

Occupational Safety and Health Training Project

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Final Progress Report

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List of Abbreviations

EHS	Environmental Health Sciences
IIE	Institute of Industrial Engineers
MS	Master of Science
OSU	Ohio State University
ISE	Industrial and Systems Engineering (program)
MPH	Master of Public Health
ASB	American Society of Biomechanics
OSUMC	Ohio State University Medical Center
MICU	Medical Intensive Care Unit
CPE	Certified Professional Ergonomist
CSP	Certified Safety Professional
PE	Professional Engineer
CIH	Certified Industrial Hygienist

Abstract

Our Occupational Safety and Health Training program is designed to satisfy the Master of Science degree program requirements of the Graduate Program of Ohio State University's Integrated Systems Engineering Department, while meeting the needs of engineers and others who wish to work, do research, or pursue further education in occupational safety and ergonomics. The program includes required courses in occupational biomechanics, cognitive engineering, occupational health, industrial accident prevention and control, human error and systems failure, statistics and experimental design, a research practicum, an applied practicum in safety &/or ergonomics, and choice in electives, including epidemiology, safety in construction and civil engineering, risk assessment, and reliability.

The specific MS program supported through the training grant funds began in 2006, and has been operating for 5 years. The program supported by this training grant has graduated six students, with two more poised to graduate in 2012. One new student joined this fall (2011). The program has an excellent track record with respect to attracting people from groups that are traditionally underrepresented in occupational safety, that is women and individuals from ethnic minorities. The program has a good track record of placement of graduates. For example, one is working for the Navy in a civil service position, as a Human Systems Engineer; another is working for a home health care agency where she was hired based on the innovative work she did for them while performing her safety practicum which was focused on identifying new interventions that could reduce the exposure of the home health aids to patient handling activities that involved heavy-to-obese patients. Still another student is continuing on in our graduate program, pursuing a PhD.

The program's impact on workers comes not only through the work of our graduates, but directly through the safety practicum that each student performs, and indirectly or longer term through the students' thesis research or culminating project. Safety practicums undertaken by our students have included an assignment with the ergonomics and safety group at Honda of America Manufacturing in Marysville OH, the aforementioned project to reduce patient handling-related loads and injuries that occur to home health aids (Interim Health Care), a project that examined the patient handling activities in a medical ICU and involved the staff in prioritizing intervention acquisition (OSU Medical Center), involvement in one area of an R01 research project in which the student developed a prototype to reduce the duration of transducer manipulation and holding while obtaining an ultrasound exam (R01OH009253), and a project to examine patterns in the injury and illness records of members of the Ohio Farmers Union, to serve as a starting point for identifying interventions to reduce or prevent those injuries (Ohio Bureau of Workers Compensation).

The NIOSH Training Project Grant has allowed us to expand the number of students we have been able to train over the last 5 years, to expand our programmatic offering beyond human factors and ergonomics, and to create a well-rounded, well-conceived program in safety and ergonomics that exposes students to faculty from several different departments and colleges at OSU, as well as numerous expert practitioners in and outside of the Central Ohio area. It has also afforded us the means to support the students' annual attendance at a professional conference (for example, the Annual Meeting of the Human Factors and Ergonomics Society).

The program and the students are building a track record of research publications, including works presented at the IIE Research Conference in 2009, the ASB Annual Meeting in 2010, and the Human Factors and Ergonomics Society Meeting in 2010 and 2011. Two manuscripts have been accepted for publication in peer-reviewed journals (both are in press), and another is under review.

Highlights/Significant Results

We have graduated six students, and four are currently enrolled in the program. The program has an excellent track record with respect to attracting people from groups that are traditionally underrepresented in occupational safety, that is women and individuals from ethnic minorities. The program has a good track record of placement of graduates. For example, one is working for the Navy in a civil service position, as a Human Systems Engineer; another is working for a home health care agency where she was hired based on the innovative work she did for them while performing her safety practicum which was focused on identifying new interventions that could reduce the exposure of the home health aids to patient handling activities that involved heavy-to-obese patients. Still another student is continuing on in our graduate program, pursuing a PhD.

The program has had a direct effect on our curriculum. In particular, the Accident Prevention course was been substantially revised in part because of the involvement of Advisory Board members and other professionals who participate through guest lectures or through advice provide to the program director regarding content. The safety practicum is a new course that did not exist prior to the program. It provides students with real work experience and opportunity to apply their new knowledge in safety and ergonomics, an expanded professional network, and enhances their skill set and portfolio.

The program has strengthened our ties to the Environmental Health Sciences program in OSU's School of Public Health, through required and elective courses that are part of our training program. We are developing a dual master's program with that program, through which a student will graduate with an MS in ISE and an MPH in EHS.

The program has also expanded and strengthened our ties with local professionals, who provide the students with internships, safety practicum experiences, facility tours, and generally share their safety expertise with the students. Companies engaged in these efforts include Battelle Labs, Honda of America Manufacturing, Interim Health Care, Abrasive Technologies, and the Ohio Bureau of Workers Compensation. This involvement demonstrates the need for safety professionals in the region.

The program has also had some synergy with certain lines of research in which the faculty are engaged. Dr. Sommerich, the program director, has been involved with research related to torque tool use in automobile manufacturing for several years, and different aspects of that line of research have been enhanced by and have involved training grant students. Another example of synergy between a line of research and the program occurred while one of the students was studying home health aids and Drs. Sommerich and Lavender were at the same time conducting a study investigating unpaid care; each project benefited from the knowledge that was acquired through the other. The R01 imaging technologist project (R01OH009253) has benefited greatly from the involvement of another one of the students. That student was not funded through the training grant, but the curriculum associated with the training grant is what attracted him to OSU. If the ISE program with a learning emphasis in Occupational Safety and Ergonomics had not existed when he was researching graduate programs, he might not have considered applying to OSU and that would have been our loss. That student was awarded the 2011 Dieter W. Jahns Student Practitioner Award for his master's thesis work at the recently held 55th Annual Meeting of the Human Factors and Ergonomics Society (Radin Umar *et al.* 2011).

