Institute for Ergonomics
The Ohio State University
At the forefront of Human Factors since 1950

2003 Year in Review: Research
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A Message from the Institute Co-Directors

Since the Institute for Ergonomics became "official" in 1998, we have come a long way. The human, by nature, involves complex interactions of the mind and body. In developing the Institute, we felt that it was important to look at human performance from a broad perspective that integrates both cognitive and physical ergonomics. This has lead to many significant advances, such as:

- The causes and the prevention or control of musculoskeletal disorders;
- The causes and prevention of design-induced error;
- The design of system architectures, tools and procedures to enhance distributed work; and
- The use of multimedia displays to improve communication.

This research has paid off handsomely. In the few years since its inception, the Institute has produced many landmark studies and been recognized through well-respected international and national ergonomics awards. Interdisciplinary teams between the College of Engineering and School of Public Health won the prestigious Volvo Award for Low Back Disorder Research in 2002, the Alice Hamilton Science Award from the National Institute for Occupational Safety & Health (2003), and the 2003 Liberty Mutual Prize for Occupational Safety & Ergonomics Research (the International Ergonomics Society's highest honor). Similarly, since the Institute began, our work in cognitive ergonomics has won the Jerome H. Ely Award for best Human Factors paper (1999), the Airline Dispatchers Federation National Aviation Safety Award (2001), and the 2002 Jack A. Kraft Innovator Award from the Human Factors & Ergonomics Society, for advancing cognitive engineering and its application to safer systems.

As you will see, our interdisciplinary approach to research has enabled the Institute to attract a substantial amount of funding, making possible these contributions to the field of human factors. During the year 2003, active grants and contracts for Institute members totaled nearly $14 million.

However, the real winners in this venture have been our students. Not only have they been involved in world-class research efforts, but they have expanded their horizons beyond the traditional boundaries for specialists in either physical or cognitive ergonomics. This interdisciplinary education has resulted in faculty positions at a number of the best universities in the nation, as well as research and development positions at numerous prestigious companies.

Although the Institute is still in its infancy, it has been growing rapidly, and the best is yet to come. We expect Institute research contributions to continue to grow and lead the nation in developing new insights. This is a very exciting time for the Institute for Ergonomics. We welcome this opportunity to share our members' accomplishments with you and encourage future interactions.

Bill Marras
Honda Professor, ISE Program
Co-Director, Institute for Ergonomics
Director, Biodynamics Laboratory

Phil Smith
Professor, ISE Program
Co-Director, Institute for Ergonomics
Co-Director, Cognitive Systems Laboratory

A Message from the Institute Program Director

In addition to the various research efforts we conduct, our members also are committed to transferring this knowledge to society, so that it has a very real and practical impact. Thus, the Institute for Ergonomics also is immersed in significant outreach efforts. In 2003, the Institute (in cooperation with the National Institute for Occupational Safety & Health) hosted a State-of-the-Art Research Symposium, focusing on the prevention of musculoskeletal disorders. It attracted academics from around the world. Feedback from this symposium has been remarkable, with attendees requesting that we repeat the symposium periodically.

Technology transfer also has been a hallmark of the Institute. We offered a variety of educational courses to companies nationwide. In 2003, we provided training, on a variety of levels and ergonomics topics, to over 100 individuals. This is in addition to dozens of informational presentations our members gave to industry, business, and educational groups.

Our consulting projects also were quite diverse; as we provided expertise on ergonomics issues involved with work as far-reaching as automotive assembly, railroad maintenance, chemical production, and orthopaedic surgery. The goal of these activities was to reduce the human costs and errors associated with work. The national focus on reducing healthcare costs signifies that our work in this area also will expand dramatically in the future.

W. Gary Allread
Program Director, Institute for Ergonomics
Institute for Ergonomics
The Ohio State University
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2003 Year in Review: Research

The Ohio State University Institute for Ergonomics is dedicated to ensuring the design of safe and effective work environments and consumer products. This requires an understanding of the physical and cognitive capabilities of people, as well as insights into how performance is affected by the use of different support technologies, tools and work practices.

The Institute continues a long tradition of human factors research at Ohio State, with an emphasis on an interdisciplinary approach to system design. To achieve this, it draws upon the extensive experience of faculty, staff, and students from a variety of disciplines, including industrial and systems engineering, computer and information science, communication, industrial design, psychology, statistics, education, physiology, biomedical engineering, public health and medicine. This interdisciplinary approach is applied to the Institute's activities focusing on education, research and consulting.

This publication highlights the various endeavors of Institute members, who were very productive in calendar year 2003. It describes the 34 funded research projects that were active in 2003, along with eight technical assistance projects, six training programs, and one research symposium held during the year.

The amount of funding brought into the University by Institute members also is quite impressive. These 34 active research projects total $13,397,386 over their funding periods. The distribution of this funding income, within nine ergonomics and human factors-related research categories, is shown in the graphic.

Institute personnel also provided services to businesses, organizations, and individuals outside the University. This generated an additional $147,859 in income was brought in through technical assistance projects, training programs, and research symposia.

Contact the Institute for Ergonomics (phone: 614-292-4565; email: ergonomics@osu.edu) for more information or reprints of this Year in Review publication. Our web site (http://ostuego.eng.ohio-state.edu/Institute/index.htm) contains useful materials, including recent newsletters and press releases, links to Institute members and laboratory web sites, and upcoming events.
Primary Institute for Ergonomics Members

William S. Marras
Director of the Biodynamics Laboratory. William Marras received a PhD in Bioengineering and Ergonomics. In addition to directing the Biodynamics Lab, he is the Co-Director of the Institute for Ergonomics and holds the Honda Endowed Chair in Ergonomics, and former NCR Professor of Ergonomics.

Bill holds joint appointments in the Department of Physical Medicine and the Biomedical Engineering Center. His research centers on industrial biomechanics issues, laboratory biomechanics studies, mathematical modeling, and clinical studies of the back and wrist. His findings have been published in over 150 refereed journal articles and over a dozen book chapters. He is a two-time recipient of the Volvo Award for low-back research. Bill also is a Certified Professional Ergonomist and holds two patents, including one for the Lumbar Motion Monitor.

Dr. Marras can be reached at 614-292-6670 or marras.1@osu.edu. His web site is: www.iwse.Eng.ohio-state.edu/ISEFaculty/marras/marras.htm. Information about the Biodynamics Laboratory is at: http://osuergo.Eng.ohio-state.edu/index.html.

Philip J. Smith
Dr. Philip Smith is Co-Director of the Institute for Ergonomics and a Professor with the Industrial & Systems Engineering program, Biomedical Engineering, and the Advanced Computing Center for Arts and Design at OSU.

Phil teaches courses in areas of cognitive systems engineering, artificial intelligence, human-computer interaction, the design of cooperative problem-solving systems, intelligent information retrieval systems, and intelligent tutoring systems. His research focuses on issues concerned with design of cooperative problem-solving to support people in performing complex tasks such as information retrieval, planning, database exploration, teaching and diagnosis, using fields such as aviation, medicine, library systems, military planning, and education as testbeds.

