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The Use of Participatory Action Research and Ergonomics in the Prevention of Work-Related Musculoskeletal Disorders in the Newspaper Industry

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The newspaper industry is one of many in which employees are reported to be at risk for work-related musculoskeletal disorders of the upper extremities and low back. The purpose of this 18-month demonstration project was to assess the usefulness of a participatory ergonomics process as a strategy to reduce the risk factors associated with musculoskeletal disorders at a metropolitan newspaper company. The company involved had 455 employees and a daily circulation of 75,200. Employees from both office and production areas participated. The participatory action research approach utilized required investigators to work collaboratively with the study population. Using a five-step continuous improvement process, the ergonomics committee identified and evaluated jobs having ergonomic risk factors. This was followed by the development, implementation, and evaluations of interventions aimed at reducing risk factor exposure. The committee's productivity and participant feedback were used as measures of the committee's effectiveness. During the project period, interventions were implemented in 11 of 12 targeted departments. Participant ratings of effectiveness for different aspects of the ergonomics process were generally favorable. The mean and median cost for ergonomic interventions were \$376 and \$25, respectively. This project demonstrated that participatory action research could be used to develop and implement ergonomic solutions that reduce the risk factors associated with work-related musculoskeletal disorders.

Keywords Musculoskeletal Disorders, Participatory Action Research, Ergonomics, Newspaper Industry

The newspaper industry employs approximately 550,000 workers in over 1700 newspaper companies in North America. The tasks associated with writing, editing, composing, print-

ing, and distributing a daily newspaper lead to increased risk for work-related musculoskeletal disorders (WMDs).^(1–6) In a study comparing WMDs in 5700 workers from various occupations (construction, manufacturing, health care, cosmetology, and newspaper work), the highest rates of missed work resulting from low back pain and hand disorders were reported by workers in newspaper production jobs.⁽⁷⁾ Bernard and associates⁽²⁾ reported that 41 percent of newspaper employees using computer keyboards suffered from an upper extremity WMD. Other studies in Europe reported the prevalence of WMDs among reporters and editors ranged from 17 percent to 54 percent depending on the specific department and body region.⁽³⁾

Job tasks in the newspaper industry that are of ergonomic concern include prolonged computer use, manual handling of newspaper bundles, repetitive upper extremity motions associated with loading inserting machines, awkward postures during printing tasks, and maintaining static positions during various office and production tasks.^(2,6) Psychosocial risk factors such as working under deadlines and job pressures are also considered risk factors for WMDs.⁽²⁾ Because of the increasing prevalence of WMDs, the potential of permanent disability, and the associated compensation costs, newspaper companies, newspaper associations, and labor organizations are investigating strategies for controlling and preventing musculoskeletal disorders in the newspaper industry.

The purpose of this 18-month demonstration project was to assess the integration of a participatory ergonomics process as a strategy to control WMDs. This article reports the results of an effort to implement a participatory ergonomics process through the use of action research methodology. Action research in an occupational setting utilizes a participative design that draws researchers and employees together to help meet research and company objectives.⁽⁸⁾ Participatory action research combines “intervention” and “research” components into a systematic and integrated process that contribute to improving the systems performance and expanding general scientific knowledge.⁽⁹⁾

METHODS AND MATERIALS

Study Design

The scientific approach to this project was one of action research. Action research is frequently used in applied behavioral sciences when investigating and implementing organizational change. This research process is characterized by the following attributes: participation, cooperation, co-learning, system development, employee empowerment, and a balancing of the researcher and employee objectives.^(8,9) The central theme of action research is the involvement of researchers and employees in a joint process aimed at meeting research and intervention objectives.⁽⁹⁻¹³⁾ When researchers participate in this type of interaction in an occupational setting their role as researcher often shifts from expert to co-learner.

In most occupational field studies, researchers have limited control over the organizational structure and daily work processes.⁽⁸⁾ Thus, it is difficult to control the many factors that may influence the outcome of research objectives. For example, hostile labor-management relationships may prevent effective communication and affect the success of ergonomic committees. Economic variables are also beyond the researcher's control and can have an affect on production, employment, and worker behavior.

There are several reasons why the authors use the action research approach when working with companies to integrate changes into their organizational framework.

