Making a Business Case for Ergonomics

By Don Bloswick, Ph.D., P.E., CPE

In the following discussion, I propose to make a business case for ergonomics. Before I returned to graduate school, I was a practicing engineer for 10 years, six of those years as a plant engineer. One thing that came to mind as I gathered my thoughts for this article and reflected on some experiences is that when I was a plant engineer I was required by upper management to justify equipment purchases with a two- to three-year payback period. If I could not show that a project would pay for itself in two or three years, it would not be funded.

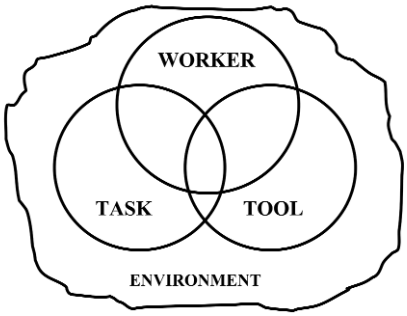
Since then, I have been involved in perhaps hundreds of projects related to the purchase of tools, equipment and processes to reduce musculoskeletal hazards. While justifying these purchases is still generally more difficult than in my days as a plant engineer, where reduced production cost or increased production were relatively easy to calculate, it is becoming easier (and more important) to illustrate the benefit of and justify the purchase of ergonomic tools, equipment, processes and training intended to reduce musculoskeletal hazards.

To facilitate and organize the remainder of this discussion, I propose that the work system can be represented by the interaction between the worker, tool and task within the workplace environment.

This representation (Figure 1), probably similar to others you have seen, is not meant to be definitive or exclusive. Rather, it is presented to serve as reference for my collection of thoughts. The concept of the task, tool and worker is self-explanatory. I propose that the environment is composed of the "3 Ps": physical, policy and perceptual. The physical environment may be thought of as the physical structure and climate. The policy environment is the management and operational structure governing the interaction between the worker and the workplace. The perceptual environment is the mental framework the worker uses to explain, understand and accept his/her place, fit, responsibility or importance ("ownership") within the organization.

In general, ergonomists deal with tasks and tools, using principles and analytical methods. One fundamental belief that

Figure 1
Work System



ergonomists hold (myself included) is that the consideration of ergonomic principles will have a direct, positive effect on the worker. While I will present evidence that this is the case, I also hope to illustrate that the consideration of ergonomic principles has a positive effect on the task (increased production, improved quality), on the policy environment (improved management acceptance of "ergonomics costs") and on the perceptual environment (improved worker satisfaction through ownership of his/ her workspace).

Based on my experience, I propose that the job of the SH&E professional is to:

1) Prevent the problem.
2) Identify the problem.
3) Evaluate the problem.
4) Develop the solution(s).
5) Justify the solution(s).
6) Implement the solution(s).
7) Evaluate the result.
8) Record and disseminate the results.

Most of us, by training and experience, have become skilled at items 2, 3, 4 and 6, and are reasonably effective at item 1. We also have become quite expert at the "technical" aspects of items 5 and 7, and can illustrate how the consideration of ergonomic principles in equipment and process design will improve the ergonomic indicators generated by analysis tools—such as reduction in the low-back compressive force, shoulder moment, NIOSH Lifting Index, Strain Index or Rodger's Analysis score.

Where we need to improve, however, is providing economic justification for recommendations (item 5), economic evaluation of results (item 7) and "closing the loop" by systematically recording and disseminating the economic (and technical) results (item 8). Unfortunately, the very areas where we need to improve (economic justification, economic evaluation, and recording/disseminating the economic results) are those critical in the justification for continued (and increased) use of ergonomic principles in workplace design.

This is not meant to suggest that the job is hopeless. More and more information is available that documents the economic payback for ergonomic design or intervention (or "the business case for ergonomics"). As noted, ergonomists often present results in terms of improvements in ergonomic indicators from analysis tools. While these indicators are legitimate measures of improvement, they are hard to "take to the bank." The remainder of this article focuses on measures closely associated with dollars. In addition, it deals primarily with the dollars associated with direct or visible costs rather than indirect or hidden costs.

I propose that the business case for ergonomics can best be presented by discussing the effect of ergonomics on the worker, task and environment.

