# Interface

a common boundary between systems, equipment, concepts, and human beings

August 2009
Vol. 3, No. 1


## CONTENTS



## INTRODUCTION Jeremy Chingo Harris, Chair, Ergonomics Branch

Greetings and welcome back following a great conference in San Antonio! Thirty-two Ergonomics Branch members attended Safety 2009, which accounts for about 10% of our membership. The Ergonomics Branch also sponsored six concurrent sessions. Look for these session topics to be included as articles in future issues of *Interface*.

Safety 2010 will be held in Baltimore, MD from June 13-16, 2010. The Ergonomics Branch professional development conference chairs are reviewing speaker submissions for Ergonomics Branch sponsorship and hope to have at least as many as we had this year. Mark your calendars now so we can also increase our attendance.

Lastly, although our membership numbers have shown excellent growth over the last two years, it appears that we have reached a plateau. We are still targeting 500 members so we can become a standalone practice specialty. I challenge you to spread the word and try to recruit a colleague or two!

## EDITOR'S NOTES Hank Austin, CSP, MS

We have begun a new series of ergonomics articles from top ergonomics researchers. The last issue of *Interface* featured an article on computer carts used in healthcare from Professor Alan Hedge of Cornell University. This issue includes an article about ergonomics research at The Ohio State University by Associate Professor Carolyn Sommerich Ph.D., CPE.

I would like to thank Cynthia Roth for all of her hard work as newsletter editor. She has moved on to bigger and better things. Please contact me at hank@nlaustin.com to share your ergonomics successes or your suggestions for newsletter improvement.

**ErgoArticle** Carolyn M. Sommerich, Ph.D., CPE, Associate Professor, The Ohio State University

## Research & Education at The Ohio State University

For many years, The Ohio State University's (OSU) Department of Integrated Systems Engineering (ISE) has housed one of the strongest human factors and ergonomics programs in the country. The program was one of the first to be accredited by the Human Factors and Ergonomics Society (HFES) and includes faculty from across OSU's campus. Primary program faculty includes William S. Marras (recently elected to the National Academy of Engineering), Steven A. Lavender and Carolyn M. Sommerich. They work in the ISE department and specialize in ergonomics and occupational biomechanics.

Also from ISE are Philip J. Smith (cognitive systems engineering), David Woods (patient safety, resilience engineering and management) and Blaine Lilly (design for usability and manufacturability). From the School of Public Health are John R. (Jay) Wilkins III (occupational risks to young people, agricultural health and safety) and John (Mac) Crawford (health risks to firefighters and police officers, neurotoxin exposure in farmers). From the OSU College of Medicine is Eric Schaub, MD (prevention and treatment of occupational diseases, evaluation of hazardous chemical exposures, occupational pulmonary and neurological diseases). From the Department of Design is Elizabeth B.N. Sanders (use of participatory research methods for the design of products, systems, services and spaces).

On-campus entities and facilities that support our programs and educational goals include the Institute for Ergonomics, Center for Occupational Health in Automotive Manufacturing (COHAM), Biodynamics Laboratory, Cognitive Systems Engineering Laboratory and Orthopaedic Ergonomics Laboratory.

Students are engaged in learning through courses in occupational biomechanics and modeling, cognitive engineering, industrial accident prevention and control, analysis and design of workplace environments, workplace musculoskeletal disorder risk factor assessment tools, human error and human contribution to system failures, principles of occupational health, research and applied practicum experiences, statistical research methods, epidemiology, environmental health and construction safety. Students also engage in learning through participation in research projects, either course-based or sponsored by industry or government agencies.

*Automotive assembly research at COHAM*

Research projects are often multidisciplinary and involve faculty and students from across campus. Current research activities include projects sponsored by Honda of America Manufacturing and the Honda-OSU Partnership to advance understanding of the effects of torque tool use on associates and to explore alternative methods of positioning associates relative to the vehicles they assemble. These studies involve faculty and students from ISE and Mechanical Engineering (ME). The Material Handling Industry of America (MHIA) is

## The Ohio State University Research (con't)

*First responder research*

sponsoring a project to initiate the Distribution Ergonomics Research Center to develop and evaluate interventions that will allow distribution workers to work more efficiently and more safely.