Dr. Smith can be reached at 614-292-4120 or smith.131@osu.edu. Additional information can be found at www-iwse.Eng.ohio-state.edu/ISEFaculty/smith/index.htm.

W. Gary Allread
As Program Director for the Institute for Ergonomics at The Ohio State University, Dr. Gary Allread manages and conducts ergonomics research and educational programs. He also provides consulting and ergonomics technical assistance to clients, focusing on the prevention of injuries and musculoskeletal disorders in a wide variety of occupational work settings.

Gary has authored peer-reviewed research articles on various ergonomics topics and also has implemented ergonomics programs in several companies. He received his Ph.D. in Industrial & Systems Engineering, with an emphasis on industrial ergonomics and biomechanics.

Dr. Allread can be reached at 614-292-4565 or allread.1@osu.edu. His web site is: www-iwse.Eng.ohio-state.edu/ISEStaff/Allread/Allread_web.html.

Catherine A. Heaney
Dr. Catherine Heaney is an Associate Professor in the Division of Health Behavior and Health Promotion at the Ohio State School of Public Health. She earned her PhD in Health Behavior and Health Education from the University of Michigan in 1988.

Cathy's academic interests include:
- Investigating psychosocial factors at the worksite that are associated with health and disease;
- Developing and evaluating occupational safety and health interventions that address psychosocial and behavioral risk factors; and
- Bridging the gaps between theory, research, and practice in health education.

Dr. Heaney can be contacted at 614-293-5837 or heaney.1@osu.edu. (Web site: http://sph.osu.edu/school/faculty/faculty.cfm?id=7).
Richard Jagacinski
A professor in the Psychology Department at Ohio State, Dr. Jagacinski has numerous research interests, including perceptual-motor coordination, aging, decision making in dynamic contexts, and human interactions with the natural environment.

Rich's research investigates the dynamic structure of skilled performance. This includes *behavioral stability* (under what conditions can a behavior continue over time, despite various internal and external perturbations?) and *adaptivity* (what are the limits of adjustment for meeting changing environmental constraints and achieving different goals?) In 2003, he co-authored (with Dr. John Flach) the book, *Control Theory for Humans: Quantitative Approaches to Modeling Performance* (Erlbaum).

Dr. Jagacinski can be contacted at 614-292-1870 or jagacinski.1@osu.edu. His web site is [www psy ohio-state edu/faculty/jagacinski/default.htm](http://www psy ohio-state edu/faculty/jagacinski/default.htm).

Steve Lavender
Dr. Steve Lavender has a joint appointment in the Departments of Industrial, Welding & Systems Engineering and of Orthopaedics at Ohio State. In 1990 he earned his PhD from OSU in Industrial Engineering. For 17 years he worked as a research scientist in the Department of Orthopedic Surgery, at Rush University Medical Center. There, Steve made significant contributions to the scientific basis for ergonomics and developed Lift Trainer, which is a behaviorally oriented approach to improving lifting techniques.

Steve directs the OSU Orthopaedic Ergonomics Lab, which focuses on the body's biomechanical response to occupational tasks, potential workplace interventions, and models to predict musculoskeletal injury development and recovery. A member of the Human Factors & Ergonomics Society, Institute of Industrial Engineers, American Society of Biomechanics, the Orthopaedic Research Society, he is also a Certified Professional Ergonomist and has published dozens of peer-reviewed journal articles.

Dr. Lavender can be reached at 614-292-9980 or lavender.1@osu.edu. His web site is [www ortho ohio-state edu/research/ergonomics/index.htm](http://www ortho ohio-state edu/research/ergonomics/index.htm).

Nadine B. Sarter
Dr. Sarter is an Associate Professor in the Departments of Industrial & Systems Engineering and Psychology at Ohio State. She received her PhD at OSU in 1994, specializing in Cognitive Systems Engineering. Previously, she was on faculty in the Institute of Aviation at the University of Illinois at Urbana-Champaign, with joint appointments in Mechanical & Industrial Engineering and Psychology and the Beckman Institute for Advanced Science & Technology.

Nadine's primary research interests include the design and evaluation of multi-modal human-computer interaction and computer supported cooperative work interfaces in support of effective human-machine communication and coordination, the development of robust decision support systems, and the use of design and training to support error management in a variety of complex domains, including aviation, the military, and the automotive industry.

Dr. Sarter can be reached at 614-688-5368 or sarter.1@osu.edu. (Web site: [www iwsc cng ohio-state edu/ISEFaculty/sarter/sarter.htm](http://www iwsc cng ohio-state edu/ISEFaculty/sarter/sarter.htm)).

James E. Sheedy
Jim Sheedy received his optometry degree and doctorate in physiological optics, from Ohio State. He was a Clinical Professor at the University of California at Berkeley School of Optometry, where he founded the first VDT Eye Clinic in 1985. Currently, he is an Associate Professor at OSU, where he continues his clinical work and research. He is active in the American Optometric Association and the American Academy of Optometry. He has also been active in the ophthalmic industry, helping to develop numerous standards and regulations.

Jim is a recognized expert in visual performance and visual symptoms. He received the Distinguished Service Award from Prevent Blindness America for his work with ultraviolet protection and coordinating efforts of the American Optometric Association and the American Academy of Ophthalmology on this issue. He has over 100 published articles.

Dr. Sheedy can be contacted at 614-247-7632 or sheedy.2@osu.edu. His web site is [www dhsheedy com](http://www dhsheedy com).
Carolyn M. Sommerich
Dr. Sommerich’s research focus is ergonomics and occupational biomechanics, with special interest in the upper extremity and office ergonomics. She has received funding for research addressing computer monitor placement, ergonomic aspects of portable computer use, and the study of risk factors for upper extremity MSDs in the furniture manufacturing industry. She is the author of papers on a diverse range of ergonomics issues, including work-related MSDs of the shoulder, assessment of carpal tunnel pressure during keyboarding, and changes in patterns of trunk muscle activity in response to lifting task requirements.

Carolyn is the past chair of the Ergonomics Committee of the American Industrial Hygiene Association and an active member of the Human Factors & Ergonomics Society. She earned her MS and PhD from The Ohio State University and returned to OSU after having a faculty position in the Department of Industrial Engineering at North Carolina State University.

Dr. Sommerich can be reached at 614-292-9965 or sommerich.1@osu.edu. (Web site: www-iwse.eng.ohio-state.edu/ISE/TFaculty/sommerich/)

James Tittle
Dr. Tittle is an Assistant Professor in the Department of Psychology at The Ohio State University. His research interests include the representation of 3-D structure from optical stimulation and the integration of visual representations from multiple sources. His most recent research efforts have concentrated on the combination of stereopsis and motion, and he plans to extend these studies to include the whole range of optical variables (e.g., texture, shading, and contour deformation) that specify 3-D environmental structure.

Dr. Tittle can be contacted at 614-292-1669 or tittle.2@osu.edu. His web site is www.cog.ohio-state.edu/people/c-faculty/tittle.html.

John R. Wilkins III
Jay Wilkins is a Professor and the Chair of the Ohio State School of Public Health’s Division of Epidemiology and Biometrics. He received his Doctorate of Philosophy from Johns Hopkins University in 1978. Dr. Wilkins most-recent interests have been in the areas of environmental epidemiology and agricultural safety and health.

