CASE STUDY #3

The Setting

The company is a medium-sized meat processor that has a nonunion production work force. The plant is an all-inclusive beef processing operation located in a metropolitan area. It contains a modern slaughtering plant that processes about 1,000 dairy cows each day (total of 300,000,000 lbs. of beef and by-products per year); a complete whole muscle boning and trimming operation that makes steaks, roasts, and ground beef; and a beef restructuring operation. The restructured beef products are supplied as roast beef to several national restaurant chains. Whole muscle products are sold to hamburger patty makers, fast food chains, meat processors, sausage makers, and the federal government for its school lunch program. In addition, a significant amount of edible offal and other meat by-products are sold in foreign markets.

The plant employs approximately 700 people in its three divisions, at least two thirds of whom are African-Americans and Hispanics. Fifteen to eighteen per cent of the production workers are women. The relationship between management and workers appears to be cooperative.

In the fall of 1993, the company was reorganized under Chapter 11. A group of investors with local economic roots purchased the company. This period of financial instability appeared to have minimal effect on the intervention. Although still committed to the goals of the project, management attention was lower for a brief period of time (approximately one month) while they struggled to ensure the economic survival of the company.

PRE-EXISTING LEVEL OF ERGONOMICS CONCERNS/ EFFORTS

The principal investigator approached the Director of Human Resources and the Manager of Safety at the plant about participation in the project. No ergonomics program existed at that time, and plant management was enthusiastic about participating in this project. They were aware of ergonomic problems in the industry and aspired to establish an ergonomics program in their plant. They were concerned primarily with the upper extremity disorders associated with repetitive motions.

SCOPE/OBJECTIVES OF THE CASE STUDY

The following implementation plan was developed. First, an ergonomics program was set up, consisting of teams that would attempt to decrease the severity and cost of cumulative trauma disorder (CTD) illnesses among plant employees. The effectiveness of these teams would be determined using both behavioral and engineering measures. The behavioral measures included results from climate surveys, while the engineering measures included the physical attributes of the jobs. The type and amount of wrist motion required to cut meat off a bone provides an example of a physical attribute of a meat processing job. The objectives of the plan were:

- Enhanced safety and health of the employees
- Decreased costs of workers' compensation premiums
- Decreased costs of training new workers to replace injured workers
- Improved morale among the employees
- Improved employee safety and health and reduced cost of occupational injuries and illnesses in the entire industry through shared results with other meat processing plants.

METHODS AND OPERATIONAL PROCEDURES

Team Formation/Member Selection

Two ergonomics teams were formed, each to work on a specific task. The two targeted tasks were the bone trimming operation (electric bone trimming department) and the meat stuffing and bagging operation. The members of each team were selected by the principal investigator and plant management. There were 15 members on the bone trimming team and 14 members on the meat stuffing team. Over the course of the year, four team members left due to job transfer or quitting the company. All of the employees who left were production workers. Not all team members attended each meeting, resulting in an average attendance of eight to nine. Most, if not all, production workers attended each meeting.

The teams were composed of management, support personnel, and production workers, providing representation from all staff who had some direct or indirect involvement with occupational injuries incurred on site. The investigators, the Director of Human Resources, the Manager of Safety, two nurses, and the Maintenance Manager sat on both teams. Additional members on each team included five or six production workers and a supervisor. Every effort was made to minimize the hierarchy of the team members and treat each member as an equal. Each team member was encouraged to speak his/her mind, and decisions were made by consensus from the team.

Two team members had difficulty understanding and speaking English, and three members either read or wrote English with difficulty. The inability to communicate in English, either orally or in written form, presented some problems during the meetings when members were asked to fill out surveys. Usually, a co-worker read the questions and answers from the survey to the worker who had trouble reading English. Another problem with language surfaced when a team member was asked to sign a consent form to have his wrist motion monitored on the bone trimming line. For those members who could not understand or read English, a co-worker who was fluent in English translated the text on the consent form into Spanish. There was also one uncooperative member on one team who sometimes disrupted meetings.

