Institute *Insider*

The Newsletter of the Institute for Ergonomics at The Ohio State University

At the forefront of Human Factors since 1950 Volume 11, No. 1, Winter, 2008

Resilience Engineering Applied to Emergency Situations

Resilience concepts have been applied to many complex systems, as a means to adapt and grow when faced with unforeseen changes. Researchers have recently used these resilience techniques to analyze emergency response actions as well.

Gomes

Analyses of emergency responses have usually concentrated on failures that were made, as a means to improve future procedures and emergency plans. However, **JoséOrlando Gomes**, a frequent collaborator with Dr. Dave Woods, and his colleagues at the Federal University of Rio de Janeiro, Brazil, Marcelo Índio dos Reis and Marcos RS Borges, have proposed a resilience approach focusing on the analysis of *successful* actions. They used group storytelling techniques to recall actions performed by emergency teams during an incident. They proposed a method aimed at recognizing resilient actions, illustrated in a case study. This method comprised six phases:

- Characterizing the system and its possible working states;
- Collectively recounting the emergency response story;
- Constructing a time-line of events described in the emergency response story;
- Identifying possibly resilient actions;
- Analyzing identified actions; and
- Selecting and incorporating the resilient actions into the emergency plans.

Stories told by participants in the event were used, as was knowledge of specialists. This produced a comprehensive analysis of their implications in the event states. The resilience engineering approach concentrated on the actions that were considered successful, i.e. those that brought the emergency from an unstable state to a stable/less-unstable state.

These researchers believe that the collective knowledge recall supported by the group storytelling technique associated with the resilience engineering approach is very promising. They were able to recover events that are not part of the official reports and, until now, only existed in participants' minds. This method needs to be refined and more case studies carried before fully ascertaining the benefits of this approach, but Gomes and his colleagues believe the discovery of resilient actions has the potential to improve response procedures.

Details of this research can be found in **Mobile Response 2007**, edited by Jobst Löffler and Markus Klann, from the First International Workshop on Mobile Information Technology for Emergency Response in Sankt Augustin, Germany. For more information, contact José Orlando Gomes, at joseorlando@nce.ufrj.br.

Marras Publishes New Book

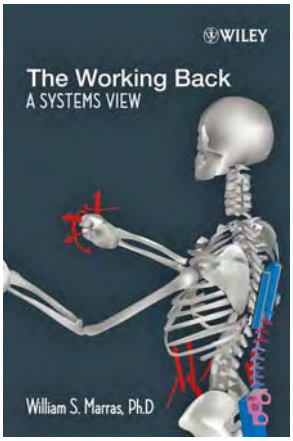
Low back pain continues to present significant problems in today's society. About 80% of the work population will experience low back pain at some point in their careers, and these ailments are responsible for over 40% of the compensation costs for work-related injuries.

Because of this, **William Marras**, an Executive Director of the Institute for Ergonomics, has recently published his multidisciplinary perspective on risk factors for low back pain. *The Working Back: A Systems View*, shows how various influences or risk factors can be considered collectively.

This unique book covers several important topics related to low back pain, including:

• Basic concepts in anatomy and physiology that are essential to understanding and preventing low back pain;

• A systems perspective on the occupational causes of back pain, not only addressing factors such as spine loading, but also considering the potential impact of psychosocial and organizational interactions, genetics, and physiology;



• The implementation of preventive engineering and administrative controls and integration of risk interventions into the workplace; and

• An expert analysis of current medical research on low back pain in one comprehensive, accessible reference.

This book also provides an understanding of the mechanisms that influence low back pain in the workplace and indicates how low back pain might be prevented, saving employers extraordinary amounts in medical costs and protecting workers from the most common on-the-job injury.

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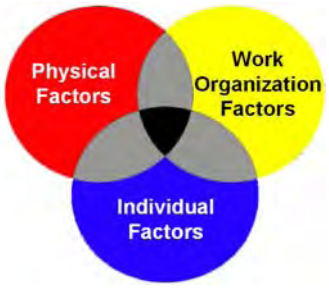
In *This* Issue . . .

Institute Announces 2008 Ergonomics Short Course Schedule

The dates for this year's ergonomics Short Course, *Putting Ergonomics Into Practice*, have been announced. It will be held at The Ohio State University's main campus, in Columbus, Ohio, twice:

Spring: May 6th - 9th, 2008
Autumn: October 7th - 10th, 2008

This unique ergonomics Course combines the fundamentals of both biomechanics *and* cognitive engineering. It provides a solid foundation for certification and practice in the ergonomics discipline. The Course also prepares participants for effectively designing and modifying work environments and products to better accommodate the capabilities and limitations of their employees.