Dr. Wilkins can be contacted at 614-293-3923 or wilkins.2@osu.edu. (Web site: http://sphp.osu.edu/school/faculty/faculty.cfm?id=26.)

David D. Woods
Dr. David Woods is a Professor in the Industrial, Welding, & Systems Engineering Department. He also is Past President of the Human Factors and Ergonomics Society. From his initial work following the Three Mile Island accident in nuclear power, to studies of coordination breakdowns between people and automation in aviation accidents, to his role in today’s national debates about patient safety, he has studied how human and team cognition contributes to success and failure in complex, high risk systems.

Dave has been on the board of the National Patient Safety Foundation and was the Associate Director of the Veterans Health Administration’s Midwest Center for Inquiry on Patient Safety. He is author of Behind Human Error, received the Jack A. Kraft Innovator Award from HFES, for advancing Cognitive Engineering to safer systems, and received a Laurels Award from Aviation Week & Space Technology, on the human factors of highly automated cockpits.

Dave currently serves on a National Academy of Engineering/Institute of Medicine Study Panel applying engineering to improve health care systems and on a National Research Council panel on research to define the future of the national air transportation system.

Dr. Woods can be reached at 614-292-1700 or woods.2@osu.edu. His web site is: http://cse1.eng.ohio-state.edu/woods.
Primary Institute for Ergonomics Research and Administrative Staff

Sue A. Ferguson
Dr. Sue Ferguson is a Senior Research Associate Engineer with the Institute and the Biodynamics Laboratory. She received her degree from OSU in 1998, where she specialized in biomechanics and rehabilitation. Sue’s current research centers on occupationally related low back injuries, the risk factors of initial and recurrent episodes, recovery process, and biomechanical effects of treatment. She has published more than 20 articles in refereed journals and was one of several researchers receiving the Liberty Mutual Prize for innovative solutions to a world-wide injury problem. She also is incoming chair of the Industrial Ergonomics Technical Group in the Human Factors & Ergonomics Society.

Dr. Ferguson can be reached at 614-537-4508 or ferguson.2@osu.edu. Her website is www.iwse.eng.ohio-state.edu/ISEStaff/Ferguson/Ferguson_web.html.

Candi C. McCain
Candi is an Administrative Associate with the Institute. She is responsible for fiscal operations, proposal preparation, and other organization duties.

Candi McCain can be reached at 614-688-8241 or mccain.3@osu.edu.

Jodi Heintz Obradovich
Dr. Jodi Heintz Obradovich works as a Research Specialist for the Institute. She earned her PhD in Cognitive Systems Engineering at Ohio State. Jodi and Dr. Phil Smith are currently lead investigators on an Army Distributed Continuous Planning project, a 5(+3) year project funded by the Army Research Laboratory’s Advanced Decision Architecture Collaborative Technology Alliance.

Jodi’s other research has taken place in aviation, where she has explored the problem of surface movement at national airports and was involved in the design and analysis of the Post-Operations Evaluation Tool (POET), which enables the FAA and airline operations centers to examine trends of inefficiency occurring in the National Airspace System. She also is currently focusing on distributed collaborative work and distributed continuous planning.

Dr. Heintz Obradovich can be reached at obradovich.2@osu.edu.

Emily S. Patterson
Dr. Emily Patterson is an Assistant Professor of Clinical Medicine at the University of Cincinnati, a Research Physical Scientist at the Getting to Patient Safety (GAPPS) Center at the Cincinnati VAMC, and a Visiting Researcher at the Institute for Ergonomics. Her research has covered a wide variety of issues in human human technology interaction in complex systems, mainly in the domains of health care, intelligence analysis, space shuttle mission control, and human computer interaction design.

Emily earned her PhD in Industrial & Systems Engineering from Ohio State in 1999, under advisor David Woods. She can be reached at patterson.150@osu.edu. More information about Dr. Patterson can be found at http://csei.eng.ohio-state.edu/emily/.

Peter A. Schabo
Mr. Peter Schabo is a Research Associate Engineer with the Institute’s Biodynamics Laboratory. He is a seasoned engineer with 26 years of experience in plant and project engineering, where he conducted ergonomic assessments, developed ergonomics designs and upgrades, and led project management and development in the maintenance of industrial engineering systems.

Mr. Schabo can be reached at 614-292-2016 or schabo.4@osu.edu. More information about Peter Schabo can be found at www.iwse.eng.ohio-state.edu/ISEStaff/schabo/schabo_web.html.
William S. Marras, Catherine A. Heaney
Dr. Marras and Dr. Heaney, along with Kermit Davis (University of Cincinnati), Thomas Waters (NIOSH), and Pumendu Gupta (University of Chicago) were named the winners of the 2003 Alice Hamilton Science Award in the Human Studies Category for their paper, *The Impact of Mental Processing and Pacing on Spine Loading*, which was published in 2002 in the journal *Spine* (Volume 27, pp. 2645-2653).

The Alice Hamilton Science Award for Occupational Safety and Health was established in 1988 for NIOSH scientists. The award is presented each year to the author(s) of a peer-reviewed publication.

Philip J. Smith
In October 2003, Dr. Smith was elected to Fellow status of the Human Factors and Ergonomics Society. This is one of the highest honors that the Society bestows upon its members. Phil was formally recognized with this honor at the Opening Plenary Session of HFES Annual Meeting in Denver, Colorado.

William S. Marras, Sue A. Ferguson
The winner of the 2003 Liberty Mutual Prize was awarded to Dr. Marras and Dr. Ferguson, in additional to Deborah Burr (The Ohio State University), Kermit Davis (University of Cincinnati), and Pumendu Gupta (University of Chicago), in recognition of their scientific paper entitled, *Kinematic Compromise Predicts Spine Loading in Low Back Pain Patients During Lifting*. This award was received in August, 2003, at the IEA XVth Triennial Congress in Seoul, Korea.

The paper addresses the potential causal mechanisms for recurrent or secondary low back pain.

The Liberty Mutual Prize, with a cash award of $5,000, recognizes outstanding, original research in the field of occupational safety and health.

Stuart Zweben
In April, 2003, the Columbus Technology Council named Stuart Zweben, Chair of Computer and Information Science, as its Outstanding Educator Advancing Technology at the annual Top CAT Award banquet. The award is given to the educator demonstrating outstanding contributions in the advancement of technology through training, teaching and/or research.

The Top CAT awards are designed to recognize those who help to build a strong technology community in Central Ohio. CTC works to help local technology-based businesses become familiar with and access resources that they need to sustain a globally competitive organization, including creators of technology, users of technology, providers of technology, and those that support these organizations.

Dr. Zweben is also on the Board of Directors for the Institute.

William S. Marras, Sue A. Ferguson
With co-authors Deborah Burr (Ohio State University) and Pumendu Gupta (University of Chicago), Dr. Marras and Dr. Ferguson were awarded the 2003 Best Poster Award at the annual meeting of the International Society for the Study of the Lumbar Spine in Vancouver, Canada (May, 2003), for their poster *Functional Impairment and the Prediction of Spine Loading*.