Team Training

The principal investigator led a one and one-half hour training session for each ergonomics team at the beginning of the project. At the begining of the training session, team members learned information about the plant's injury statistics and workers' compensation claims. Most of the training session focused on the physical aspects of CTDs in the workplace, the risk factors, and how to prevent CTDs through interventions. Training continued throughout the project during meetings when ergonomic issues were discussed by the university investigator and the team members. Provisions for team-building training were limited to the investigator encouraging team members to openly express their thoughts.

Team activities re Defining/Solving Problems

The plant management and the principal investigator targeted two tasks for ergonomic intervention in this project, the bone trimming operation (Challenger knife) and processed meat stuffing and bagging jobs. The bone trimming job was targeted because of the recorded high incidence rate of CTDs and also because it is a job that is performed in most, if not all, trimming and deboning operations in red meatpacking plants throughout the U.S. Results from ergonomic intervention in this job could have widespread benefits throughout the red meat industry. The second targeted job, stuffing and bagging of processed meat, was selected because of several complaints from employees and also the repetitive and forceful wrist actions required for this job, as observed by investigators. Improvements in both these jobs had been attempted before without progress. It was hoped that solutions could be developed through the participatory process.

For each team, the topic for each meeting was decided by the principal investigator, who introduced the topics in the following sequence throughout the project duration. The number of meetings devoted to each topic is also listed.

- Introduction to project (1 meeting)
- Ergonomics training (1 meeting)
- Identification of problems on each team's respective jobs and brainstorming sessions on ergonomic controls (1 meeting)
- Discussion of feasibility, classification, and selection of brainstormed ideas for ergonomic controls (1 meeting)
- Further discussion of selected ergonomic controls (1 meeting)
- Completion and collection of both pre-test and post-test surveys (administered in second, third, and fourth quarters of the project), in addition to status report on project. (3 meetings)
- Final meeting (1 meeting)
- Appreciation party sponsored by management (1 meeting)

During the meetings, the teams developed solutions to problems by consensus. Each meeting usually lasted one hour and took place at the end of the work day (usually around 2 to 3 PM). The principal investigator led each meeting and outlined the topic for that meeting. Then he opened the floor for opinions on the topic. He encouraged every member to speak his/her mind and not feel inhibited. After discussion, a decision was made by the team members by consensus (i.e., there were no voiced disapproval of decisions made by the team, although every member was encouraged to voice his/her opinion during the discussions).

The ergonomic controls were generated by the team members. The principal investigator opened the floor for generation of possible ergonomic intervention controls and strategies. Most team members contributed ideas, and most of the ideas were suggested by the respective production workers. After all the possible ideas for ergonomic controls were suggested, they were classified into three categories of feasibility:

1. Controls that were easily and inexpensively implemented
2. Controls that had moderate expense and difficulty in implementing
3. Controls that were expensive and difficult to implement

The classification of the controls was made by the supervisors and managers of the respective job, plant engineers, the Director of Human Resources and the Manager of Safety. After the controls were classified, the hierarchy of feasibility of the controls was presented to all team members at the next team meeting. The team discussed the classification of feasibility and then decided by consensus which controls to implement. All team members were free to discuss and challenge the classification and change the classification, providing the other team members agreed to the changes by consensus vote. To minimize cost and enhance feasibility, the selected and implemented ergonomic controls for each of the two jobs were of either low or moderate expense and difficulty.

The ergonomic controls were implemented by the maintenance technician, who was also a member of each team. He responded expeditiously to each team's requests, and he usually implemented each control within one week. The controls were implemented with the cooperation and involvement of the supervisors, managers, and production workers, all of whom were members of the ergonomics team.

Each hourly team member usually was paid overtime (1.5x) for time spent in meetings because the meetings were held after a full day of production. The company also provided facilities to conduct meetings, provided maintenance technicians release time and materials to implement ergonomic controls, and sponsored a party at the end of the project for all those personnel involved.