The Worker

The economic impact of ergonomics related to the worker can be illustrated through a reduction in injury/illness rates and, more importantly, through a reduction of the costs associated with these rates. A few representative cases help illustrate this point.

Sikorsky Inc., a helicopter manufacturer, noted a 25-percent drop in OSHA recordable incidents and a 75-percent drop in lost workday incident and severity rates after the implementation of ergonomics training, work teams and engineering controls (Thayler). After the implementation of workstation improvements such as the installation of powered lift devices, worker training and job enlargement, AT&T Global Information Systems had no lostdays due to injury in years three and four, down from 298 lost workdays prior to implementation of the program (American Psychological Assn.).

Fieldcrest-Cannon, a textile manufacturer, reduced work-related musculoskeletal disorders (MSDs) from 121 to 21 in

three years after installing lift assist devices and a new, worker-designed, improved bagging system [ErgoWeb(b)]. Woodpro Cabinetry, a furniture manufacturer, experienced a 40-percent drop in workers' compensation costs after the implementation of ergonomic changes including the installation of conveyors to reduce manual lifting, angled tables to reduce bending, and the implementation of a job rotation program [ErgoWeb(b)].

In the California facilities of Sun Microsystems, the average cost of MSD claims dropped from $12,000 in 1992 to $2,500 in 2002 after the purchase of ergonomic chairs and equipment, worker training and workstation assessments [OSHA(f)]. Springs Window Fashions reduced MSD compensable claims from 45 in 1999 to zero in 2002 through the redesign of workstations in two different work areas [OSHA(e)].

Gold Kist Inc, a poultry processing facility, reduced its MSD claim rate by 80 percent between 1990 and 2001. In the year prior to the program, the company had eight MSD-related workers' compensation claims with 345 lost workdays [OSHA(c)].

A major insurance company in the U.S. implemented an ergonomics program including extensive worksite evaluations. In the three years after the initiation of the program, the company's MSD-related workers' compensation claims were 6, 4 and 1, respectively, including 104, 91 and 89 lost workdays [OSHA(a)].

While this is not a comprehensive list, I hope it illustrates how MSD injuries/illnesses and their associated costs can be reduced through a consideration of ergonomic principles in the workplace.

Before continuing, let's consider some instances relating to the cost-benefit of ergonomics in which I have been personally involved. Through the UAW-Ford-Visteon Partnership, a comprehensive program of ergonomic intervention and training was implemented throughout the company. This program was (and is) based on union involvement and worker involvement.

In two major operations areas, the MSD lost-time injury rate and the MSD severity rate, both good measures of cost, dropped by more than 70 percent between 2000 and 2002. In some situations, however, there actually may be an increase in reported musculoskeletal cases during the first year or so after the implementation of a comprehensive ergonomics program because of increased worker involvement and awareness.

I worked with one manufacturing plant of approximately 1,100 employees, 700 involved in direct labor, in which there had been 10 upper-extremity musculoskeletal disorder (UEMSD) cases costing approximately $100,000 in the year before implementation of an ergonomics program.

In the year after the program and an aggressive medical management process were implemented, the number of cases increased to 45, but the cost of these injuries dropped to approximately $40,000. This reduction in cost continued the following year.

In another facility with approximately 4,500 employees, the implementation of an overall ergonomics program was a primary factor in the reduction of lost workdays associated with UEMSDs from 613 to 149 to 50 over a three-year period. The actual incidence rate of UEMSDs, however, remained relatively constant. (As noted, lost workdays are a good indicator of cost.)

I propose that an increase in the rate of reported MSDs is not necessarily the sign of an ineffective ergonomics program. If there is a corresponding reduction in lost workdays and medical costs, an increase in incidence rate may reflect an environment where workers are encouraged to report minor disorders early, when they can be corrected with minor worksite modifications before they become serious and require expensive medical intervention.

The Task

The economic impact of ergonomics related to the task can be evaluated through increased productivity and/or increased quality. While an ergonomics intervention effort at Ethicon, a Johnson and Johnson company, had inconclusive results from an ergonomic standpoint, productivity was increased by more than 10 percent (Longmate and Hayes).