NIOSH sponsors several current projects. One project's goal is to improve a new model of work-related carpal tunnel syndrome and involves OSU faculty from ISE, ME and physical therapy. Another NIOSH-sponsored project's goal is to reduce the physical burden of work performed by imaging technologists and involves faculty and students from ISE, design and radiologic sciences. Research on elements of first responder work, including communications and methods of patient handling, are also underway.

In addition to drawing upon expertise from across campus, our program enlists the support and involvement of professionals in human factors/ergonomics, design and safety from central Ohio and beyond. Safety professionals from the Ohio Bureau of Workers' Compensation, Battelle Memorial Institute and Safex participated in the most recent offering of our accident prevention and control course.

Students participate in monthly meetings of ASSE's Central Ohio Chapter. The Human Factors and Ergonomics Society's student chapter recently provided students with opportunities to speak with designers concerned with reducing human error in the use of medical devices, engineers who apply unique methods for assessing fall protection harness design and human factors consultants who encounter questions such as, "How much pull force does it take to tie a barge to a mooring?" and "Is there a less physically stressful way to wash the outside of an airplane?"

NIOSH recognized our program by awarding us a training grant. This allows us to provide financial support to qualified students who are seeking a master's degree in ISE and who wish to apply their engineering skills to the areas of human factors/ergonomics and occupational safety.

To learn more about what we do and what we offer, including graduate programs, short courses, consulting services and research expertise and capabilities, please refer to the contact information listed below.

NIOSH-sponsored Training Program: Carolyn Sommerich, (614) 292-9965, sommerich.1@osu.edu

Institute for Ergonomics: Gary Allread, (614) 292-4565, allread.1@osu.edu

Biodynamics Laboratory & COHAM: William Marras, (614) 292-6670, marras.1@osu.edu

**OSU Websites**

- Biodynamics Lab (http://biodynamics.osu.edu/)
- Center for Occupational Health in Automotive Manufacturing (http://coham.osu.edu/)
- Center for Resilience (http://resilience.osu.edu/CFR-site/index.htm)
- Cognitive Systems Engineering Lab (http://csel.eng.ohio-state.edu/)
- Department of Integrated Systems Engineering (http://www.ise.osu.edu/)
- Institute for Ergonomics (http://ergonomics.osu.edu/)
- NIOSH-Sponsored Training Program (http://www.ise.osu.edu/ISEFaculty/sommerich/TPG/home.html)

**ErgoArticle** Cynthia Roth, Ergonomic Technologies Corp (ETC)

## Ergonomics, Workers' Compensation & Return to Work

Ergonomics, as an applied science, can take any company from reacting to workers' compensation claims, lost worktime and production or quality issues to a proactive approach.

Workers' compensation is a system through which employers can purchase workers' compensation coverage. The coverage can be purchased from private insurance companies or state-run workers agencies, known as state funds. In 14 states, state funds compete with private insurers (competitive funds), and in five states, the state is the sole provider of workers' compensation insurance. The only state in which workers' compensation coverage is truly optional is Texas, where about one-third of the state's employers are non-subscribers. Those who opt out of the system can be sued by employees for failure to provide a safe workplace. State funds also function as the insurer of last resort for businesses that have difficulty obtaining coverage in the open market.

Workers' compensation systems are administered by individual states, generally by commissions or boards who ensure compliance with laws, investigate and decide disputed cases and collect data. In most states, employers are required to keep records of accidents. Accidents must be reported to the workers' compensation board and to the company's insurer within a specified number of days.

The costs to employers include premiums, payments made under deductibles and the benefits and administrative costs incurred by employers who self-insure or fund their own benefit program. In the mid-1950s, private sector employers paid an average 0.5% of payroll for workers' compensation. By 1970, this figure was 1%. Employer costs escalated steeply in the 1980s to 2.18% in 1990 and then declined. In 2001, they started to rise again. Estimates by the National Academy of Social Insurance put workers' compensation costs as a percentage of payroll at 1.76% in 2004, up from 1.73% in 2003 (benefits are rising less steeply.) However, a wide variation exists in costs among states and industries so that the highest-rated (the inherent riskiest) groups could pay several hundred times that of the lowest (safest) as a percentage of payroll. The firm's own safety record is also taken into account.

Workers' compensation claims costs have two components: payments for lost income, which is usually linked to a state's average weekly wage, known as indemnity costs, and payments for medical care. Two decades ago, indemnity costs made up the greater part of total losses. For example, in 1983, indemnity represented 56% of the total. By 2003, indemnity was only 45% of losses as medical costs grew. How do we control these costs?