The Director of Human Resources, who reports to the Chief Operating Officer of the plant, is responsible for the activities of both ergonomics teams. However, in an operational and administrative sense, the teams' activities were led and monitored by the principal investigator. Outside of team meetings, the principal investigator talked on a regular basis with the Director of Human Resources, the Manager of Safety, and the supervisors of the respective jobs. The fiscal and administrative aspects of the team were separated in order to avoid either the perception or occurrence of disproportionate influence on the team from management. The Director of Human Resources intentionally attended only a few meetings to minimize the possibility of exerting disproportionate influence on the team.

Decisions that had a fiscal impact were made ultimately by the Director of Human Resources. However, in every fiscal case, he endorsed the consensus decision made by the ergonomics teams. He also served on each ergonomics team, so he contributed to discussion of the feasibility, selection, and implementation of the ergonomic controls and also made the final decision on costs of each team's activities. He supported the ergonomics teams in the following way:

- Providing money to pay each hourly team member for time spent in meetings (usually overtime pay)
- Changing the normal work operations on the bone trimming and meat stuffing lines to accommodate the principal investigator in data collection efforts (surveys and wrist motion)
- Changing the normal work operations to try out the feasibility of new ergonomic controls (i.e., new Challenger knife)
- Releasing time and money for the Maintenance Department to implement the ergonomic controls
- Being genuinely concerned about the safety and health of the production workers and decreasing the incidence and severity of injuries and illnesses

The ergonomics teams gained credibility among the production workers by including a substantial portion of the teams' members from the targeted jobs. The teams' work was publicized in the plant's quarterly newsletter that is distributed to all employees.

TEAM ACCOMPLISHMENTS

Bone Trimming: The Challenger knife is an electric hand-held knife that trims meat from bones with a circular blade that rotates within an open disc. (Since the start of this project in January, 1993, the Challenger knives were upgraded with a model that features a faster rotation speed and less vibration than their predecessors.) Eight operators, who work side-by-side in 30-inch work spaces, use the Challenger knife to remove meat from bones at the end of the fresh meat line. The operators then push the removed meat through circular cutouts in their work spaces, and the meat falls into containers under the holes. Each operator's production and quality are recorded every hour. Each operator must collect at least 30 lbs. of meat per hour.

The number of hours employees work each week varies according to seasonal changes in the number of dairy cows taken to market. Typically, production increases in the autumn because dairy farmers cull their herds of weak and infirm cows before the long winter season. In the autumn of 1991, the bone trimming operators worked an average of 15 to 20 hours of overtime per week. Of the eight operators, three reported CTD illnesses during Autumn 1991. The problems with the bone trimming operation did not diminish when the workload returned to the normal 40-hour week. Four operators reported CTD illnesses during the first seven months of 1992. (Note: all claims of CTD illnesses due to repetitive trauma were checked and verified as CTDs by the plant nurse).

As indicated in Table 1 the incidence rate of CTDs for the bone trimming operators increased over the last six years, ranging from no CTDs per 200,000 hours of exposure to 74.1 for the first seven months of 1992. The Director of Human Resources and the Manager of Safety became aware of the hazards in the bone trimming knife operation and were enthusiastic about using participatory ergonomic teams to reduce CTD risk factors and prevent CTDs in the bone trimming operation.

Year	# of wrist CTDs reported on OSHA 200 form	Incidence Rate of Wrist CTDs per 200,000 hours
1988	0	0.0
1989	1	10.7
1990	3	32.1
1991	4	42.7
1992 (first 7 months)	4	74.1

Table 1. Incidence rate of wrist CTDs per 200,000 hours of exposure in the bone trimming operation. Wrist CTDs included carpal tunnel syndrome, tenosynovitis, and tendinitis.

Members of the bone trimming team brainstormed ideas on how to improve the job. All team members were instructed by the principal investigator to feel free to offer any ideas and defer any judgment or evaluation until the next meeting. All of the team members participated in the generation and discussion of ergonomic controls, as demonstrated by the fact that most of the generated ideas were suggested by the production workers. The feasibility of all ideas was discussed at the following meeting, and consensus was reached by the team that the following ideas should be implemented or at least investigated.

