentives can best be communicated and promoted by their participation in the research.
3. The tradition of labor-management cooperation and the existence of joint institutions such as the apprenticeship and training centers and health and welfare funds provide convenient precedents and offer a foundation for participation by different levels of the construction hierarchy. These factors would encourage workers and their union representatives as well as contractors and safety representatives to be involved in implementing changes in the workplace.
4. The decentralization of the industry and its methods coupled with the dominance of small employers with less than 10 employees requires a compatible decentralized approach to intervention to insure the widest possible diffusion of effective controls within the industry. Participatory approaches to the diffusion of in-

terventions that include workers as participants will result in controls reaching small employers on the CA/T faster than would result from a trickle down diffusion strategy that starts with owners and managers.

DESIGNING AN INTERVENTION STRATEGY

The three-year development period of the COHP has been one of gradual immersion into the economic and social systems of the heavy and highway construction industry in Boston. That immersion has created the conditions needed for development of an "emergent design" [Borg and Gall, 1989] for participatory intervention. In qualitative research, emergent design develops through an interactive process between researcher and participant subjects and evolves as the researcher gathers data that shed light on the views and issues of concern to the subjects.

This development period has also allowed for a period of education on the science of ergonomics within the local construction industry. If participants are to have ownership of the research [Wigmore, 1994], knowledge imbalances must be addressed. Each group, researchers and subjects, must learn each others' business. While the researchers of the COHP have been learning about the construction industry, awareness training has been provided to the participants through the unions and safety related groups. At this time, two construction workers from different trades have taken intensive ergonomics training and will be co-training other workers in collaboration with the researchers. The intent is to increase the participation of workers in the research as they develop the skills, interest, and confidence to work jointly with researchers to design and implement a variety of intervention strategies.

The goal of participatory methods is not simply to elicit and facilitate the participation of articulate individuals. It is to design ways in which the economic and cultural values of the worker populations find expression in the research, so that the interventions are more likely to be successful. This goal occurs within the participatory forms of the design. Questions have evolved which provide ongoing guidance to the many choices that must be made during the emergent design process. These questions are

1. Who should participate in implementing and evaluating intervention strategies? How will those groups be identified and accessed?
2. What interventions should be evaluated? By what criteria should potential interventions be evaluated?
3. How can appropriate interventions be introduced to the appropriate participants? What is the best route to promote widespread acceptance of an intervention in the field?

PARTICIPATORY FORMS

The forms of participation may vary but are likely to exist where the goals and activities of the research interact with the decision-making infrastructure of construction [Gjessing et al., 1994]. These participatory forms can include

1. joint labor–management committees
2. union forms such as local meetings and training activities
3. independent forms, such as research circles, established for the sole purpose of participating in the research

The forms being used by the COHP are evolving and emerging with the deisgn of the research and are determined in large part by the ability of the researchers to shape the design in order to merge with the determinant conditions of the construction industry.

The construction industry has a rigid hierarchy that reflects the larger economy in the United States. But at any point in this hierarchy, the participants operate with a larger degree of autonomy than do their counterparts in industrial and service sectors where jobs are characterized by fixed workplaces. For example, contractors typically bid on a job by responding to specifications with a dollar amount for which they can do the job. There is typically engineering oversight to make sure that the specifications are met but, as long as the job proceeds on schedule and the structure is physically sound, there is little concern for the construction process employed. The knowledge base and experience of the particular management personnel involved determines the processes used.

On a more micro-level, the typical work day of a construction worker includes meeting with the foreman and the rest of the crew, being informed about the job to be done on that day, and going and doing it. As long as the expected pace of production is maintained and nothing unexpected occurs, the workers are on their own. These conditions are quite different from those of the manufacturing or service sector worker whose individual production is measured against all other workers doing similar jobs and whose work is specified to conform to methods that may be formalized in writing and standardized in great detail.