Nationally recognized leaders in ergonomics, including Dr. William Marras and Dr. Philip Smith, will share their knowledge and experience to help you recognize and control occupational injuries and problems in your facility.

Timely, objective, and fact-based information will be presented on the principles guiding ergonomic interventions through interactive lectures, hands-on demonstrations, and the use of ergonomics assessment tools.

Topics covered include:

- How to address body size differences in the workplace (anthropometry)
- Biomechanical principles related to physical work and injury risk, and how they relate to the low back, shoulders, neck, and hands/wrists
- Using ergonomic assessment tools
- Implementing and sustaining successful ergonomics processes
- Returning injured employees to the job
- Effective computer workstation designs
- Integrating cognitive and organizational issues into the workplace

Interested in more information? Contact the Institute for Ergonomics (614-292-4565; ergonomics@osu.edu) or download a Short Course brochure from our web site: http://ergonomics.osu.edu/.

IN THE NEWS

Carolyn Sommerich was elected chair of the Education Technical Group of the Human Factors & Ergonomics Society. This TG involves the design of educational systems, environments, interfaces, and technologies with human factors education. It comprises educators, researchers, students, and others interested in educational human factors and ergonomics. The group seeks to foster a free exchange of ideas, techniques, and products among members to further the cause of educating Human Factors professionals.

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Carolyn Sommerich spoke on, "Teaching and Learning with Mobile Technology in High School: A Human Factors Perspective," for the Distinguished Lecture Series at the University of Wisconsin-Madison's Industrial & Systems Engineering Department (December 7th, 2007).

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At the 54th Annual Meeting of the Orthopaedic Research Society, **Steve Lavender** presented the poster, "Does the Use of a Back Support Belt Impair the Recovery of Spinal Kinematics in the 12 Months Following a Work-Related Low Back Disorder?" (March 2nd-5th, 2008, San Francisco, California.) His co-authors were Denise M. Oleske, Mary M. Kwasny, and Gunnar B.J. Andersson.

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"Adapting Construction Work to the Changing Labor Force" was the topic of a lecture given by **Gary Allread** at OSHA/OSU Construction Safety Day Program (January 23rd, 2008).

William Marras delivered the Geoff Kelafant Lecture, "Trade-offs in Patient Handling Risk: Pushing and Pulling" at the 8th Annual Safe Patient Handling & Movement Conference, held March 10th-14th, 2008 in Lake Buena Vista, Florida.

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On March 12th, 2008, **Steve Lavender** also lectured at the 8th Annual Safe Patient Handling & Movement Conference in Lake Buena Vista, Florida. Steve discussed, "High Risk Patient Handling Tasks for EMTs."

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Gary Allread spoke on, "Using a Wireless EMG System for Field Ergonomics Assessments" at the 11th Annual Applied Ergonomics Conference in Orlando, Florida (March 12th, 2008). His co-presenter on this subject was Penny Prince, Corporate Ergonomist with American Airlines.

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Upcoming Conferences

International Society for the Study of the Lumbar Spine
Geneva, Switzerland, May 26th – 31st, 2008
www.issls.org/annualmeetings/meetingupcoming.htm

Cognitive Science Society
Washington, DC, July 23rd – 26th, 2008
http://ccc.utexas.edu/cogsci08/

National Safety Council
Anaheim, California, September 19th – 26th, 2008
www.congress.nsc.org/nsc2008/public/Content.aspx?ID=36&SMID=36

Human Factors and Ergonomics Society
New York City, September 22nd – 26th, 2008
www.hfes.org/web/HFESMeetings/08annualmeeting.html

The Working Back, continued from page 1

Marras

This book gives readers the knowledge to assess a work environment and prescribe effective interventions. It is a hands-on reference for ergonomists, manufacturing engineers, process engineers, industrial engineers and managers, safety engineers, nurses, therapists, chiropractors, physicians, and workers with back pain. It is also an excellent resource for graduate or undergraduate students of kinesiology, physiology, ergonomics, physical therapy, nursing, industrial design, engineering, and general medicine.