Phase I (Simplest and least expensive)

- Move location of Challenger knife motor away from workers' heads
- Extend table for upper level trimmers so they can catch the "good bones" and stack them
- Investigate nonslip gloves

Phase II

- Investigate feasibility of smaller blade on Challenger knife (readily available)

Phase III (more complex and more expensive)

- Modify Challenger knife: angle the blade and add stop to handle
- Investigate feasibility of a chair or lean-to stool
- Investigate feasibility of adding a footrail
- Investigate whether height of table for upper level trimmers needs to be lowered

Because of the short time frame for the project, there was only enough time to implement one phase of ergonomic controls and monitor the members' responses before and after. Because of the potential contribution to CTDs, modifying the Challenger knife was included as a control to be implemented.

Final Ergonomic Controls for Bone Trimming Operation:

- Moved location of Challenger knife motor away from workers' heads.
- Extended table for upper level trimmers so they could catch the "good bones" and stack them.
- Investigated nonslip gloves
- Modify the Challenger knife: angle the blade and add a stop to the handle.

The first two controls were implemented in July. The third control (gloves) was implemented by distributing free samples of alternative gloves, which were donated by a local supplier, to the bone trimming workers. The workers did not feel these new gloves were any better than the gloves they were already using. Implementation of the fourth control was attempted but never completed because of the time required to redesign the Challenger knife.

Processed Meat Bagging Operation: At the end of the line in the Processed Meat Division, a team of four workers fills plastic bags with restructured roast beef with a meat stuffer, weighs them, closes the stuffed bag with a tipper tie machine, and then loads the bag into a box. The team fills 6,000 to 7,000 bags per eight-hour shift. The stuffer and tipper tie jobs are two tasks that require repetitive hand and wrist movements. The four workers rotate from one operation to the next throughout the day. During an eight-hour shift, each worker operates the stuffer and tipper tie machine for approximately two hours each.

Although there have not been any recorded CTD illnesses in the processed meat bagging operation, the workers in this area have complained several times about sore hands, wrists, and forearms. Considering the number of bags filled each day and the numerous quick wrist motions required to stuff and close each bag, it is plausible that some of these workers may have CTDs in their incipient stage. The Director of Human Resources and the Manager of Safety recognized the potential for CTD illnesses to be caused by this bagging operation and wanted to take early action to prevent development of CTDs.

Members of the meat stuffing team brainstormed ideas on how to improve the job. All team members were instructed by the principal investigator to feel free to offer any ideas and defer any judgment or evaluation until the next meeting. Similar to the bone trimming team, all members participated in the generation and discussion of ergonomic controls. The feasibility of all ideas was discussed at the next meeting, and consensus was reached by the team on a final list of possible controls.

- Replace stand with one that is not as slippery and has a lip on back edge
- Eliminate the four-inch discrepancy between the table top and conveyor belt
- Investigate moving height of meat stuffing machine
- Investigate ways to minimize condensation on stuffing frame to reduce force required to pull bag out of stuffing frame
- Investigate methods to reduce the amount of gripping force required to get the air out and clamp it.

The first two controls on the final list were implemented in July and August. Anthropometric analysis showed that the third control was not necessary. The meat stuffing ergonomics team spent considerable time on the fourth and fifth ideas on the final list. The fourth and fifth items in the final list were intractable problems that had been investigated prior to this study by plant staff. Controls that were suggested by the ergonomics team for the fourth and fifth items either violated USDA rules for meat processing or had been tried before and rejected because they did not work. Some of the suggestions for the fourth item (minimize condensation on the stuffing frame to reduce pulling force) included putting a Teflon coating on the framing box, putting larger holes in the frame box, and using other gripping bags. Most of the suggestions for the fifth item (reduce the amount of gripping force required to clamp the bag) included automation, which had already been implemented on an existing, totally automated meat stuffing line in the plant. Another suggestion was job rotation of workers, which was already occurring on the meat stuffing line.