William S. Marras
In November 2003, Dr. Marras was inducted into the Wayne State University’s College of Engineering Hall of Fame. This award is given to distinguished engineering alumni who have made significant career achievements.
Disability-Related Research

Projects 1 and 2

Title: Assistive Technology of Ohio
Principal Investigator: William S. Marra (Co-PI: Sheldon R. Simon)
Funding Source: National Institute on Disability and Rehabilitation Research
Funding Periods: 08/01/00 - 10/31/03 and 08/01/02 - 07/31/03
Award Amount: $595,695 and $794,260

Description
AT Ohio is a federally funded program, which is a 501(c) 3 institution. It was established in 1992, in response to the passage of the federal law known as the Tech Act. This Act was enacted by Congress to promote implementation of programs of technology related assistance for individuals with disabilities.

AT Ohio’s mission is to ensure that everyone with a disability who needs technology or related services in order to live, learn or work will receive the required equipment or services in a timely manner. The program is especially sensitive to rural and other underserved populations and have programs designed especially for them.

AT Ohio collaborates with persons with disabilities and others to initiate system changes through statewide programs. These programs are designed to increase the availability and use of assistive technology devices and services. Issues of poverty, unemployment, low income, cultural diversity, and where a person lives create difficulties in obtaining assistive technology. AT Ohio is dedicated to making sure those difficulties do not prevent a person with a disability from getting the assistive technology or service he or she needs.

Project 3

Title: Ohio State University Technology Outreach Program for Assisted Self-Help
Principal Investigator: William S. Marra
Funding Source: Appalachian Regional Commission
Funding Period: 06/01/03 - 05/31/04
Award Amount: $200,000

Healthcare Research

Project 1

Title: Creating Safety and Reducing Medical Error with Bar Coding
Principal Investigator: David D. Woods
Funding Source: Veterans Affairs
Funding Period: 10/01/01 - 08/31/03
Award Amount: $342,022

Project 2

Title: Midwest Patient Safety Center of Inquiry on GAPS in the Continuity of Care
Principal Investigator: David D. Woods
Funding Source: University of Chicago
Funding Period: 10/01/99 - 03/31/03
Award Amount: $501,471
Project 1

Title: The Effects of Multi-Modal Information Presentation on Timesharing and Attention Management in the Modern Car Cockpit
Principal Investigator: Nadine B. Sarter
Funding Source: CAR Industrial Consortium
Funding Period: 10/01/02 - 09/30/03
Award Amount: $86,235

Description
The focus of this CAR-funded research project was to examine the effects of distractions and of concurrent and sequential multi-modal information presentation on time-sharing (i.e., the concurrent performance of the driving and any secondary tasks) and attention management in modern car cockpits. In particular, a simulator study was conducted to compare participants’ driving performance and their responses to unexpected, potentially hazardous, events while they interacted with a navigation system, a cell phone, a car stereo, and a warning system. These systems presented information via three modalities - vision, hearing, and touch. The main findings from this study indicate reduced phase delay effects for driving errors with tactile navigation cues and increased response times to the various tasks and systems in case of concurrent multi-modal presentation of information.

Project 2

Title: Self-Evolving Adaptive Interfaces
Principal Investigator: Philip J. Smith
Funding Source: Dayton Area Graduate Studies Institute
Funding Period: 07/01/01 - 12/31/03
Award Amount: $33,000

Description
This collaborative project with faculty at Wright State University has been exploring analogies between strategies implicit in the functioning of biological systems and performance on distributed military planning tasks.

Project 3

Title: Maximizing Visualization Effectiveness
Principal Investigator: David D. Woods
Funding Source: Aegis Research Corp.
Funding Period: 09/15/02 - 09/30/04
Award Amount: $205,000

Description
The goal of this project is to analyze how leading-edge visualizations support practitioner decision making.
Low Back Disorder Research

Project 1

Title: Identifying Safe Load Moment Exposures for the Back
Principal Investigator: William S. Marras (Co-PI: Steve Lavender)
Funding Source: National Institute for Occupational Safety and Health
Funding Period: 09/30/02 - 09/29/03
Award Amount: $1,631,268

Description

Low back pain (LBP) continues to represent the leading occupationally related musculoskeletal disorder experienced by workers. Previous surveillance studies have indicated that the most robust individual marker of risk for occupationally related LBP is load moment. Even this crude measure is capable of outperforming more computationally complex assessment tools such as the NIOSH lifting guide and revised equation. In addition, many biomechanical studies suggest that the load moment exposure represents a biologically plausible pathway for a low back injury mechanism. However, no studies have attempted to specifically define the association between a various components of load moment exposure and LBP risk. Thus, the objective of this study is to explore how exposure to various components of load moment (i.e. components of the duty cycle) relate to LBP risk.

This goal will be accomplished by developing and analyzing a rich and diverse database where the magnitude of the moments as well as the temporal exposure vary. Two phases will be necessary to complete this goal. Phase I will use an existing database of 515 manufacturing jobs to help understand the relationship between load moment and exposure frequency. Statistical models will be constructed and tested to help understand which features of the temporal exposure to moment might provide sensitive measures. In addition, instrumentation will be developed to precisely monitor load moment exposure. The final component of Phase I will involve the recruitment of various distribution centers needed to create a prospective database (phase II). Phase II will employ the moment measurement instrumentation in an industrial study of materials handling. In this prospective study, 1200 participants will be monitored for clinically relevant indicators of LBP status at the beginning and the end of an 18-month exposure period. During the exposure period, components of the workplace will be monitored including precise load moment exposure, temporal aspects of exposure (e.g. duty cycle, cumulative exposure, etc.), load position, etc. Workers will be monitored over an eight-hour shift. Upon completion of the prospective observation period, injury reporting, changes in clinical back status, etc. will be evaluated as a function of the load moment and temporal exposure characteristics using statistical models. In addition, easily measured surrogate indicators of the most predictive model measures will be developed so that these findings can be used to assess risk with minimal equipment.

Collectively this study will not only enhance our knowledge of how exposure to various aspects of load moment affects LBP risk but will also lead to applicable measures with both high sensitivity and specificity for control of risk in the workplace.
Project 2

Title: Muscle Overexertion during Repetitive Lifting
Principal Investigator: William S. Marras
Funding Source: NIOSH
Funding Period: 09/30/02 - 09/29/03
Award Amount: $942,959

Description
Occupationally related low back disorders (LBDs) are the leading cause of lost workdays and the most costly occupational safety and health problem facing industry today. LBDs are particularly prevalent in manufacturing, distribution centers, and warehouses, where repetitive lifting is common. No current risk assessments can determine how risk changes during repetitive lifting at various frequencies throughout a workday. This study will assess how exposure to different lifting frequencies over time can result in unacceptable biomechanical risk of LBD.

Our preliminary studies point to two injury mechanisms: (1) Different lift frequencies affect spine kinematics and muscle recruitment patterns, which alter the direction and magnitude of spinal loading, thereby exceeding spine tolerances; and (2) Exposure to repetitive lifting throughout a workday changes muscle recruitment patterns over the work period, also increasing spinal loading. Hence, a lift frequency acceptable early in the workday may exceed biomechanical tolerance limits as the day progresses. This study will explore changes in muscle recruitment and spinal loading when workers lift one of three weights (corresponding to industrial exposure ranges) at six different lift rates over extended workdays. The lift frequency and duration will be judged risky and unacceptable when the spinal loads exceed documented spine tolerance limits.