Book chapters include:

- Back Pain Magnitude and Potential Risk Factors
- Function, Structure, and Support of the Back
- The Process of Pain
- Potential Pathways to Back Pain
- The Assessment of Biomechanical Forces Acting on the Low Back
- The Influence of Physical Work Factors on Muscle Activities and Spine Loads
- Psychosocial and Organizational Factor Influence on Spine Loading
- Individual Factors Role in Spine Loading
- Physical, Individual, and Psychosocial/Organizational Risk Factor Interactions
- Engineering Controls to Mediate Back Pain at Work: Tools for the Assessment of Physical Factor Impact on Spine Loads and Intervention Effectiveness
- Administrative Controls for the Workplace: Psychosocial and Organizational Interventions
- Integrating Risk Interventions into the Workplace
- Understanding Recurrent Low Back Pain and Implications for Return to Work

Ordering Information

The Working Back: A Systems View, 2008
by William S. Marras, PhD
ISBN: 978-0-470-13405-4 • 320 pages • US $94.95
Phone: 800-225-5945
E-mail: custserv@wiley.com
Web: www.catalog.wiley.com

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Holiday Festivities

The Institute's annual Holiday Gathering was held December 7th, 2007. About 70 Institute colleagues and their guests attended the private event at the Due Amici restaurant in downtown Columbus.

Here are some of the candid photos taken at the event.

Graduate student Dawn Chandler and Professor Steve Lavender

Graduate students Michael Smith (l.) and Alicia Borgman (r.) with guest Adriana Ley

Senior Research Engineer Sue Ferguson and Professor Eric Schaub

Selected Spring Quarter 2008 Courses

Resilience Engineering

Course Number: ISE 694R (No prerequisites)
Time: Wednesdays and Fridays, 10:30 -12:00
Instructors: Joseph Fiksel and David Woods

This course will provide graduate students and advanced undergraduates with a practical introduction to the concept of "resilience" and its application to both technological and human systems. Resilience engineering involves the design and management of complex systems to achieve safety, continuity, and environmental sustainability.

Resilience is defined as the capacity for systems to survive, adapt, and grow in the face of turbulent change. Resilience engineering reduces the vulnerability of a system to disruptions and improves its adaptability to changing conditions. This course covers models of adaptive capacity in the face of different types of disruptions, ranging from technological failures to climate change. These concepts will be applied in many contexts including supply chain management, space missions, risk management, health care, and sustainable product design.

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Accessibility, Visitability and Universal Design

Course Number: C&R Plan 871.08 ()
Time: Tuesdays, 6:30 - 8:18
Instructor: L. Scott Lissner

This course will review the current standards for accessible design and trends towards Visitability and Universal Design in the built environment. Areas covered will include policy at the local, state, and federal level; residential and urban planning, site development and landscape design issues, and building design issues. Discussions will emphasize environmental influences on individual behavior and social interactions.

Class projects will be utilized to update Access for All: an Illustrated Handbook of Barrier Free Design for Ohio developed and distributed by the Ohio Governor's Council on People with Disabilities as a best practices guide for full range of professionals responsible for building physical environment and a resource for those interested in the full integration of people with disabilities.

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Systems Thinking

Course Number: ISE 694W (No prerequisites)
Time: Thursdays, 12:30 - 3:00
Instructor: David Woods

Introduction to concepts and heuristics in systems thinking and how to apply them to manage complex projects in aerospace, health care, energy, security and other fields. Class provides a comprehensive set of system engineering concepts, including systems of systems approaches, and how these are used to design, model, manage and evaluate complexity in development projects, software intensive systems, distributed work systems, adaptive control, management of large scale enterprises.

Class covers a sequence of approaches to systems to introduce core concepts: control systems, adaptive systems, human systems, cognitive systems, distributed systems, self-organizing systems, co-evolving systems, complex systems, and systems of systems. Each of these perspectives will be examined in the context of Beinhocker's analysis of systems and complexity.

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Technology, Efficiency, and Happiness

Course Number: Psych 695.04
Time: Tuesdays, 4:00 - 5:48
Instructor: Richard Jagacinski

This course will examine various ways of evaluating new technologies (e.g., cell phones, SUV's, the Internet, sports equipment). Many new consumer products seem like they might improve our lives through increased efficiency and convenience in performing specific tasks. However, technology often has hidden costs such as unexpected effects on social behavior and cultural values, unexpected health consequences, increases in behavioral complexity, surprising patterns of errors in task performance, greater financial expense, and negative environmental impact. It is therefore difficult to predict whether new technology will make us happy, increase creativity, or generally improve our quality of life.

This course will consider how one can measure and/or predict the consequences of new technology so that both designers and consumers can make better choices.