Ergonomics identifies and eliminates risk factors that lead to musculoskeletal disorders (MSDs), which are cumulative trauma-type workers' compensation claims (sprains, strains, carpal tunnel syndrome, etc.), and can bring an employee back to work faster with less chance of reinjury. This is based on ergonomics intervention in job methodologies, equipment, tools and personal protective equipment (PPE). These interventions may be engineering, administrative or PPE, but they all serve as the right "fit" for the job, fitting the task requirements to the employees.

How do we protect older and younger employees and keep them working, and how do we bring rehabilitated patients/employees back to work no matter what their age?

## Ergonomics, Workers' Compensation & Return to Work (con't)

Workplace health and safety considerations are not a valid reason to prevent older workers from continuing to work. If the U.S. government targets for increased employment of older workers are to be met, it will require new "work ability" approaches from employers, including occupational health and safety programs and workplace-level "age management strategies." Requiring assessment of jobs to see that job tasks take proper account of workers' physical capabilities and limitations, with a particular focus on older workers and any possible job redesign, tools or equipment, changes in work hours or schedules or reassignment, will help keep all people working and safe.

In the U.S., 50% of industrially injured employees do not return to work at all if they are off work for 12 weeks. Literature searches show that insurance carriers report less than a 1% return-to-work rate for claimants out of work for two years or more on a workers' compensation claim. Forty to 71% of workers' compensation litigants with chronic pain problems are misdiagnosed. Misdiagnosed claimants cost the insurance industry millions each year in wasted medical treatment and delay of proper treatment. Proper diagnosis and treatment can save companies money.

Workers' compensation costs rose by 467% in one year alone (Mizor, A.F., Health Insurance Institute of America, Source Book of Health Insurance Data, Washington, DC, 1996), and workers are resistant to the return-to-work process. The median cost of a workers' compensation claim was $391 (Deyo, Cherkin, Conrad, & Violinn, Annual Review of Public Health, Vol. 12, pp. 141-158, 1988). The most alarming data state that the average cost for all claims combined in 2002-2003 was $17,787, up 12% from the 2001-2002 average of $15,865 (National Council on Compensation Insurance).

The medical community must be better educated about the type of job and job requirements an employee performs. This ranges from actual job methodologies to interaction with equipment and tools. Patients/employees return to the same job that contributed to the claim without an ergonomics process established first. Ergonomic processes through objective assessment and solutions create a more proactive workplace rather than a reactive workplace where injuries still occur. The ergonomics process also provides jobs that employees can return to without risk of reinjury through objective data results. If doctors, supervisors, managers, etc. had an ergonomics task report that described each element of the job requirement, ergonomic risk factors, body part affected, right or left side of the body and time limitations to perform the job safely, restrictions might be less severe and employees would not be put back on the same jobs for which workers' compensation claims are paid. This prevents chronic injuries developing and keeps all employees working.

Ergonomic risk factors have been reported and published for more than 30 years. We are all aware of them, and yet we have not been sophisticated enough to break down a job element by element, as is done with a job safety analysis (JSA). With the ergonomics assessment data, all risk factors are identified (awkward postures, force, repetition, vibration, contact stress, environment, personal risk factors) and can be addressed and reduced. The body part involved is also identified, including right or left locations. These data are necessary to understand where and what the ergonomic intervention needs to be and is the beginning of a return-to-work process. Prior to implementing the solution, administrative controls and/or PPE can be deployed to keep the employee safe from reinjury.

The medical community must be a major part of workers' compensation and return-to-work systems through the understanding of job requirements and ergonomics. Return-to-work policies must include an ergonomics job assessment prior to the employee returning full-time to the job that might have contributed to the injury.

**ErgoArticle** Winnie Ip, CPE, Director of Consulting, Humantech

## ROI of Ergonomic Improvements: Demonstrating Value to the Business

With the economic challenges we all currently face, one thing is clear: we cannot afford *not* to invest in ergonomics. Fiscal responsibility means companies are choosing carefully the programs they implement and any initiative that can show measurable gains or a reduction in cost is likely to "weather the storm." Demonstrating payback on safety programs is an ongoing challenge for many safety professionals. Showing the value of an ergonomics program and individual workplace improvements is part of that challenge, especially using traditional lagging measurements.