These findings will aid our understanding of the portion of the population at risk for spine structure (disc) injury as a function of load magnitude, lifting frequency, and lift period duration. These results also will provide quantitative guidance for the mediation of work-related LBDs for the millions of workers performing materials handling tasks in manufacturing and distribution center environments.

Project 3

Title: The Control of Occupationally Related Secondary Low Back Injuries
Principal Investigator: William S. Marras
Funding Source: Ohio Bureau of Workers' Comp.
Funding Period: 07/01/99 - 06/30/03
Award Amount: $722,025

Description
The most costly occupationally related health problem facing industry today is low back pain. In 1996, the Ohio BWC reported that low back problems accounted for nearly 40% of compensation costs, totaling nearly $210 million. Also, 80% of low-back disorder (LBD) costs are attributable to only 16% of the cases. Thus, enormous savings can result from managing these high-cost cases.

These high-cost LBDs typically occur when workers are returned to jobs that are inappropriate for their capabilities. This situation increases the likelihood that a secondary injury or exacerbation of the initial injury will occur. These secondary injuries are much more severe and costly than the initial injury and often result in a permanent disability. Hence, it is often the case that workers with low back pain are returned to work early with the intent of minimizing the cost of the injury, where, in reality, this approach greatly increases the total injury cost. Thus, return of the worker with a low back disorder to the workplace at the appropriate time is an extremely important decision. Currently, a void exists in that we have no scientifically based process to make this decision. However, by quantitatively comparing the biomechanical capabilities of the worker to the workplace characteristics, it is possible to predict the probability of LBD recurrence. This information would make it possible to manage and control this costly situation.

Thus, the objective of this study is to develop a quantitative assessment tool that can be used by the BWC and employers to scientifically return workers who are suffering from low back disorders to the workplace, while minimizing the risk of suffering a secondary, and costly, low back disorder.
Project 4

**Title:** Spinal Load and Stability during Pushing  
**Principal Investigators:** William S. Marras and Kevin P. Granata  
(Virginia Tech)  
**Funding Source:** National Institute for Occupational Safety and Health  
**Funding Period:** 09/15/02 - 07/31/06  
**Award Amount:** $546,065

**Description**  
This project is further developing and using an electromyography assisted biomechanical model to assess loads on the lumbar spine in response to isokinetic pushing, cart pushing, and pushing of loads attached to an overhead bridge.

Project 5

**Title:** Biomechanical and Psychosocial Risks for Low Back Disorders  
**Principal Investigator:** William S. Marras (Co-PI: Catherine A. Heaney)  
**Funding Source:** National Institute for Occupational Safety and Health  
**Funding Period:** 09/01/02 - 08/31/03  
**Award Amount:** $846,835

**Description**  
Occupationally related low back disorders (LBDs) represent a major occupational health concern. The etiology of this health problem is complex and poorly understood. The proposed study investigates the role of biomechanical job demands and psychosocial work characteristics in increasing LBD risk among employees in manual materials handling jobs. Although there is a wealth of knowledge associated with each of these categories of risk factors, there is a dearth of studies that have rigorously investigated both categories of risk factors in the same work environment. Therefore, it is difficult to estimate the contribution of each of these risk categories to the overall risk for occupationally-related LBDs.

We hypothesize that both types of risk factors make independent contributions to the risk of LBDs, and that psychosocial work characteristics are more likely to increase risk for LBD when biomechanical job demands are moderate to low than when they are high. The proposed study uses a prospective cohort design. It significantly increases the standard of scientific rigor of investigations in this area through: (1) reliable, valid state-of-the art measures of both psychosocial work characteristics and biomechanical job demands; (2) assessments of exposure variables at multiple points in time; (3) the use of an array of outcome measures for LBD including a validated, highly quantifiable clinical assessment of low back functional status; and (4) adequate power to formally assess both additive and potential interactive effects of the two categories of risk factors.

With adequate quantification of exposures, we will be able to accurately estimate the extent to which exposures (both psychosocial and biomechanical) need to be decreased to reduce LBD risk. We will also be able to discern when and under what conditions an intervention to improve the psychosocial work environment will be likely to reduce the incidence of LBD and its associated morbidity among manual materials handling employees.
Project 6

Title: Neuro-Fuzzy Prediction of Spine Loads in Response to Multiple Risk Factors
Principal Investigator: William S. Marras (Co-PI’s: Kermit Davis, University of Cincinnati; Waldemar Karwowski, University of Louisville)
Funding Source: National Institute for Occupational Safety and Health
Funding Period: 09/30/02 - 09/29/03
Award Amount: $1,438,661

Description
Occupationally related low back disorders (LBDs) continue to be the leading cause of lost work days and the most costly occupational safety and health problem facing industry today. It has been well established that most occupationally related LBD risk is associated with manual materials handling activities as well as psychosocial influences in the workplace (National Academy of Sciences, 2001). In addition, individual factors can influence risk. However, our ability to characterize risk associated with these various dimensions of LBD risk has been rather poorly understood. Recent literature indicates that a common link within each of these risk dimensions involves increases in trunk muscle coactivation that can lead to increased spine loading and subsequent LBD. Electromyographic (EMG)-assisted models provide the only means to accurately assess and quantify the effect of changes in trunk muscle coactivation upon spinal loading. However, the collection of EMG under most industrial conditions is impractical.

The objective of this work is to develop a Spine Loading Assessment System (SLAS) that has the capacity to assess trunk muscle coactivation patterns and subsequent spine loading in response to multiple risk dimensions. This system would permit one to accurately estimate spine loading as a result of physical workplace factors, psychosocial factors, and individual factors but would not require the use of EMG. This objective will be achieved through the development of a Hybrid Neuro-Fuzzy Engine (HNFE). This engine would act as a system artificial "brain" able to synthesize information about the workplace and assess how the trunk musculature would behave. The engine will interface with a well-developed biologically driven dynamic biomechanical model of the trunk. In this manner, we will be able to accurately predict spine loading in the workplace in response to various risk factor dimensions without the need to collect EMG data in the workplace.

Collectively, the SLAS will have several benefits. First, it can be used to assess the risk of spine structure damage believed to contribute to low back pain as a function of work dimensions commonly associated with the workplace. Hence, this model will have immediate applications to workplace designs. Second, the system will provide insights as to how the various dimensions of risk synergistically impact the musculoskeletal system. Finally, it will facilitate further investigations regarding stability and coactivity.
Project 7

**Title:** Workplace-Based Rehabilitation for Low Back Disorders  
**Principal Investigator:** Steve Lavender  
**Funding Source:** Rush-Presbyterian  
**Funding Period:** 09/01/02 - 03/31/04  
**Award Amount:** $68,586

**Description**

The overall goal of this project is to promote recovery from work-related low back disorders among UAW hourly employees. There are many ways to impact musculoskeletal disorders, specifically back injuries. The specific purposes of this project are to determine the effects of personal protective equipment (back belts), education, and job factors upon recovery from a work-related low back disorder.