EVALUATION OF TEAM EFFECTIVENESS AND PROGRAM OUTCOMES

In addition to the two jobs for which team-directed solutions were attempted, various other measures and observations served to assess team functioning and performance as well as to gauge its impact. The team process was evaluated with organizational development principles. Ergonomic factors of repetition, wrist motion, and productivity were also measured before the implementation of the new Challenger knife on the bone trimming line. However, the new knife will be tested on the bone trimming line after the publication of this case study. The workers' wrist motion will be measured shortly after the redesigned knife is installed.

Measures of Team Function/Effectiveness

The organizational development aspects of the team process was assessed with a battery of surveys. Each survey was intended to assess a specific aspect of the team's progress from an organizational behavior point of view. Among the surveys administered were:

> A *team meeting survey* was administered after each team meeting to determine if any issues needed to be corrected immediately to assure smooth team meetings
>
> A *job satisfaction survey* to assess the job satisfaction of production workers before and after each phase of ergonomic intervention. Job dissatisfaction may affect a team member's view of the team's progress and may also lower the threshold for reporting pain or injury
>
> An *overall climate survey* to assess how team members felt about the company and their role in it
>
> A *team climate survey* to assess how team members felt about the organizational aspects of their ergonomics team, its mission and progress, their role on the team, and their co-members

Each of these surveys consisted of a series of statements. Respondents expressed their agreement or disagreement with the statement on a 7-point scale (7 = strongly agree and 1= strongly disagree). The following observations were gleaned from the survey results.

The members of both ergonomics team (bone trimming and meat stuffing) felt the meetings were run well. Overall, the team members felt good about the meetings, felt they were run efficiently, and felt they were about the right duration. The participatory nature of the ergonomics teams resulted in an enhanced awareness of the value of each team member's contribution. The team members rated their fellow members' contributions to the team process higher at the end of the project than they did at the beginning. This demonstrated that the participatory team process affected the members' acknowledgment of each other's contributions positively. This was also reflected in the high marks for respect and treatment received from co-workers. The enhanced value members placed on their co-workers was a major benefit of the team process.

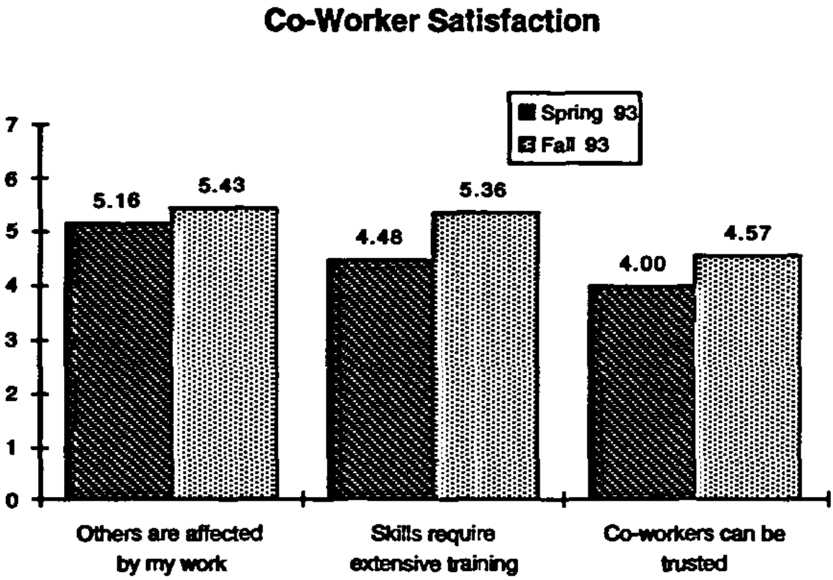

Figure 1. Co-Worker Satisfaction: Mean Responses from All Team Members

In general, the team members felt new ideas could be suggested and discussed freely, and these ideas could originate at the team level. The members felt the team process encouraged questions to be brought out into the open, which could account partially for an apparent increase in team morale among the production workers throughout the project period. The ergonomics training and discussion made the team members more aware of safety issues affecting their work. This probably contributed to a relative reduction in their general belief that good safety practices were being used.