### Typical Cost Justification Methods

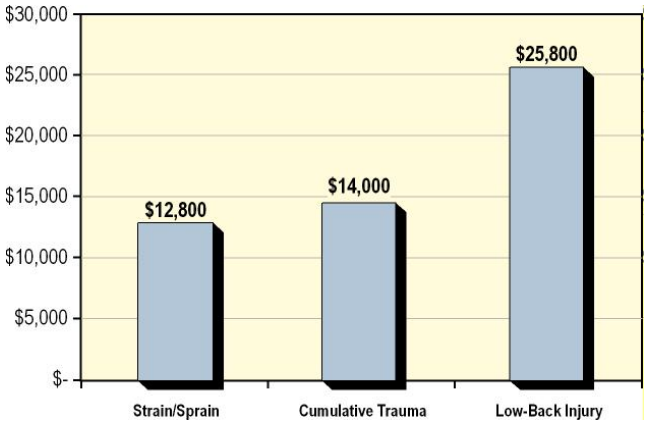
There are many business reasons to support an ergonomics initiative. Three typical primary justification drivers include regulatory compliance, health and safety performance and production enhancement.

### Regulatory Compliance

Although no federal ergonomics standard currently exists, ergonomics still falls under OSHA's general duty clause, which states that every employer must provide "a safe working environment for their employees." Some states have plans specific to ergonomics, such as California. In addition, other states are in the process of initiating state standards, like the Michigan Ergonomics Standard. Others have taken voluntary action, such as Minnesota's Ergonomics Task Force and Oregon's Ergonomics Stakeholder Group. OSHA has also issued guidelines for certain industries (e.g., poultry processing and patient handling), but these are voluntary guidelines, not regulatory standards. Outside the U.S., there are European and non-European Union guidelines and standards, such as EN ISO 12100, an ergonomic design standard for machinery, and ISO standards 5349: 1:2001 and 2:2001, which address vibration exposure.

### Health and Safety Performance

Business managers know that health and safety performance is an important element in maintaining a motivated, well trained workforce. The financial benefit of reduced workers' compensation costs related to work-related musculoskeletal disorders (WMSDs) can be substantial. The graph below shows approximate averages for three types of WMSDs as reported by various data sources in the U.S.[1, 2, 3]




**Approximate Average Costs of WMSDs**

## ROI of Ergonomic Improvements: Demonstrating Value to the Business (con't)

Historically, ergonomics has always had a positive impact on health and safety. We know this by looking at the savings in terms of direct and indirect costs. It is estimated that the ratio of indirect to direct costs is 4:1[4], and this is often visualized using the "iceberg" analogy (for every $1 of direct costs above the water, there are at least $4 of indirect costs below the water).

Direct costs are those that can be tracked to a WMSD incident. Examples include:

- Medical costs
- Workers' compensation payments
- Insurance premiums

Indirect costs are often hidden and increase when WMSDs occur. Examples include:

- Time to manage and treat WMSDs
- Costs to recruit and train replacement workers
- Overtime or lost productivity

The limitation of using regulatory compliance and health and safety performance as the principle drivers of justifying an ergonomics program's return on investment (ROI) is that these models are typically founded on lagging metrics. Compliance and safety performance are visible but lack reliability.

**Production Enhancement**
Productivity and value-added improvements have proven to be the most straightforward means of cost-justifying ergonomic improvements. Productivity is measured at the workstation level, so it fits easily into typical cost justification processes. Also, the positive productivity impact of ergonomic improvements is simple to predict and to quantify in many areas, including:

- Quality
- Delivery
- Production (measured at the workstation level)

For these reasons, the production enhancement model is the least visible but most reliable in justifying ergonomic improvements.

**Creating Business Value Through Ergonomics**
In today's business climate, any initiative that does not deliver measurable (short- to medium-term) value is considered an option, rather than a requirement. Ergonomic improvements are more likely to be supported and accelerated if they fit into a cost-justification process.

Cost justification is a normal business process that managers and executives use to weigh the costs and benefits of various improvement initiatives. Managers are challenged every day to do more with less and are often measured on how quickly they can improve productivity and quality. Cost justification:

- Enables communication between safety, engineering and management
- Takes the focus away from injuries (reactive)
- Focuses on taking action before an injury occurs (proactive)
- Enables you to prioritize countermeasures (compare payback periods)
- Makes good business sense and affects the bottom line

## ROI of Ergonomic Improvements: Demonstrating Value to the Business (con't)

Management must often weigh the merits of ergonomic improvements against other potential projects. Ergonomic projects that result in ROI are both effective *and* efficient in reducing hazard exposures.