This research is supported by the UAW-GM National Joint Committee on Health and Safety as a priority concern as a means of improving productivity and reducing costs due to potentially avoidable work-related health conditions.

There is limited research on ergonomic risk factor exposures in distribution operations. This makes it difficult to design primary or secondary prevention programs.

There exists data suggesting a lifting belt would be an effective aid to recovery from low back disorder in distribution center jobs. One of the aims of this work is to further evaluate the role lifting belts can play in secondary prevention efforts.

As part of this study jobs are assessed for ergonomic risk factor exposures using the lumbar motion monitor and the corresponding Low Back Disorder (LBD) risk model. In addition to providing the data necessary for our analyses the results from each assessment are shared with plant health and safety leadership so that they can be used to develop or refine workplace interventions.

Workers at the GM facilities who have recently experienced a LBD, but are now currently working, are recruited to participate in a longitudinal study that involves assessments at five time points over a 12-month follow-up period. Each participant:

- Is randomly assigned to either a back support or a control group;
- Is provided education on lifting and back safety;
- Is provided education on healthy lifestyles; and
- Is provided blood pressure screening.

We believe that this type of comprehensive approach is required to control losses in a plant due to work-related low back disorders. Because our research is comprehensive and includes education, ergonomics, and, back supports, we can help a plant understand and take action on how to reduce work-related low back disorder recurrence, promote faster recovery, and reduce absenteeism.
Project 1

Title: Continuous Adaptive Planning in the U.S. Army
Principal Investigator: Philip J. Smith (Co-PI: Jodi Heintz Obradovich)
Funding Source: Army Research Laboratory
Funding Period: 06/01/01 - 09/30/04
Award Amount: $550,000

Description
A critical challenge for the Military is supporting distributed work in the development of robust operations plans. Especially challenging is the continuous and dynamic planning that occurs during the execution phase of operations when revisions of these plans may be required in the face of unanticipated events. In previous research, we have identified alternative architectures for supporting such distributed work, as well as a number of different technologies and processes that can be used to significantly enhance continuous distributed planning in military operations. The relevant technologies include:

- Tools to support rich synchronous and asynchronous communication.
- Advanced displays to support visualization.
- Artificial intelligence approaches to support planning and plan adaptation.

Such tools support the development of a common frame of reference by all of the participating agents, and allow them to more effectively communicate and coordinate during continuous planning activities. They also use active decision support technologies to allow mixed initiative interactions among human and computer agents.

This work for the Army Research Laboratory focuses on the following questions:

- How do different architectures for distributing work affect performance on tasks involving initial plan development and continuous and dynamic planning during the execution phase of operations?
- Can tools be developed to effectively support the distributed plan development and adaptation process?

To date, several observational studies have been conducted at Army Warfighter exercises. In addition, a prototype tool to support asynchronous communication of rich multimedia messages, the Collaborative SLide ANnotation Tool, has been developed and tested, demonstrating improvements in situation awareness in the communication of battle operations orders of 47-65%.

Project 2

Title: Intelligent Propulsion System Foundation Technology
Principal Investigator: Nadine B. Sarter
Funding Source: Glenn Research Center
Funding Period: 08/01/03 - 04/30/04
Award Amount: $148,125

Description
The overall goal of this research project is to contribute to enhanced aviation safety by developing a human-machine interface that helps prevent incidents and accidents involving malfunctions of future intelligent propulsion systems. The specific objective of this task is to develop the conceptual design for a use-centered cockpit interface that:

a) informs flight crews about predicted and actual malfunctions of the propulsion system in a timely and effective manner. and
b) supports them in their fault management activities, which include prognosis, detection, diagnosis, and compensation.

To this end, a review of the design of, and difficulties with, existing glass cockpit engine indications and display systems was conducted, and potential new functions (including improved prognostic capabilities) and associated failure modes of future propulsion systems are being identified.

Based on the findings from these activities, candidate designs for components of the fault management interface will be designed, evaluated, and iteratively refined, through heuristic evaluations and cognitive walkthroughs with pilots.
Project 3

Title: Advanced Decision Architectures: Building Information Superiority in the Army through User-Centered Decision Support
Principal Investigator: David D. Woods (Co-PIs: Philip J. Smith, B Chandrasekaran, Wayne E. Carlson, Nadine B. Sarter, Emily S. Patterson, W. Gary Allread)
Funding Source: Micro Analysis and Design
Funding Period: 06/01/01 - 09/30/04
Award Amount: $361,898

Description
This research contains two sub-projects.

The first involves Event Patterns as the Basic Unit of Communication in Human-Computer and Distributed Teams. The objective of this project is to understand and overcome challenges in making event patterns a basic building block of visualization and collaboration. The primary benefit of this project is shifting the unit of display from data elements to events is a critical part of information fusion from dispersed sensor nets in surveillance and personnel detection, to control a mix of assets (soldiers, robots, UAVs), and for horizontal fusion of data to C2 commanders as they coordinate forces in complex and urban terrain. Examples include:

- The hierarchical event template structure integrates data from distributed sensors and algorithms to reveal events which deviate from typical behavior and threat behavior for surveillance and personnel detection.
- Point-of-view becomes a central variable in human-machine interaction, fusing information from and simplifying interaction with a suite of autonomous resources that monitor activities in a scene.
- Visual narrative organizes diverse data about mission plans and contingencies.

The second sub-project relates to Dimensions of Human-Robot Control. Its objective is to develop new forms of coordination between human and robotic resources. The results can be used to help design future soldier-robot teams. The new concepts for remote perception are particularly relevant to Military Operations in Urban Terrain (MOUT), search and rescue, and using robots in confined spaces.

Project 4

Title: Human-Robot Coordination and Advanced Decision Architecture
Principal Investigator: David D. Woods
Funding Source: Micro Analysis and Design
Funding Period: 06/01/01 - 09/30/04
Award Amount: $120,000
Project 5

Title: *Event Patterns and Advanced Decision Architectures*
Principal Investigator: David D. Woods
Funding Source: Micro Analysis and Design
Funding Period: 06/01/01 - 09/30/04
Award Amount: $244,669

Project 6

Title: *Multi-Modal Interaction and Advanced Decision Architectures*
Principal Investigator: Nadine B. Sarter
Funding Source: Micro Analysis and Design
Funding Period: 06/01/01 - 09/30/04
Award Amount: $270,000

Description

The battlefield of the future will be characterized by high levels of complexity and dynamism. It will involve a large number of human and machine agents in various locations, needing to collaborate on planning and problem-solving tasks, sometimes under considerable time pressure and risk. This implies that effective information systems and information operations, i.e., the ability to collect, store, distribute, fuse, and share information, will become increasingly important for the success of every U.S. Army operation.