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Graduate Student News

New Students

Laura Czuba

(czuba.5@osu.edu)

Advisor: Dr. Carolyn Sommerich

Hometown: Elizabeth City, NC; Latrobe, PA

Laura recently graduated from East Carolina University (located in Greenville, NC) and is now working on a Masters degree here at Ohio State University. Her study interests include ergonomics and lean manufacturing. She enjoys designing products for people having different capabilities, to ease their work and life.

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Peter Le

(le.105@osu.edu)

Advisor: Dr. William S. Marras

Hometown: Westminster, CO

Peter's research interests lie in spine biomechanics/ neuromuscular disorders, particularly in the area of low back disorders. He enjoys running, soccer, various outdoor activities (hiking, skiing, etc.), reading, music, and exploring art and science museums. He is also a big fan of the ongoing mysteries of science and medical research and hopes to eventually make a strong contribution to this field.

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Congratulations to **Sahika Vatan Korkmaz**, who successfully defended her doctoral dissertation in December, 2007! She will graduate in March, 2008. Her committee consisted of advisor Dr. Carolyn Sommerich and other Industrial Engineering professors, Dr. Steve Lavender and Dr. Phil Smith.

Sahika's dissertation was titled, *Application of Participatory Ergonomics Principles into an Educational Environment: Improving a High School Information Technology Program via Interventions*. An abstract of this research follows.

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Application of Participatory Ergonomics Principles into an Educational Environment: Improving a High School Information Technology Program Via Interventions

Sahika Vatan Korkmaz

Dissertation Abstract

The promise and potential of information and communication technologies to improve education in educational environments is offset by potential for problems that can stem from an unhealthy information ecology and/or lack of knowledge about healthy computing. Educational ergonomics is defined as that field of human factors and ergonomics science concerned with the interaction of educational performance and educational design. Opportunities abound for ergonomics expertise to be applied in these educational settings to improve the technology programs for all stakeholders, but especially for primary stakeholders: students and teachers.

The long-term goals of this line of research were to improve teachers' effectiveness with technology and incorporating it into their curriculum and to improve the health of students by introducing concepts of healthy computing (computer ergonomics) to them. These goals were addressed in this research through a participatory approach that employed an action research model. Specific aims included 1) establishing small groups of teachers to meet weekly to engage in collaborative exploration of the use of technology in their classrooms and assessing progress of their learning; and 2) establishing a small group of students to learn, in a participatory fashion, about healthy computing and develop instructional and informational materials for other students.

Teachers' team and self-evaluation surveys and interviews indicated that a majority of Participatory Ergonomics and Technology (PET) team members were satisfied with their participation and the quality of the teams and the study. PET team members indicated this study either met or exceeded their expectations that they had before participating to this study. Almost all teachers indicated that they would participate in the following years and encouraged other teachers to participate. PET team member teachers' perception about their own computer proficiency and their belief

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PUBLISH or perish

Recent publications written by Institute members (indicated in **boldface** font) include:

A Comparison of Fatigue Failure Responses of Old Versus Middle-Aged Lumbar Motion Segments in Simulated Flexed Lifting

S Gallagher, **William S Marras**, AS Litsky, D Burr, J Landoll, and V Matkovic, 2007, *Spine*, 32(17): 1832–1839.

Spine An international journal for the study of the spine

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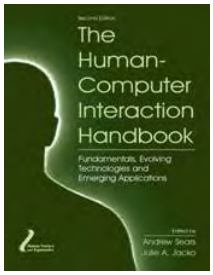
Human-Centered Design of Decision Support Systems



Philip J Smith and N Geddes, 2007, in *The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications*, 2nd Edition, Lawrence Erlbaum Associates.

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Identification of Key Variables using Fuzzy Average with Fuzzy Cluster Distribution

Y Hou, JM Zurada, W Karwowski, **William S Marras**, and K Davis, 2007, *IEEE Transactions on Fuzzy Systems*, 15(4):673-685.

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Low Back Pain and the Workplace

A Garg, F Gerr, JN Katz, **William S Marras**, and B. Silverstein, 2007, letter to the editor of the *Journal of the American Medical Association*, 298(4):403-404.

JAMA®

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Low Back Pain Recurrence in Occupational Environments

William S Marras, **Sue A Ferguson**, D Burr, **Pete Schabo**, and A Maronitis, 2007, *Spine*, 32(21):2387–2397.

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Modification of an EMG-assisted Biomechanical Model for Pushing and Pulling

EW Theado, **Greg G Knapik**, and **William S Marras**, 2007, *International Journal of Industrial Ergonomics*, 37:825–831.