At Red Wing Shoes, implementation of an ergonomics program that included training, conditioning, stretching, adjustable chairs, equipment modification and the hiring of an ergonomist, reduced workers' compensation costs from $4.4 million to about $1.3 million in five years and also reduced manufacturing time [Gauf(b)].

At General Seating, ergonomics training, job rotation, and task and workstation redesign reduced lost workdays by 70 percent and also increased worker productivity [Gauf(a)].

In one poultry processing facility, the substitution of an ergonomically designed pistol-grip deboning knife for a traditional straight knife resulted in workers' compensation savings of approximately $100,000 per year, and also allowed an increase in line speeds of two to six percent. Profits were increased even more due to more efficient deboning (Hendrick).

In two hospital laundry facilities in Canada, installation of assist equipment, efforts to affect worker attitudes (training, positive feedback) and job rotation had a payback time of approximately one year when increased productivity was considered (Village). The purchase of battery-operated hand tools in an electric power utility company was justified based on a one-year payback considering only the cost of replacement workers and retraining due to MSD injuries (Seeley and Marklin).

These increases in productivity are not limited to the plant floor. Schneider cites several cases where productivity of office workers improved from four to 15 percent when ergonomic principles were applied to the office workplace. One study by the U.S. Internal Revenue Service found an eight-percent increase in data entry rates after the implementation of ergonomic seating (IRS). In a study of data entry staff at a Singapore Airline terminal before and after ergonomic changes (document holders, footrests, lighting, increased rest pauses), output (keystrokes/hour) increased by 25 percent (Donkin).

Examples of increased production resulting from ergonomic improvements are not limited to industrialized countries. In East Java Indonesia, the implementation of ergonomic principles in the loading/unloading of sugar cane in cane processing factories resulted in fewer clinical visits and increased productivity (Manuaba). It is also interesting to note that in Pakistan, an ergonomically designed loom resulted in "major health improvements for adult carpet weavers" [ErgoWeb(a)]. The publication also noted that that these looms may reduce child labor, assumedly because the modified task allows adults, not just children, to do the work.

Improved quality is also an indicator of economic viability. In one study, the installation of ergonomic furniture result-

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ed in a decrease in documentation preparation error rates from 25 percent to 11 percent (Schneider). In the previously noted study at a Singapore Airline terminal, the error rate decreased from 1.5 percent to 0.1 percent, in addition to the noted increase in keystrokes/hour.

In one of the few controlled studies into the effect of improper workplace design on product quality, one of my students and I performed a controlled lab experiment in which subjects performed an assembly operation with set MSD risk factors (Wick and Bloswick). The product output quality was determined by the correct tightness and alignment of the assembled item. We found that variability MSD risk factors explained 90 percent of the tendency to tighten attachments below the required torque. It is worthwhile to note that Ford Motor Co. considers a decrease in product quality at a workstation as a possible indicator of the need for an ergonomic review.

The Environment

I noted that the environment is composed of physical, policy and perceptual components. Consideration of ergonomics in product and process design will obviously have an impact on the physical environment. In addition, I proposed that ergonomics affects the perceptual environment, which I defined earlier as the worker's perception of his/her fit, responsibility or feeling of importance ("ownership") within the organization.

Subjective measures of this perception would have to be based on psychological or psychosocial tests of the worker. In my opinion, objective markers of how a worker population feels about responsibility, importance or ownership are rates of absenteeism and worker turnover.

Schneider reports that after a group of 123 office workers were provided with ergonomic office furniture, overall absenteeism fell from four percent to less than one percent. He also reports that in a study by the Norwegian State Institute, after improvements to workstation layout and seating, turnover was reduced from 40 percent to five percent per year and 40 percent of employees on disability leave returned to work.

The U.S. Dept. of Labor reported that after installation of ceiling lifts and sit-to-stand lifts, the resignation of nursing aids dropped from an average of 23 per year to approximately three per year. (The resignation rates were not reported.) [OSHA(b)].

I am convinced that ergonomics programs cannot be successful without worker participation. A continuing benefit of increased worker ownership is their participation in the ergonomics process, which will generally lead to an increase in the quantity and quality of worker input in the ergonomic design/change process. An even more important result of ownership is increased worker involvement in the implementation of the ergonomic design/change process, without which the improvement process has little chance of success.