The significant decrease in mean responses to questions that addressed deadlines and openness to discussion of new ideas was probably related to unrealistically high expectations at the onset of the project. The mean score for "team members keep their deadlines" decreased from before ergonomic intervention to after intervention.

The mean score for "the team is open to discussion of new ideas" also decreased. Team members started to feel frustrated in the fall and winter months of 1993, probably due to the fact that only one of the three planned levels of ergonomic intervention was actually implemented. This was due to the investigator's optimistic expectation that three levels of intervention and all of their required activities, such as administration of surveys, implementation of controls, etc., could be accomplished in one year. Also, the surge in production during the fall of 1993 made it difficult to schedule meetings and to maintain the previous level of resource commitment to the project.

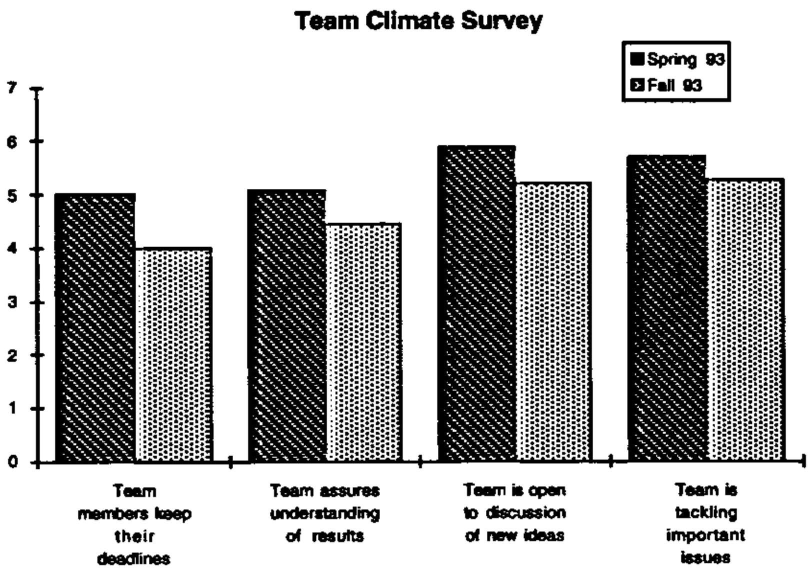

Figure 2. Team Climate Survey: Mean Responses from All Team Members

The team survey suggested that there was little perceived relationship between the work performed at the plant and the work of the team. The purpose of the team and members' responsibilities were not clearly defined. A decrease in mean score for "the team makes sure to consider safety in the workplace" was probably due to the workers learning more about safe work practices and the cause of occupational injuries and illnesses from the training sessions and discussions, and, due to their enhanced awareness, consequently perceiving their work stations were not as safe as they had believed.

The production team members felt very positive about "coming up with new ideas to replace unproductive ones." This result is not surprising in lieu of the fact that most of the ideas generated for improving the job came from the production workers. The production workers also felt that the team process "encouraged questions to be brought out openly" and "team members (can) ask for help when they need it." Interestingly, the non-production members thought the team was ineffective in "coming up with new ideas to replace unproductive ones. The negative response could be due to selecting tasks (bone trimming and meat stuffing) for which the apparent ergonomic interventions became more difficult to implement as the project progressed.