The goal of this research project is to support timely and effective information sharing through multi-modal information presentation and exchange. In particular, we are developing a framework and guidance for the integrated and adaptive use of various modalities (which will ultimately include visual, auditory, tactile, and olfactory cues) in support of synchronous distributed coordina
tive functions, especially in highly dynamic high-tempo military operations.
Project 1

Title: Designing Ergonomic Interventions for the Fire Service
Principal Investigator: Steve Lavender
Funding Source: University of Illinois
Funding Period: 09/30/02 - 09/29/03
Award Amount: $100,786

Description
The fire service remains one of the most hazardous industries in this country. Its work-related injury rates and total annual costs exceed those for most other occupations. Consistently, musculoskeletal injuries are the major type of firefighter injury, particularly in emergency medical service (EMS) operations, which are much more frequent than fire suppression. Tasks performed during EMS runs contain many of the same risk factors associated with musculoskeletal injury. Unfortunately, few studies have analyzed the biomechanical issues during EMS operations. Previously, we identified and quantified the biomechanical and postural risk factors associated with EMS tasks in the fire service. We are now in a position to design, develop, and evaluate targeted ergonomic interventions for this population of workers.

The purpose of this work is to develop and evaluate up to ten ergonomic interventions that reduce biomechanical loads and are considered worthy of adoption for by EMS workers. A user-centered participatory process will be employed, much like what has been advocated by NIOSH and others. The specific aims of the research are:

- Design specific equipment and work method interventions that address ergonomic concerns during EMS operations;
- Develop and build equipment and refine work methods based on the design process;
- Test equipment and refined work method in a lab setting using simulated EMS tasks; refine and re-test equipment and methods as necessary based on participant feedback and biomechanical results; and
- Implement and evaluate the interventions in the field to obtain usability and acceptability feedback from end users performing EMS operations.

The intervention development and implementation process in this project is comprised of four phases. In Phase 1, focus groups will be conducted with firefighter/paramedics, to discuss ideas for equipment modifications and work method refinement. In Phase 2, the interventions that require the fabrication of equipment will be built and modifications to work methods refined. Phase 3 will test the modified equipment and work methods in a laboratory environment, to quantify the effects on tissue loading. In Phase 4, we will implement and evaluate the interventions in six field tests with firefighter/paramedics by collecting usage data after each emergency run and usability and acceptability data via written survey and group interview at the completion of each field test period.

The ultimate goal of this project is to have identified up to ten successful interventions that are biomechanically validated and superior to their existing counterparts and are judged to be worthy of adoption for use in the field by the end-user firefighter/paramedics.
Project 2

Title: Ergonomics Assessment Method for Work/Worker Systems
Principal Investigator: Carolyn M. Sommerich
Funding Source: NIOSH
Funding Period: 09/01/02 - 08/31/04
Award Amount: $32,293

Description
The aim of this project is to make a comprehensive assessment of a work-worker system from an ergonomics perspective. This relies on several common types of tools (questionnaire, work measurement protocols, and biomechanical assessment), with specific new tools being developed. The questionnaire provides qualitative information. Work measurement protocols supply temporal information and biomechanical data. Biomechanical assessments provide a view of the internal activity necessary to carry out work activities. The assessments are used to produce multi-dimensional work-worker profiles. The worker profile characterizes workers’ interactions with their work; the work profile characterizes physical and administrative work elements. These profiles are used to identify associations between worker attributes and perceptions, health outcomes, and work profiles. These methods are being applied to mobile computing, an emerging area of office ergonomics.

The long term objective of this research is to develop a predictive model of work-related musculoskeletal impairment that includes physical, psychosocial, work organization and personal factors, and has generalized applicability across job types for use in research from initial exploration to intervention demonstration efforts.

Project 3

Title: US-Brazil Higher Education Consortia Program
Principal Investigator: David D. Woods
Funding Source: Fund for the Improvement of Post-Secondary Education
Funding Period: 10/01/03 - 09/30/07
Award Amount: $200,000

Description
Initiated an undergraduate engineering student exchange program between the U.S. and Brazil, in Training Industrial Engineers to Manage High-Risk, Complex Systems: Applying Cognitive Engineering to Human Error and Automation in the Oil Industry. This is a collaboration between the Ohio State University, the University of Virginia, Universidade Federal do Rio de Janeiro, and Universidade Federal do Rio Grande do Norte, with industrial partner Petrobras/Transpetro Dutos & Terminais. Five ISE undergraduetess are preparing to spend six months in Brazil working with local university and oil company as part of capstone project.
Project 1

**Title:** Visual Effects of the Luminance Surrounding a Computer Display

**Principal Investigator:** James E. Sheedy

**Funding Source:** Herman Miller

**Award Amount:** $35,418

**Description**

Purpose: The luminance surrounding a computer display can potentially reduce visibility of the display (disability glare), result in sensations of discomfort (discomfort glare), and result in transient adaptation effects from fixating back and forth between the two luminance levels. The objective is to measure the effects of surround luminance levels upon these functions in younger and older adults to determine recommended surround luminance levels.

Methods: The younger age group comprised 20 subjects (mean and standard deviation of 27.9 ± 5.9, range 23-39 years) and the older group of 17 subjects (mean and standard deviation of 55.5 ± 4.3, range 47-63 years). The central task was presented on a 17 inch (diagonal) LCD computer display with white background luminance of 91 Cd/M2. For each experiment the following surround luminance levels were tested: 1.4, 2.4, 8.9, 25.5, 50, 91, 175, 317, and 600 Cd/M2. Disability glare was tested with low contrast (20%) visual acuity charts, transient adaptation was tested with a task that required regular fixation between the 2 luminance levels, discomfort measured with questionnaire after reading stories with different surround luminance levels, and preference determined by method of adjustment.

Results: Surround luminance had a significant effect upon transient adaptation (p<0.0001), optimal performance occurred at 50 Cd/M2 and above for the young group and at 91 Cd/M2 and above for the older group. Neither low contrast acuity (disability glare) nor symptoms when reading were significantly related to surround luminance. The preferred surround luminance was 86.9 Cd/M2 for the young group and 62.2 Cd/M2 for the older group, slightly below the central luminance of 91 Cd/M2.

Conclusions: The effects of the surround luminance within the tested range are not large, however the data show that the lowest surround luminance levels should be avoided and that surround luminance levels at or slightly below that of the central task are preferred.

Project 2

**Title:** Filters on Computer Displays - Effects on Legibility, Performance and Comfort

**Principal Investigator:** James E. Sheedy

**Funding Source:** 3M

**Award Amount:** $25,646

**Description**

The hypothesis is that using a contrast-enhancing filter (CEF) on a computer display will improve display legibility, reading speed and visual comfort. Twenty subjects performed reading tasks, letter counting tasks, and legibility measurements on 8 display conditions: a cathode ray tube (CRT) and liquid crystal display (LCD) matched for size and luminance - each at high luminance, with 2 different CEFs and a lower luminance to match one of the CEFs. The CEFs decreased both luminance and contrast when applied to the displays with the brightness set high, although the contrast was better with the filters compared to a matched luminance display without a filter. The legibility measurements support the positive effect of the CEFs due to improved contrast but the larger negative effect due to reduction in luminance results in a net loss of legibility. Performance on the reading and letter counting tasks was not improved with the CEFs.
Symposia: The State-of-the-Art Research (STAR) Symposium: Perspectives on Musculoskeletal Disorder Causation and Control

Summary: The Institute organized and presented a forum in which 24 individuals from the U.S., Canada, and Europe, who were experts in medicine, engineering, biomechanics, and epidemiology, discussed recent research and future trends related to reducing the incidence of musculoskeletal disorders.