A decision was made by the COHP to enter the hierarchy of construction at several different levels and to have participants from each level examine parallel intervention strategies. Participants' responses to the strategies and to the suggested controls will be analyzed at each level for perceived workability and acceptance. Accessing stable groups with continuity of participants has been one of the most problematic pieces of the intervention strategy. The center of the pyramid, which consists of contractors and trade unions, is the easiest to enter. They are responsible for

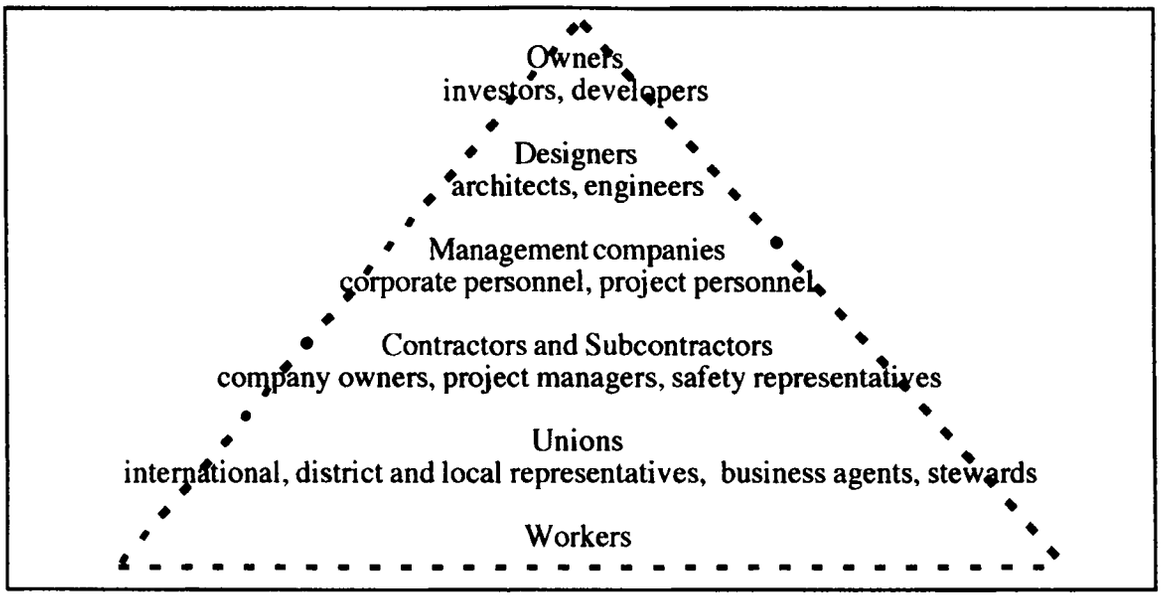

FIGURE 1. Construction industry hierarchy.

production, costs, and safety, and they have frequent meetings to discuss these issues. It has been more difficult, however, to enter the pyramid, in a structured fashion, at either the top or bottom.

Where groups have been accessed, ethnographic techniques have begun to be employed to collect and analyze qualitative data from the participants. For example, participant and nonparticipant observation, focus groups, key informant and open-ended interviews have all been used. These methods are designed to identify and describe the shared culture of populations [Lofland and Lofland, 1984] and have proved to be both compatible with the research objectives and effective when used on construction worksites.

Three advisory groups that span different levels of the hierarchy are currently meeting or being developed. The Research Project Advisory Committee (RPAC) consists of representatives of labor, management and the owners of the CA/T (the Massachusetts Highway Department). This group is responsible for negotiating access to the project and the terms and conditions of field research activities. Although the composition of the group crosses the hierarchy vertically and includes representatives from all levels, except the worker level, power still resides with management and the owners, who may impose a virtual veto at any stage of the process. A second group, the Subcommittee on Intervention, is a subcommittee of the RPAC. At this writing, it is composed principally of management safety representatives. It is planned that foremen and stewards will be included in this group in order to capture the intersection of labor and management's front-line responsibility for safety conditions on-site. A third group, still being developed, will be composed of union representatives, including rank-and-file members and trainers from a variety of local training and apprenticeship programs. The goal for this group is to create a research circle [Harnsten, 1994], which will become an integral part of the design process of the research.

PARTICIPATORY ACTIVITIES

With immersion, education, and participatory forms, the COHP is now undertaking pilot activities to assess the feasibility and suitability of the research methods. Two of these activities are described here.