1. The action research approach emphasizes a coequal and interdependent relationship between researchers and employees.⁽⁸⁾
2. Participation by employees enhances the development of new ideas, changes in individual behaviors, and long-term program acceptance.⁽¹⁴⁾
3. The long-term goal of employee participation is to transfer ownership and control of the process to employees themselves which enhances the likelihood of success.⁽¹⁵⁾
4. Participatory action research focuses on system development rather than individual behavioral change. The intent of a participatory action research intervention is the development of system structures that foster continuous learning as the ongoing approach to "managing" the system.⁽⁹⁾

Because the purpose of this demonstration project was to evaluate the use of action research in ergonomics, a pre-experimental study design ("one-shot case study" approach) was incorporated.⁽¹⁶⁾ There were no pre-intervention data to compare to the post-intervention data. The results of the post-intervention data among the participants is presented and discussed.

Overview of the Project

The newspaper company involved in the project is responsible for production of a daily metropolitan newspaper with a current circulation of 75,200 and 102,000 Sunday editions. There are 455 employees. Approximately 90 percent of the workforce is

hourly (non-supervisory), 75 percent are male, and 15 percent are minorities. There was no organized labor representation at the facility at the time of the project.

The primary objectives of this project for the investigators included the determination of the prevalence of WMDs, introduction of the action research process as an intervention tool, and the description and assessment of the participatory approach to ergonomics. The primary objectives of the newspaper company were to develop ergonomic interventions for the most problematic job tasks and decrease the prevalence of musculoskeletal disorders.

The project was funded through the Newspaper Association of America, a professional trade organization representing approximately 1500 newspaper companies in North America. Several meetings were held with the association and the newspaper company to discuss the scope and purpose of the project. These initial meetings helped clarify the objectives of the trade association, newspaper company, and the investigators. The overall project lasted approximately six years and was divided into three phases: the detection phase which consisted of determining the prevalence and extent of WMDs; the intervention phase consisting of implementation of the ergonomics process; and the information dissemination phase. The focus of this article is the intervention phase that lasted approximately 18 months.

The intervention phase began with ergonomic education and training for ergonomic committee members. The ergonomics committee consisted of representatives from various departments including the newsroom, advertising, information systems, sales, imaging, packaging (inserting operations) and distribution, maintenance, safety and health, and human resources. There were a total of 12 participants, half of whom were hourly employees. The ergonomic education program for the committee members consisted of approximately 20 hours of lectures, demonstrations, and problem-solving sessions relating to ergonomic principles and the ergonomics process. Additional ergonomic awareness education was provided to all company employees and consisted of a one-hour didactic presentation to groups of 12 to 20 employees. The investigators provided the ergonomic training.

Ergonomic meetings were held once a month and facilitated by one of the investigators. On three occasions during the project period a committee member facilitated the meetings. During the monthly meetings, previous project work was summarized, new issues or developments were discussed, and plans for the next month were outlined and assigned. Informal sessions between the monthly meetings were also held by small groups of committee members working on specific projects. At the end of the project period, a self-administered questionnaire was administered to determine the participants overall impressions of the participatory ergonomics process.

Ergonomics Process

The strategy employed to implement ergonomic changes within the newspaper company involved a cyclical problem-solving process. This cyclical process includes five specific but



FIGURE 1

The ergonomics process is a continuous improvement model of problem identification and analysis, followed by the development, implementation, and evaluation of ergonomic solutions. (Original source: *Orthopaedic Physical Therapy Clinics of North America*, 5/2:274, 1996. Used with permission of publisher.)

overlapping steps: (1) identification, (2) analysis, (3) solution development, (4) implementation, and (5) evaluation (Figure 1). This process is similar to other problem-solving models in participatory action research^(8,9,17) and in quality management.^(18,19) When integrated with ergonomic intervention, this process is referred to as an ergonomics process.⁽⁶⁾ The identification of WMDs and their associated risk factors is the first step in the ergonomics process. Once WMDs are identified, specific work tasks and methods are analyzed for detecting risk factors and developing potential solutions. Based on the findings from the analysis, a prioritization for solution development and implementation is planned. The implemented solutions are then evaluated. In most instances, the initial solutions are imperfect, and therefore the situation is reanalyzed and the cycle repeated until a satisfactory result is obtained.