**Calculating ROI**
In the manufacturing environment, time is the dominant currency, and we know that awkward postures, high forces and repetitive movements take more time to complete. The challenge is quantifying the financial benefits of reducing force, frequency and posture. Motion time can be converted to money.

Ergonomics can affect productivity in two ways: elimination of non-value-added tasks and reduction in motion waste. Motion time is often related to ergonomic risk, and methods exist for identifying and quantifying time savings as a result of eliminating or reducing non-value-added motions.

Industrial and operations engineers use motion study to improve processes and to determine appropriate workloads. The technique predicts the time required to perform a task and/or operation. This analysis method requires operations to be broken down into tasks, task elements and basic motions. Many tasks that involve excess motion often require more time to perform the job and are a source of ergonomic risk to the employee. For example, tasks that require extended reaching can be improved from a motion time standpoint by moving the objects closer. Reducing reaching in this way will also reduce ergonomic risk, back bending, raised shoulders and extended elbows. Therefore, motion time analysis can be used to calculate time savings resulting from ergonomic improvements. Motion time analysis can also be used as a supplemental resource when requesting financial buy-in from management/engineering.

**Productivity Impact**
Cost justification is based on the ability to choose the best ergonomic improvements for the available resources. For each ergonomic improvement, the benefit should outweigh the cost (benefit-to-cost ratio). The easiest and most effective way to estimate benefits of ergonomic improvements is to focus on productivity impact. Time savings from eliminating non-value-added tasks and reducing motion times can be used to project effects on productivity.

$$\text{Projected Productivity Impact} = \frac{\text{Total Time Savings}}{\text{Total Operation Time}} \times 100\%$$

**Payback Period**
To cost-justify ergonomic improvements, calculate the payback period. This is the amount of time that savings must accumulate to "pay back" the initial investment cost. Payback period is typically expressed in years or months.

To calculate a payback period, an annual savings calculation is required as well as the cost of the investment. Calculate annual savings by multiplying the productivity impact by the fully burdened direct labor cost of the operation. The benefits burden typically ranges from 25% to 33% of the hourly wage. A conservative measure is recommended.

$$\text{Annual Savings} = \text{Productivity Impact} \times \text{Annual Direct Cost}$$

$$\text{Payback Period (Years)} = \frac{\text{Cost of Improvement}}{\text{Annual Savings}}$$

## ROI of Ergonomic Improvements: Demonstrating Value to the Business (con't)

To calculate ROI, subtract the initial investment from the annual savings and divide by the initial investment. Typically, an ROI of fewer than three years is desirable.

$$\text{Return on Investment} = \frac{\text{Annual Savings} - \text{Initial Investment}}{\text{Initial Investment}}$$

**Summary**

For your ergonomics process or safety program to be successful, you must be able to demonstrate its business value—and value is measured as money. To demonstrate value of ergonomic improvements:

1. Focus on proactive goals and measures people can act on.
2. Use objective, real-time methods.
3. Demonstrate value to other initiatives (quality, cost, time, etc.).
4. Calculate and communicate the cost-benefit of improvements (ROI).
5. Achieve tangible results.

**References**

[1]Bureau of Labor Statistics (2002). *Lost-worktime injuries and illnesses: Characteristics and resulting time away from work.* USDL 02-196, Washington, DC.
[2]National Safety Council (2001). *Injury facts*.
[3]Health and Safety Executive (2001). Health and safety statistics, part 2: Occupational ill-health statistics.
[4]MacLeod, D. (1995). *The ergonomics edge: Improving safety, quality and productivity*. New York: John Wiley & Sons.

**Winnie Ip**

Winnie Ip, CPE, Director of Consulting for Humantech, manages and implements complex, large-scale ergonomics programs in a wide range of industries (petroleum, pharmaceutical, consumer products, food and beverage). She holds a bachelor of science degree in kinesiology from the University of Waterloo in Ontario. Ip is a professional member of the Industrial Designers Society of America.

## Ergonomics Branch Seeks New Members

We are a hard-working, fun-loving group who enjoys exchanging ideas, solutions and new innovations. The Ergo Branch is always looking for new members to join our ever-growing group, and we hope to be a standalone practice specialty soon.

To learn more about the Ergonomics Branch, contact any one of us or Scott Valorose, our Membership Chair.