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Strategies for Designing Distributed Systems: Case Studies in the Design of an Air Traffic Management System

Philip J Smith, **Amy L Spencer**,and **Charles E Billings**, 2007, *Cognition, Technology and Work*, 9(1):39–49.

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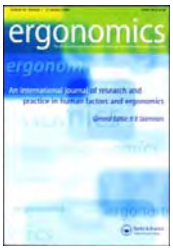

A Survey of High School Students with Ubiquitous Access to Tablet PCs

Carolyn M Sommerich, R Ward, K Sikdar, J Payne, and L Herman, 2007, *Ergonomics*, 50(5):706-727.

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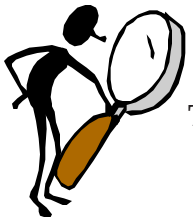
Biodynamics Laboratory Reprints

Looking for a biomechanics article published by Dr. William Marras and his colleagues? Check out the publications link of the Biodynamics Lab web site, http://biodynamics.osu.edu/publications.html, for reprints.



Research Corner

This issue of the Bulletin summarizes recently published research

Strategies for Designing Distributed Systems: Case Studies in the Design of an Air Traffic Management System

Philip J Smith, **Amy L Spencer**,and **Charles E Billings**, 2007, *Cognition, Technology and Work*, 9(1):39–49.

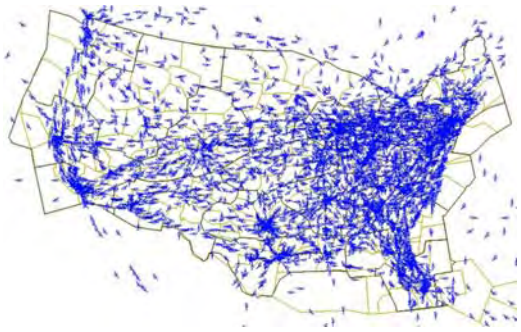
Abstract

The air traffic management system in the USA is an example of a distributed problem-solving system. It has elements of both cooperative and competitive problem-solving. It includes complex organizations such as Flight Operations Centers, the FAA Air Traffic Control Systems Command Center (ATCSCC), and traffic management units at en route centers that focus on daily strategic planning, as well as individuals concerned more with immediate tactical decisions (such as air traffic controllers and pilots).

The design of this system has evolved over time to rely heavily on the distribution of tasks and control authority in order to keep cognitive complexity manageable for any one individual operator, and to provide redundancy (both human and technological) to serve as a safety net to catch the slips or mistakes that any one person or entity might make.

Within this distributed architecture, a number of different conceptual approaches have been applied to deal with cognitive complexity and to provide redundancy. These approaches can be characterized in terms of the strategy for distributing: (1) control or responsibility, (2) knowledge or expertise, (3) access to data, (4) processing capacity, and (5) goals and priorities.

This paper provides an abstract characterization of these alternative strategies for distributing work in terms of these five dimensions and illustrates and evaluates their effectiveness in terms of concrete realizations found within the National Airspace System.



Participatory Ergonomics, continued from page 6

about the usefulness of IT statistically increased from pre- to post-intervention based on scales developed for this research and scales developed by other researchers. Follow up with participants the year following the study showed some were disseminating knowledge gained as a participant to other teachers. Based on qualitative and quantitative evaluations, it is possible to conclude that this approach is a viable method that may have short and long term positive effects on supporting teacher collegiality and improving teachers' use of IT.

Further, results of the comparison of scores for pre- and post-intervention surveys that tested students' ability to recognize problematic computer use conditions and make appropriate recommendations for change showed an increase, for the student PET team and the group of students they trained. The control group whose students were only exposed to the information provided by a brochure showed no such increase in knowledge. Student PET team members were satisfied with the quality of this study, quality of the training materials they created, and they felt it was worth the time and effort they invested in this study.

Limitations of this research and future directions, which may be based on this research, are also discussed. One major general limitation about the methodologies used in the study, participatory ergonomics process and action research, should be acknowledged here. Participatory Ergonomics, along withAction Research, is limited in the ability of having an impact on the bigger picture unless the participants are truly empowered. Unless the participants are empowered, they may not be able to make any changes or evaluate the changes that are being made by other parties. If the participants do not have the ability to be part of the change, then the whole idea behind action research falls apart. In this sense, in order to be able to apply participatory ergonomics to an environment along with action research methodologies, the organization in that environment should be open to the potential changes that will be made by the empowered participants.

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