Problem Identification

The objective of the identification step is to identify WMDs and the occupational activities that may precipitate, exacerbate, or cause the disorders. Four primary sources of information were used to determine the extent and location of ergonomic problems at the newspaper company. These consisted of employee questionnaires, Occupational Safety and Health Administration (OSHA) 200 logs, observation of work tasks, and discussions with employees. Self-administered questionnaires consisting of a symptom and job factors survey were used as an active surveillance instrument.⁽⁵⁾ The symptom survey assisted in the identification of anatomic areas with the highest prevalence of self-reported job-related aches and pains. The job factors survey was used to identify the workplace conditions that the employees thought contribute to WMDs. OSHA 200 logs were also used to identify WMDs. Factors that were assessed on the OSHA 200

logs consisted of a description of the incident, employee's department, number of lost workdays, and amount of restricted work time associated with the disorder. Working tasks were then observed to determine if the most obvious risk factors (high forces, high repetition rates, and awkward postures) were present. Additionally, informal discussions were held with employees to ascertain their opinions on specific work tasks and possible risk factors.

Once the WMDs and risk factors were identified, an initial prioritization schedule for solving targeted ergonomic problems was established. Jobs or departments with the majority of diagnosed injuries or illnesses (based on OSHA logs and subsequent medical reports) were considered first. Within those departments, priority was given to analyzing tasks that were associated with the most disabling injuries (e.g., low back strain, carpal tunnel syndrome). Jobs associated with symptoms of MSDs (identified on the survey) were targeted next, followed by jobs associated with work practices that had ergonomic risk factors as observed by the committee.

Problem Analysis

The objectives of the problem analysis step were to better understand the job and task requirements and to determine the specific circumstances causing the identified problem. In the analysis of ergonomic problems, specific work tasks, methods, and equipment were analyzed. Several tools and techniques were used to collect a combination of quantitative and qualitative data for the job task analysis.⁽²⁰⁾ This newspaper ergonomics committee used a combination of checklists, direct observation and measurements, and videotape analysis to analyze the problems identified.

Quantitative data collected included measurements of weight and size of materials handled, distances traveled with load, reaching distances in the working area, and production rates (individual and machine rates). Qualitative data collected included descriptions of forces and postures to which workers were exposed. The ergonomics committee also collected information from department managers regarding the purpose of tasks and any unusual or special circumstances (i.e., new inserting machine on order) that may influence potential changes. As in the problem identification step, employee feedback was sought to help evaluate the task in more detail. Selected employees were questioned about any discomforts or difficulties associated with the job task and if they had any suggestions that might improve their working situation.

Solution Development

Potential solutions addressing ergonomic problems can be developed throughout the ergonomics process. It is not unusual to identify and implement an immediate ergonomic solution (i.e., raising the height of a monitor) during the identification stage. These types of "quick fixes" do not require a complete detailed analysis before a solution is implemented. With more involved

tasks, however, a more formal process of solution development is required. The ergonomics committee at this newspaper used brainstorming sessions to collect ideas, regardless of cost, practicality, and feasibility, for ergonomic solutions. In most instances, the ergonomics committee reached a consensus on the desired solution. Because the ergonomics committee did not have their own budget, specific departments had to approve the potential interventions and allocate resources for the implementation.

Solution Implementation

Implementation of the recommended solutions was primarily the responsibility of the departments in which the job was located. The maintenance department, however, was often involved in the fabrication and installation of many engineering solutions for other departments. Prior to ergonomic implementation, employees were informed of the changes and feedback regarding the proposed solutions was ascertained.

In most instances the ergonomics committee tested the solutions prior to full-scale implementation. To help plan the testing and implementation the committee addressed the following issues: (1) How will the solution be tested? (2) What steps will be involved in implementing the change? (3) Which personnel will be involved in making the change? (4) What is the time frame for implementation? (5) What provisions will be made to reduce downtime?

Evaluation of Ergonomic Solutions

Once an ergonomic intervention was prototyped and implemented, employees were asked to give feedback to the ergonomics committee member assigned to their area. The feedback provided a short-term assessment of the intervention's effectiveness. This non-structured evaluation of the intervention with the affected employees consisted of the following questions:

- Did the intervention reduce job-related discomfort, pain, or fatigue?
- Did the intervention make the task easier to perform?
- Did the change create any other problems at your workstation?

To assess long-term effectiveness, the committee reevaluated the changes four to six months post-intervention. An assessment of the following outcomes were planned to determine the long-term effectiveness: (1) error and accident rates, (2) employee morale and job satisfaction, (3) quality, (4) illnesses and injury rates, (5) absenteeism, and (6) production efficiency.