International Truck and Engine Corp. experienced a decrease in its MSD injury rate and also reported that "the culture and attitudes of a veteran workforce have been transformed because they have been allowed to participate in decisions that impact their jobs. (Prior to this project, the workers were reluctant to get involved because of the union-management relationship)" [OSHA(d)].

In my experience, the policy component of the environment, as defined by management's understanding and support of the ergonomics effort, inevitably moves in a positive direction when injury/illness rates and costs, productivity and quality, and worker perception and satisfaction are positively affected.

It has been argued that strong unions hinder the ergonomic design/change process. This has not been my experience. The existence of a strong union, the main purpose of which is the improvement in the life of the worker, can be a key to success. However, it requires management to involve the union in a meaningful way. One example with which I am familiar is the UAW-Ford Ergonomics Process. This process involves the UAW union at every level. At the plant level, actual ergonomic analyses and abatement recommendations are often performed by skilled union members, sometimes with the assistance of a salaried plant ergonomist. Union cooperation is facilitated by a policy, in some UAW-Ford plants, that personnel reductions resulting from ergonomic changes should be dealt with through normal retirements and attrition.

Looking to the Future

One major area for future work is continued research to enhance the understanding of the causes of musculoskeletal disorders. Improved models of how exposure (magnitude and duration of risk factors) relates to (or perhaps actually causes) musculoskeletal disorders will allow a better focus on high-priority areas. In turn, this will allow us to abate the most critical hazards and document the positive results.

Another area of interest is the development of systems to facilitate the sharing of effective interventions within large companies and between collaborating companies. Hopefully, this is only the beginning. Perhaps some day we will we able to sit down at the computer, enter a few keywords, and easily search through relevant cases and examples in the quest to optimize the worker, task, tool and environment system. ■

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Management Practice Specialty Officers Elected by Acclamation

The Nominating Committee of the Management Practice Specialty nominated D. Paul Riley, CSP, as Administrator and Christopher M. Gates, ARM, as Assistant Administrator.

As required by the Society Operations Guide, the Nominating Committee's decision was submitted to, and approved by, the current Management Practice Specialty Administrator and Assistant Administrator, and the Society Nominating and Elections Committee.

No other Management Practice Specialty member submitted a written petition for nomination by Feb. 15, 2006, therefore, the slate stands as submitted.

In accordance with Society Operations Guide 11.2, since the nominees were unopposed, Paul Riley and Chris Gates are hereby declared elected by acclamation. Join us in congratulating these new officers of the Management Practice Specialty.

Executive Leadership

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Greetings to all of you from my home in small town middle America. The main street in my recently adopted whistle-stop, one-horse, out-of-the-way community is less than 200 yards long and lined with century old Box Elder trees. The street leading into town used to be a major highway, but has subsequently, when the freeway bulldozed its way through the county, become a dead-end street that leads to the turn of the century marble block court house in the city square, meanders around the monument respecting those hero's who fought and in some cases died in the War to End all Wars, then heads back out of town, down that two-lane highway that was built by the wives and widows of those who fought in that war.

Why would I make reference to a small Rocky Mountain city of less than 300 citizens that's only claim to fame is a metal arch that welcomes visitors of the "prohibition era" to the world's finest game and bird refuge? Simple! Our one-horse town with its ever-famous dead-end street is soon going to become part of the squall of the housing boom that is creeping across America. One of our local peach tree farmers has sold his 900 acres for a new "whiz-bang" housing development complete with fast food, gas and service locations.

As a young man enjoying growing up in this "Mayberry RFD" clone of a city there were 37 communities that meandered along State Highway 89 from Ogden on the North to Provo some eighty miles to the South. Today, the farms, lakes, rivers and open high mountain desert planes of the Wasatch Front have become one large mismanaged megalopolis.

As a young man, the drive from my hometown to Provo to the South was just over two hours on a mostly two-lane highway. Through the 1970s and 1980s, the trip was cut to nearer 45 minutes on a nice four- to six-lane freeway. Today the drive, even in my old fishing truck with the big block "high speed" engine, takes just over two hours on what is now a congested six-lane super highway.

So you ask, what does all of this have to do with me? Better still, what does it have to do with the Management Practice Specialty? Kind of you to ask. In preparing