Intervention Ideas

As a means of introducing the concepts of intervention and beginning the participatory process, ideas for possible technological and organizational controls are being collected from various sources including the ergonomics literature (especially studies from Scandinavia) and modifications observed in the field. Each "Intervention Idea" is outlined on a single sheet of paper. The "Idea" is described and discussion questions are included in the outline. These "Ideas" are first reviewed for ergonomic soundness by the field researchers at the COHP research team. Next the "Ideas" are presented to the members of the advisory committees for their review, comments and revisions. The objective of the "Intervention Ideas" activity is to present the same information regarding controls to the various advisory groups, in order to gather qualitative data using ethnographic methods on the perceived efficacy and efficiency of the idea itself and to gauge acceptance and resistance by

INTERVENTION IDEA
"Tool tree"

Carpenters working in a large on-site shop on the Central/Artery Tunnel use hydraulic nail guns and electric tools (drills, saws, screw guns) throughout their shift. The tools weigh 10-20 lb. They have constructed "tool trees" in order to make the tools easier to reach. The "trees" are 3 ft. 8 in. high and have 4-6 "branches." The workers reach down to a level of 2 ft. - 3 ft. 2 in. to access the tools. This keeps the tools nearby and avoids the alternatives of a clutter of benches or keeping the tools on the floor.

The "tool tree" reduces bending and lifting which could contribute to back injuries and other sprains and strains. In research terms, a modification in the workplace which reduces the risk for musculoskeltal injury is called an "ergonomic intervention." The "tool tree" makes the job easier and reduces risk. It is, therefore, an "ergonomic intervention."

Discussion questions:

What is the "tool tree" commonly called?
Is it a commonly used piece of equipment?
Have you ever seen a piece of equipment like this mounted on wheels or castors for greater mobility?
Would it work?

FIGURE 2. Intervention idea.

various levels of the construction hierarchy to a new idea, which may be introduced or more widely promoted in construction. The model employed is one of repeated cycles of discussion, reflection and action used in community health education [Blondet and Hogarty, 1994]. In each phase, the product ("Intervention Idea") is revised and improved; in each cycle, participants are exposed to the "Idea" itself and to the process of analyzing a specific ergonomic problem.

Comparison of Safety Systems

A second intervention activity, a comparison of the safety systems of two different contractors, was designed to explore differing stakeholders' perceptions of the safety programs used on-site, as well as the relationship between those perceptions and the safety records of the subject companies. Two large construction contractors on the CA/T have been identified on the basis of having different safety records and different safety management systems. Employing ethnographic methods, data are being collected on a wide range of issues related to the safety systems within each company, specifically concerning knowledge, beliefs, and attitudes regarding exposure to risk factors for ergonomic injuries. These data include perceptions regarding the health and safety culture on-site (including norms, beliefs, context, and behaviors) and the formal safety systems in place at each company. Data are being collected, using the participatory methods described above, from representative populations within at least three distinct levels of the hierarchy of the construction industry as represented by these two companies. Workers and management personnel in the field, as well as designated representative of owners, management, and labor, are included as respondents.

Data-source triangulation, a method of classifying and comparing data from different sources, will be used to create a description of the internal safety system of each of the two companies, including where the respondents' perceptions agree, where they differ and the degree of any differences. The data on each company will be compared to create a qualitative description of effective and noneffective components of safety and health management [Moir and Buchholz, 1995].

CONCLUSION

The COHP has developed participatory forms and activities but is not yet engaged in participatory intervention research. This requires a level of involvement by construction industry participants that has not yet been attained and that must emerge from the design and its activities. As participation by groups within the local industry increases, the study design will be guided by the following criteria:

1. Participation must include stakeholders from all levels of the construction industry hierarchy.
2. Participatory forms must flow from the culture and norms of the industry and its workplaces.
3. Potential for widespread acceptance within the industry as determined by the advisory groups must be a criterion for further evaluation of interventions.
4. Strategies for diffusion of both technological and organizational interventions must be part of an overall intervention strategy.

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