Assessment of Participatory Process

Committee productivity and participant feedback were used to determine the effectiveness of the ergonomics committee efforts. Productivity was determined by comparing the number of areas identified as needing ergonomic attention to the number of areas that had ergonomic solutions implemented. An anonymous

self-administered questionnaire adapted from Moore and Garg⁽¹⁷⁾ was employed to obtain feedback from the ergonomic committee participants regarding committee size, committee representation, the components of the ergonomics process, committee productivity, and committee function. The questionnaire used a five-point rating scale (1—very unfavorable, 5—very favorable; or 1—strongly disagree, 5—strongly agree) where appropriate. A questionnaire was completed by each member of the ergonomics committee at the end of the one-year project. Responses were tabulated and analyzed by the investigators.

RESULTS

Identification of Problem Areas

One of the first activities performed to determine the extent and location of WMDs was a self-administered questionnaire that was distributed to all 452 employees. Four hundred and six completed questionnaires were returned (90% response rate). The average age of the employees responding to the questionnaire was 37 years (s.d. 7.3 years) and 50 percent were female. The low back, neck, and hands/wrists areas had the highest 12-month period prevalence of self-reported work-related musculoskeletal problems. Fifty-four percent of the respondents reported work-related low back pain in the previous 12 months. Low back pain accounted for the highest prevalence of self-reported missed work in the preceding 12-months (13.2%). The job factors that employees reported as contributing most frequently to work-related musculoskeletal problems were: (1) working in the same position, (2) workstation not being adjustable, and (3) repetitive tasks. The prevalence of self-reported musculoskeletal problems and subsequent missed work were higher among production employees (press area, inserting operations, maintenance, distribution) than among office employees for all anatomical areas (upper extremity, back, and lower extremity). The OSHA 200 log of recordable injuries and illnesses for the 12 months preceding ergonomic interventions was consistent with the questionnaire results. Over the 12 months prior to ergonomic interventions there were 61 OSHA 200 log recordables, 45 of which were considered musculoskeletal in nature (excluding lacerations, traumatic injuries, dermatitis, etc.). Of the 45 musculoskeletal injuries and illnesses, 8 involved the low back and 37 were classified as disorders associated with repeated trauma. Low back disorders accounted for a total of 91 (median = 3, mean = 11) days away from work and 272 (median = 8, mean = 34) days of restricted work duty. Of the illnesses associated with repeated trauma, upper extremity strain was the most common descriptor of the illness. Thirty-eight (84%) of the 45 WMD OSHA 200 recordables were associated with production work and 7 (16%) were associated with office tasks. The majority of WMD OSHA recordables in production occurred with tasks involved with inserting operations in the packaging and inserting operations. There were no WMD OSHA recordables associated with pressroom tasks. Observation of various work tasks by ergonomic committee members

TABLE I

Work areas identified as needing ergonomic intervention at a newspaper company

Office and pre-press areas	Production areas
Newsroom	Inserting
Advertising	Jogging
Accounting	Pressroom
Imaging center	Distribution
Circulation	Quarter-fold
Paste-up	
Graphic arts	

and discussions with employees supported the findings of the questionnaire and OSHA 200 logs.

Productivity of Ergonomics Committee

There were 12 general areas within the newspaper company identified as needing ergonomic improvements (Table I). Within the 12 areas, there were often several tasks that were identified as needing ergonomic attention. Some ergonomic solutions developed for one area were often used in others (e.g., where computer work was a primary task).

At least one ergonomic intervention was implemented in all seven office and pre-press areas during the project period. In many cases a detailed ergonomic process with a thorough analysis was not required for implementation of the interventions. Nevertheless, the interventions (whether administrative or engineering) required approval from within that specific department. Ergonomic interventions were implemented in four of the five production areas. Although some interventions were introduced, no changes were made in press operations. There were no OSHA 200 log recordables associated with pressroom tasks and no representatives from the pressroom participated on the ergonomics committee during the project period.

There was a range of ergonomic solutions in both the production and office areas. Examples included ergonomic office chairs, indirect lighting, adjustable-height workstations, foot and wrist rests, document holders, headsets, pallet jacks, paste-up board risers, jogging cages, inserting machine forearm supports, and various equipment modifications. When possible, ergonomic modifications (such as adjustable-height desks) were constructed by company personnel. Administrative controls were also implemented. For example, the hourly load rate of inserting equipment was decreased to allow workers more time to load the inserting heads. This administrative change allowed longer pauses between task cycles when employees loaded the machine. At the slower rate, the inserting equipment had fewer jams and less downtime resulting in improved production efficiency (inserting job completed in less time). Other engineering and administrative solutions were developed for a variety of the production tasks and discussed in detail elsewhere.⁽⁶⁾ The aver-

age cost for an ergonomic solution (not including administrative costs) was \$376 (median \$25—range \$2–\$2,495).