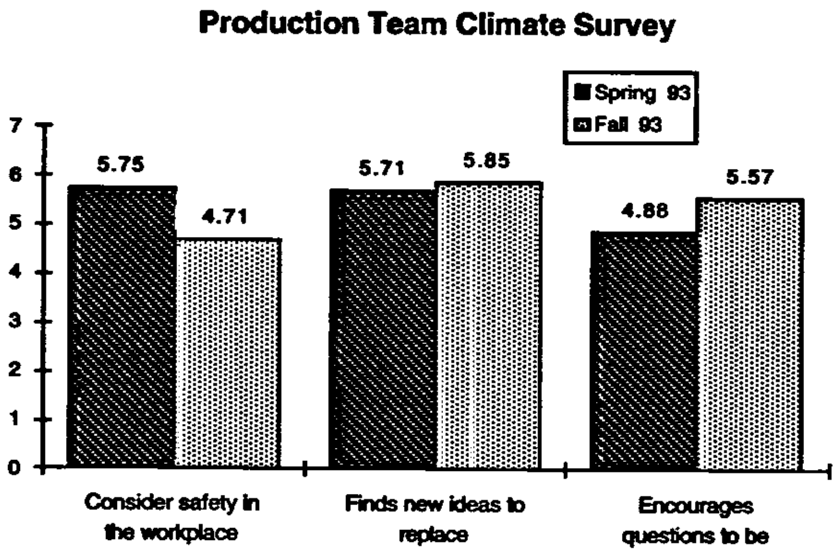

Figure 3. Team Climate Survey: Mean Responses for Production Team Members

In general, the non-production members' responses to "deadlines," "team effectively follows up its actions," and "team delivers on its promises" indicate that the supervisors had high expectations of the team's capabilities at the onset of the project and may have set unrealistic goals. One way to address the problem of unrealistic expectations is to reassess the goals, and adjust them as the project proceeds and evaluate the time and resources available to integrate the team's work with the production work.

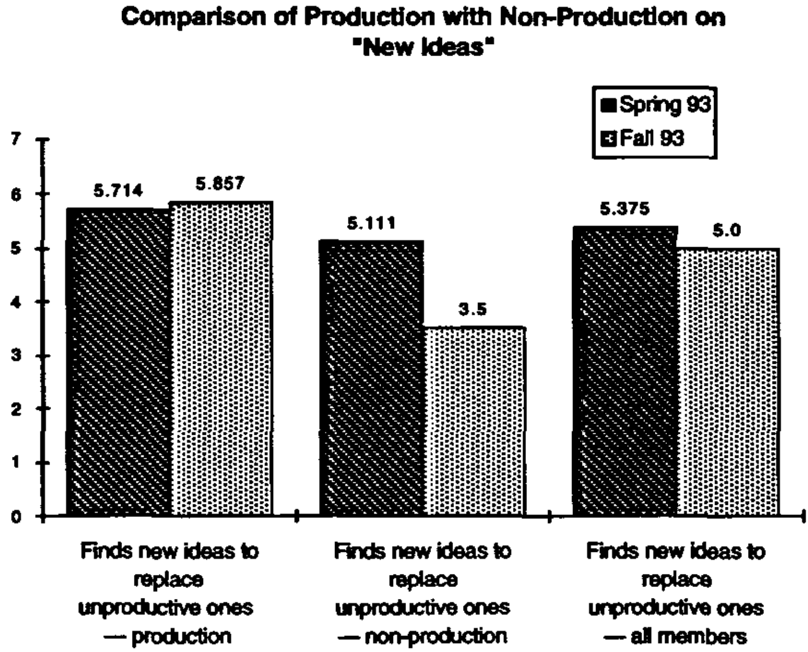

Figure 4. Comparison of Mean Responses from Production and Non-Production Team Members on "New Ideas"

Engineers, supervisors, and the Manager of Safety informally looked at trying to improve the health and safety aspects of the bone trimming and meat stuffing jobs prior to the start of the ergonomics project and found that the jobs were difficult to improve. Although the ergonomics teams did modify some aspects of these two jobs, the ergonomics teams ran into the same problems when they addressed these jobs during 1993. The bone trimming is a physically rigorous job that requires intensive hand and wrist motions while operating the electric bone trimming knife. The team thought the most obvious improvement to the job was redesigning the knife. Two versions of a redesigned knife were tested, and feedback from the affected bone trimming workers was incorporated into a third design, being tested in the summer 1994. Improvements were made to the meat stuffing job, such as replacing the floor stand and leveling the work surfaces. However, the most biomechanically stressful part of the meat stuffing job was tying the top of the stuffed bag. Many ideas were suggested, but none were feasible alternatives to the current method of tying it manually. In retrospect, the targeted tasks of bone trimming and meat stuffing proved to be too problematic for an inexperienced ergonomics team that wanted to see results quickly.