These experts were:

- William S. Marras, PhD, The Ohio State University
- Thomas R. Waters, PhD, National Institute for Occupational Safety & Health
- Don B. Chaffin, PhD, University of Michigan (Plenary Address)
- John Howard, MD, National Institute for Occ. Safety & Health (Keynote Address)
- Laura Punnell, ScD, University of Massachusetts, Lowell
- Fredric E. Gerr, MD, Rollins School of Public Health
- Marjorie Baldwin, PhD, Arizona State University
- Stuart M. McGill, PhD, University of Waterloo
- Moshe Solomonow, PhD, Louisiana State University, Health Sciences Center
- Robert G. Radwin, PhD, University of Wisconsin–Madison
- William T. Stauber, PhD, West Virginia University
- David Rempel, MD, University of California
- Ann E. Barr, PhD, Temple University
- Beth A. Winkelstein, PhD, University of Pennsylvania
- David G. Simons, MD, Author of Muscle Pain
- Partap Khalsa, PhD, State University of New York at Stony Brook
- Donald Cole, MD, Institute for Work and Health
- Charlotte Leboeuf-Yde, PhD, The Medical Research Unit in Ringkjøbing County
- Michael Feuerstein, PhD, Uniformed Services University of the Health Sciences
- Andrew S. Imada, PhD, A.S. Imada & Associates
- Richard Wells, PhD, University of Waterloo
- Barbara Silverstein, PhD, Washington State Department of Labor and Industries
- Stover Snook, PhD, Harvard University School of Public Health
- Robert Gatchel, PhD, University of Texas Southwest Medical Center at Dallas

Information from each of these 24 presentations was published in a special issue of the Journal of Electromyography and Kinesiology (Volume 14, Issue 1, pp. 1-78, February 2004).

The symposium was co-sponsored by the National Institute for Occupational Safety and Health. This two-day event was attended by approximately 130 researchers, practitioners, and students.
Technical Assistance Projects

**Project:** An Ergonomic Evaluation of the Rubber Stamp Production Area  
**Summary:** Institute members performed a one-day assessment of company’s stamp assembly area and provided oral recommendation for job improvement.  
**Company:** Deluxe Business Services (Streetsboro, OH)  
**Amount:** $795

**Project:** Identification and Prioritization of Ergonomic Risks  
**Summary:** Institute members provided a plant-wide ergonomics evaluation for each of seven facilities within this company, documented ergonomics hazards, collected quantitative data, and provided the facility with a report identifying the highest-level ergonomics risks as well as recommendations for job improvement.  
**Company:** Alcoa (for facilities in: Elyria, OH; Avenel, NJ; Rogers, MN; Manteno, IL; Hazleton, PA; Laval, Quebec, Canada; and Summerstown, Ontario, Canada)  
**Amount:** $19,964

**Project:** Evaluation of Jobs at Security Metal Products  
**Summary:** Institute personnel used the Lumbar Motion Monitor as part of an evaluation of the injury risks related to four jobs in the facility. Provided OSHA with results and recommendations for job redesign.  
**Company:** Occupational Safety and Health Administration (Oklahoma City, OK)  
**Amount:** $11,000

**Project:** An Ergonomic Evaluation of Blending and Packaging Jobs  
**Summary:** Institute personnel used the Lumbar Motion Monitor as part of an evaluation of the injury risks related to two jobs in the company. They were provided with the results and recommendations for job redesign.  
**Company:** Ametek Chemical Products Division, Westchester Plastics (Wapakoneta, OH)  
**Amount:** $4,858

**Project:** Case review of Collins vs. Union Pacific  
**Summary:** Assisted attorneys by reviewing the ergonomics considerations of a litigation case.  
**Company:** Abele & Sanderson, LLC (St. Louis, MO)  
**Amount:** $600

**Project:** An Evaluation of Postures Related to Joint Replacement Surgery  
**Summary:** An evaluation was conducted of an orthopaedic surgeon who suffered from cumulative trauma as the result of performing his job. He and his healthcare provider were provided with a report documenting ways in which he could lessen his discomfort when working.  
**Company:** UnumProvident Corporation (Worcester, MA)  
**Amount:** $464
## Technical Assistance Projects

**Project:** Identification of Ergonomic Risks and Solutions at TRC  
**Summary:** Institute members conducted an ergonomics site inspection of the company, reviewing three primary departments. These included jobs at computer workstations, laboratory testing and calibration, and physically intensive materials handling. From the dozens of jobs studied, 52 ergonomics issues were identified, and 16 of these were considered high priority. Recommendations for job improvement also were given.  
**Company:** Performance Management Consultants (Dublin, OH)  
**Amount:** $9,338

**Project:** Discovery for Coburn v. Union Pacific Railroad  
**Summary:** The Lumbar Motion Monitor was used to identify the risks associated with 16 separate tasks required of railroad. The data were analyzed and the results presented to the client.  
**Company:** Larry Lockshin, Esq. (Sacramento, CA)  
**Amount:** $5,386

**Project:** Ergonomic Analyses of Ten Welding Job Processes  
**Summary:** Ten job processes determined to have the highest number of musculoskeletal injury concerns were evaluated, using various assessment methods. Several of the processes involved Lumbar Motion Monitoring of company employees. Two of the ten processes involved more-detailed data collection and analysis; these were simulated in the Biodynamics Laboratory. Reports were developed and presented to company personnel that summarized injury risks to employees and detailed recommendations for job improvement.  
**Company:** Honda of America Manufacturing, Inc. (Marysville, OH)  
**Amount:** $40,800

## Training and Demonstrations

**Project:** Ergonomics Training  
**Summary:** Provided general ergonomics awareness training to grounds maintenance employees.  
**Company:** Columbus (OH) Recreation and Parks  
**Amount:** $1,438

**Project:** LMM Training for Amerisure in Farmington Hills, Michigan  
**Summary:** Trained company personnel on use of the industrial Lumbar Motion Monitor and its data collection and analysis software.  
**Company:** Biodynamic Solutions, Inc. (Columbus, OH)  
**Amount:** $1,284

**Project:** Ergonomics Training of Warehouse Employees, and Employee Training Using LiftTrainer  
**Summary:** Provided employees with general ergonomics awareness training and information on various techniques to evaluate and reduce low-back injury risk in their warehouse.  
**Company:** Columbus (OH) Recreation and Parks  
**Amount:** $1,700

**Project:** LMM Training for WellTech  
**Summary:** Trained company personnel on use of the industrial Lumbar Motion Monitor and its data collection and analysis software.  
**Company:** Nexgen Ergonomics (Montreal, Quebec, Canada)  
**Amount:** $350

**Project:** LMM demonstration at the Life Sciences Showcase  
**Summary:** Showcased use and applications of the Lumbar Motion Monitor at a technology forum.  
**Company:** Biodynamic Solutions, Inc. (Columbus, OH)  
**Amount:** $400

**Project:** Putting Ergonomics Into Practice - The Autumn 2003 Ergonomics Short Course  
**Summary:** Led 20 health and safety professionals from around the country through an intensive 3½ day ergonomics training course.  
**Amount:** $22,757