Ergonomic Committee Self-Assessment

Ergonomic committee self-assessment questionnaires were completed by all 12 (100%) of the ergonomic committee members. All respondents felt that the size of the committee was “about right.” Nine (75%) of the participants felt the committee was appropriately balanced with managers and hourly employees. Two respondents indicated that line employees were under-represented and one indicated that management was under-represented on the ergonomics committee. Eight (67%) of the committee members indicated that all newspaper departments were adequately represented. The four participants who disagreed indicated that the pressroom was under-represented. Half of the committee members indicated that the ideal meeting length was 1 hour (range 30 minutes–2 hours) and 67 percent indicated that a frequency of once per month (range 24/year–4/year) was ideal.

Performance ratings of the ergonomic process steps were generally favorable (Table II). Solution implementation had the highest mean rating of 3.7 on a 1–5 scale.

The lowest rating was given to evaluation of interventions. The relatively low rating for intervention evaluation is likely due to the time constraints during the 18-month project period. Most of the committee’s effort was focused on the other four steps of the ergonomics process.

Mean ratings on a scale of 1 to 5 (1, strongly disagree; 5, strongly agree) of various aspects of the ergonomic meetings are summarized in Table III. High ratings were given to the participants’ ability to “express their concerns” and that the meetings were of a “cooperative” nature. Ratings were more neutral for meetings being “energetic,” “focused,” and “interesting.” Using the same rating scale, participants rated the statement, “The ergonomics process has had strong management commitment,” neutrally with a mean of 3.4 (range 2–5).

Regarding the pace of ergonomic activities, 75 percent of the participants indicated it was “about right” whereas 25 percent indicated it was “too slow.” No participants indicated that the pace of ergonomic activities was “too fast.” All participants indicated that the feedback from other employees regarding

TABLE II

Ratings of the ergonomic process elements on a scale of 1 to 5 (1, very unfavorable; 5, very favorable) by participants on an ergonomic committee at a large newspaper company

Process elements	Mean	Range
Problem identification	3.5	2–5
Problem analysis	3.4	2–5
Solution development	3.4	2–5
Solution implementation	3.7	2–5
Evaluation of intervention	3.3	2–5

TABLE III

Ratings of the ergonomic meetings and management commitment on a scale of 1 to 5 (1, strongly disagree; 5, strongly agree) by participants on the ergonomics committee at a large newspaper company

	Mean	Range
The meetings were focused.	3.5	2–5
The meetings were energetic.	3.3	2–5
The meetings were interesting.	3.5	2–5
The meetings were informative.	3.8	2–5
The meetings were cooperative rather than divisive.	4.1	3–5
The meetings allowed everyone to express their concerns.	4.4	3–5
The ergonomics process has had strong management commitment	3.4	2–5

the ergonomic interventions was either “favorable” or “very favorable.” When asked about the committees’ “best accomplishments,” five (42%) members indicated that new chairs for employees in various office areas were one of the best. Other best accomplishments cited included “employee involvement and awareness in ergonomics” (n = 4); “reductions in musculoskeletal disorders” (n = 3); “improvements in the inserting area” (n = 2); and an “increase in productivity” (n = 1).

When participants were asked about obstacles that hindered the ergonomics committee’s progress, lack of time and insufficient resources were the two most commonly cited (50% of participants cited at least one) obstacles. Lack of interest and poor attitudes were also cited (by two individuals) as obstacles to progress. Examples of the comments regarding obstacles that hindered progress included:

1. “Time—we are often stretched too thin as employees.”
2. “Other commitments—people being spread too thin to devote time necessary.”
3. “Budget and everyone being really busy and not able to spend as much time as possible on this matter.”
4. “The reluctance by some to admit there are problems and attitudes of some that employees are the problem and complain too much.”

When queried for general comments the following were noted:

1. “We should include a few more new people who are working in the actual conditions . . . invite 2–3 people from a department for the brainstorming sessions.
2. “Rotate members every few years so that there is an old and new mix.”
3. “There needs to be a focus on real ergonomic concerns rather than people just whining.”
4. “I think the facilities department was very helpful in accommodating several departments with low-budget remedies to help out their ergonomic concerns.”