Measures of Benefits

Symptoms surveys were filled out by the production workers on both ergonomics teams and their health status assessed before and after ergonomic intervention. Each respondent was identified by name. The survey took about three minutes to fill out if there were no discomforts, and about 7 to 10 minutes for every discomfort.

In general, there was a difference in the number of subjects reporting discomfort between pre- and post-test conditions. Of 13 reported areas of discomfort, all except one were in the upper extremity. About half of the reported areas of discomfort were in the fingers, hand, and wrist. The number of discomfort areas reported by the production team members who filled out both the pre- and post-test surveys increased throughout the year. This could have been due to the seasonal surge of production for the bone trimming operators during the fall of 1993, at which time they were working ten-hour days. Another possible cause of the increase in discomfort was the employees' enhanced knowledge and awareness of CTDs.

CONCLUSIONS AND RECOMMENDATIONS

In this case study, production workers were active members of the ergonomics teams and were involved in most aspects of the process except for targeting the tasks for interventions and determining the initial classification of feasibility of controls. However, team members were free to discuss and change the classification, providing the other team members agreed to the changes by consensus vote.

Management provided commitment and support to the participatory ergonomics project, and provided staff time and resources for implementation of the project. However, the future of the ergonomics team process at this company is uncertain. Although work is continuing to complete the first phase of ergonomic controls on the bone trimming line throughout the summer of 1994, the ergonomics teams and their meetings have not been sustained. One of the overall goals of the participatory ergonomics project was to establish a sustainable ergonomics process at a meat processing plant. To achieve long-lasting improvements in health and safety in their workplace, management must develop and sustain a process that involves both production and management employees on a regular basis.

Although the ergonomics intervention in this plant had shortcomings, the process of participatory ergonomics teams still appears to be an effective method for generating, implementing, and evaluating improvements in the health and safety of the workplace. The ergonomics process needs sufficient time to manifest benefits. One year is typically not long enough to see permanent benefits, and a two or three year trial period is usually recommended, particularly if a number of ergonomic interventions is planned. The benefits of sustaining the ergonomics team process extend beyond improvements in health and safety statistics into the realm of general management-labor relations. Survey data from the past year showed that the team process expanded team members' awareness of the value of each other's contributions, established a forum for bringing up questions and offering suggestions to improve work sites, increased overall morale, and reinforced the notion that groups can discuss ideas effectively and generate solutions to problems.

The participatory ergonomics process should be sustained if permanent positive improvements in the health and safety of workers are going to occur as a result. Recommendations for sustaining participatory ergonomic interventions include:

- Survey team members to gauge team dynamics and attitudes
- Clearly establish the purpose of the team, members' roles, and expectations of outcomes

- Set realistic goals for the team. Striving for overly ambitious outcomes sets the stage for disappointment among the team members.
- Start out with jobs or tasks that offer the opportunity for salient ergonomics interventions that could be implemented easily and inexpensively. These jobs should have high visibility and have ergonomic controls that are likely to produce positive results quickly. Tackling highly visible, relatively easy projects at the beginning of the ergonomics process allows an inexperienced ergonomics team to gain momentum quickly and promotes a positive attitude among the team members.
- Assess the effects of the ergonomic intervention multi-dimensionally:
    - Monitor epidemiological statistics, such as incidence rate and severity.
    - Measure affected workers' attitudes toward any specific change in the job layout, the ergonomics team, and the company.
    - Monitor the health status of the affected production workers with discomfort surveys to determine if there are any illnesses in their incipient stages.
    - Measure relevant biomechanical factors, such as wrist motion, force levels, posture, or vibration; and monitor changes in production, absenteeism, and quality of work.

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LESSONS LEARNED

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