5. “We need to know what support top management gives to the ergonomics program.”
6. “There should be more communication from ergonomic committee members to the employees.”

DISCUSSION

The goal of this project, as defined by the newspaper company management, was to reduce the prevalence of musculoskeletal disorders associated with newspaper work. The purpose of this demonstration project for the investigators was to demonstrate and evaluate the effectiveness of a participatory ergonomics process to meet the goals of the company. This investigation was a demonstration project rather than an experimental intervention study where control or comparison groups are used to draw definitive conclusions about causal relationships. Thus, it was not possible in this study to make definitive conclusions regarding factors that caused or contributed to the observations.

Based on productivity, the ergonomics committee was successful in the development and implementation of ergonomic interventions. All but one of the areas identified as needing ergonomic changes had interventions in place at the conclusion of the project period. However, not all interventions were evaluated to determine their effectiveness or impact. There are several explanations for the lack of ergonomic solutions in the pressroom. One major factor was the lack of direct representation from the press area on the ergonomics committee. Though the production manager was involved on the committee, no one person was a strong advocate for that area. Additionally, equipment modifications on newspaper presses are difficult and must be performed quickly between press runs. The committee also realized that in several years the newspaper would get new presses and that ergonomic issues should be addressed at that time.

Group performance ratings on the ergonomic process steps were very favorable. The steps with the highest ratings were problem identification and solution implementation. Though some job tasks were analyzed in detail, many did not require an extensive analysis and the ergonomics committee often jumped to solution implementation. This was especially true in the office areas. Once an intervention was in place the committee did not usually follow through with an evaluation of the intervention effectiveness. An evaluation was typically done if the employee indicated there was a problem with the intervention.

Although the ergonomics committee meetings were not rated highly for being energetic, they did receive high scores for being cooperative and allowing members to express their concerns. The high scores suggest that the participatory model was an effective approach for communicating ergonomic issues within the ergonomics committee, where decisions were based on group consensus. Though most of the members felt comfortable with the composition of the ergonomics committee, some wanted more management representation while others wanted more employee representation. Some members questioned the management’s commitment for the ergonomics program. Major obstacles hindering the committee’s progress were lack of time to devote to the project and an insufficient budget. Committee

members indicated that they had other responsibilities and did not have sufficient time to devote to ergonomics. Money for ergonomic changes came from departmental budgets as well as the newspaper's operating budget. The ergonomics committee did not have direct access to financial resources.

Moore and Garg⁽¹⁷⁾ utilized a similar study design addressing participatory action research in the red meat packing industry. The ergonomic teams in the packing plants used a structured problem-solving method with similar steps (elements) as the one in the present study. The authors also used participant feedback questionnaires to assess the effectiveness of the participatory process. Regarding the elements of the problem-solving process, participants rated their effectiveness for "problem evaluation" highest and "intervention implementation" lowest. The authors summarized that "implementation" was rated lowest of the five elements due to relatively few interventions being implemented during the project period (approximately 12 months). Many interventions were proposed for the following year when plant renovations were to be completed. In the present study "implementation" was rated highest and "intervention evaluation" lowest. Our project period of 18 months was sufficient for implementation, but perhaps not for full evaluation of the interventions. Moore and Garg⁽¹⁷⁾ indicated that team leadership was an important factor for insuring a sense of participation by ergonomic team members. The authors concluded that participatory ergonomic teams can be successful at analyzing jobs and developing solutions to reduce risk factor exposure. Our project demonstrated that a participatory ergonomics process also leads to the successful implementation of ergonomic solutions aimed at reducing risk factor exposure.

A basic tenet of the ergonomics process and participatory action research is participation by various "stakeholders" within the system including the owners, employees, and researchers. The focus of participation and empowerment is to assure system members a sense of control over their work. This focus is not unlike that of employee empowerment and has the potential to affect the overall climate of the intervention process.⁽²¹⁾ Active participation and perceived ownership of ideas by employees enhances the likelihood of successful intervention implementation.^(15,22)

Experienced workers who perform job tasks on a daily basis often have ideas on how to make these jobs less strenuous and more efficient. Ergonomic solutions, however, may not come to fruition if employees are not encouraged to express their ideas, become involved in the decision making process, and receive support from management. With participatory action research, the employees ("insiders") contribute their local theories and practical knowledge of the workplace while the researchers (so-called "outside experts") contribute their theoretical knowledge and methodological expertise. The goal therefore is to develop interventions that are both contextually grounded and also rooted in accumulated theoretical knowledge.⁽⁹⁾ In too many situations outside experts are called in and impose their solutions without regard to all stakeholders, especially those performing the actual tasks. Participatory ergonomics encourages participation from

both employees and management and enhances the likelihood of long-term ergonomic changes within the system.

As stated previously, this project utilized participatory action research as a collaborative approach between researchers and company personnel to foster ergonomic changes within the organizational framework. Because this approach emphasizes shared control and decision making, there were role-related tensions among organization members and researchers. This created conflicts and frustration for the various stakeholders. For example, committee operational norms agreed upon at the outset included issues such as: everyone's ideas should be heard, everyone's opinion is weighted equally, confidentiality is maintained, and decisions are based on consensus. It was apparent that the people within the company had not worked together previously on the basis of such norms. Committee members from management initially assumed greater leadership, participated more, and struggled with the additional responsibilities. Production employees enjoyed being "off the floor" and attending meetings, but they quickly became frustrated feeling that nobody listened to them. Hourly employees and management members initially blamed the company's ergonomic problems on each other. For example, hourly employees on the committee felt the lifting requirements were beyond safe limits; management members felt workers just needed to lift correctly. As researchers, we wanted to intervene during these types of discussions, but we resisted being overly directive. We felt the potential for organizational change was greater if committee members resolved conflicts and discovered solutions with little researcher influence. As the participatory process progressed, several ergonomic interventions were developed and implemented. After some initial success with interventions, the committee developed an identity and gained recognition and respect throughout the facility. The committee began to take equal credit for its contributions (successes and failures) which eventually led to greater cohesiveness within the group. Though both hourly employees and management were initially skeptical of each other's motives, they eventually became convinced that they could have shared goals that would be mutually beneficial.

As researchers from the university we were viewed as a "neutral party" which helped facilitate cooperation between salaried and hourly committee members. At the same time, the committee initially perceived us as the outsiders having little practical experience in industrial settings. And though as researchers we had been involved with other industries, we had little experience in the newspaper industry and were co-learners during the project. From a research perspective, we needed to be cognizant of company and individual limitations with regard to the research. Over an 18-month period the employees were barraged with questionnaires, various forms of data collection (videography, electromyography, nerve conduction studies, sensibility tests, etc.), and ergonomic meetings. It was often difficult to perform these activities with little disruption to the employee or compromises in research methods. Although our goal was to get a 100 percent response rate on the self-administered questionnaires, we were not allowed to follow up on the non-respondents.

This was a policy established by the administrators of the newspaper. Another factor out of our control was the selection of ergonomic committee members (hourly or salaried). Committee members selected by management may have been chosen based upon their communication skills, resulting in a favorable bias for the participatory process.

One of our goals as researchers was to have the ergonomics committee become less dependent upon our guidance as the project progressed. The ergonomics process functioned relatively well with our leadership but we were unsure if the process would continue after our departure. During the year following the project we returned on several occasions to determine the status of the ergonomics process and determine if the process had been adopted by the company. By the end of the second year, the production manager indicated that ergonomics had been phased into most, but still not all, aspects of newspaper production. Rather than continuing with a separate ergonomics committee, ergonomic subcommittees had been developed within the safety and health committee and production teams. During the following year the owners of the newspaper company implemented a participatory ergonomics process in their television and radio divisions. Additionally, plans for a new off-site newspaper production facility were being drawn up with ergonomics as a primary issue in the planning phases. Although the formal participatory ergonomics committee no longer existed, the ergonomics process appeared to be well integrated throughout the company, including divisions where we had no direct contact. Thus, an organizational (systems) structure that facilitated further development of the ergonomic process appeared to be continuing after our involvement within the company.

CONCLUSIONS

This project demonstrated the use of action research as a method to assess the integration of a participatory ergonomics process. Integration of a participatory ergonomics process model can lead to the successful development and implementation of solutions to reduce employee exposure to ergonomic risk factors. The participatory process can also be a vehicle for organizational changes within the company even after the researchers and/or consultants have departed. Many of the most effective ergonomic interventions originated from the employees who were performing the task on a daily basis. It is important that participants are given adequate time for the additional responsibilities associated with the integration of the ergonomics process.

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