Outcomes/Relevance/Impact

As described above, the primary outcomes of the program are the students who have or are currently participating in the program, the impact the students have had in their internships and safety practicum experiences, as well as the impact the graduates are having in their current employment. The program has also had an impact on our curriculum, making it stronger and more useful for students, partly through the networking opportunities it affords the students, and partly through the real world experience the students gain first hand in their practicum or internship or second hand through the interaction with local and national safety professionals who guest lecture in our accident prevention and control course or participate as a member of our Advisory Board. The importance of expanded ties with OSU's EHS program also should not be underestimated. Additionally, publications from research in which the students are engaged will begin to bring more attention to the program.

Technical Report

Accomplishments

The specific MS program supported through the training grant funds began in 2006, and has been operating for 5 years. The program supported by this training grant has graduated six students, with two more poised to graduate this academic year. The program got off to a delayed start at the beginning of the project because the notification of the award came well after students starting graduate school in the fall of 2006 had made their plans and choices for graduate school. However, since then, we have been steadily building momentum, and have had a full complement of students, some funded through the training grant and some through other means who have or are pursuing the program's curriculum. That curriculum offers a balance of safety- and ergonomics-related courses, research training and experiences, and a practicum experience, amongst other learning opportunities. Information about the faculty who support this program is provided in the Appendix.

The program and the students are building a track record of research publications, including works presented at the IIE Research Conference in 2009, the ASB Annual Meeting in 2010, and the Human Factors and Ergonomics Society Meeting in 2010. Two manuscripts have been submitted to peer-reviewed journals, and another is being prepared.

Amongst other learning opportunities that students gain from are seminars and lectures provided by guest speakers. A list of researchers and safety professionals that have addressed the students is provided just below:

- Stephanie Helgerman, MS, CSP, Battelle Science and Technology International
- Ralph Oliveti, CSP, Safex
- Michael R. Ely, CSP, Ohio Bureau of Workers Compensation
- Kirk Brunner, Honda of America Mfg., Inc.
- Don Bentley, PE, CIH, Ohio Bureau of Workers Compensation
- Dianne Grote-Adams, MS, CSP, CIH, Safex
- Darrell R. Wallace, Ph.D., Youngstown State University
- Dan Feeney, Ohio Bureau of Workers Compensation
- Marion Lewis, Honda of America Mfg., Inc.
- Robert A. Minor, JD, Vorys, Sater, Seymour and Pease LLP
- James Scholl, CIH, Ohio Bureau of Workers Compensation
- Michael Gregory, CSP, Director of Safety, The Ohio State University Medical Center

- Steve Wurzelbacher, Ph.D., CPE, National Institute for Occupational Safety and Health
- Dr. Rob Radwin, University of Wisconsin-Madison
- Dr. Mark Redfern, University of Pittsburgh
- Prof. Robin Murphy, Texas A&M University
- Dr. Pascale Carayon, University of Wisconsin-Madison
- Dr. Tim Butterfield, during his post-doc at OSU
- Dr. Emily Patterson, The Ohio State University
- Dr. Richard Hughes, University of Michigan
- Chris Hamrick, MS, CPE, ESIS
- Dr. Liz Sanders, The Ohio State University
- Dr. Barrett Caldwell, Purdue University
- Reade Harpham and Dave Wourms, Battelle Memorial Institute
- Dr. Gary Allread, OSU Institute for Ergonomics
- Dr. Nadine Sarter, University of Michigan

Students

Students supported with training grant funds. A narrative description of the students' experiences is provided in this section of the report.

Dawn Chandler (graduated; Advisor – Sommerich, Committee Member - Lavender)
Dawn was involved in research through the research practicum course. That work was presented at the IIE Research Conference in 2009 (Sommerich *et al.* 2009). For her master's project, Dawn chose to investigate patient handling challenges experienced by nursing staff in the MICU at the OSU Medical Center. The project title and abstract are provided just below:

Title: Ergonomics in the Medical Intensive Care Unit of The Ohio State University Medical Center

Abstract: The primary objective of this project was to identify, through structured, planned observation, the ergonomic risks registered nurses (RNs) and patient care associates (PCAs) are exposed to in the Medical Intensive Care Unit (MICU) of the Ohio State University Medical Center, particularly concerning care for obese patients. The scope involved detailed observation of patient handling activities in the MICU, extensive investigation of patient handling solutions, and developing a method for the RNs and PCAs to use to prioritize their perceived risk when performing patient handling tasks involving obese patients. The RNs and PCAs reviewed the equipment- and device-based solutions to select possible options for implementation with the goal of reducing the injury risk associated with patient handling. Options were considered separately for two scenarios: 1) the remaining time in the current MICU, and 2) future planning for the new MICU tower.

Results of the project were presented and provided to Michael Gregory, CSP, the Director of Safety of the OSUMC.

Prior to conducting this project, Dawn participated in a safety practicum in the form of a summer internship with Honda of America Manufacturing. Upon graduation, Dawn was offered a position at Honda. However she chose to accept a position as a human factors engineer in the Human Systems Integration Branch of the Naval Sea Systems Command, Naval Surface Warfare Center, Dahlgren Division. In her job, she is concerned with the safety of shipboard systems with which service personnel interact. While working there she has been taking courses through the Navel

Postgraduate School in pursuit of certification in Human Systems Integration. Her group encourages active participation in professional societies.

Olivia Hernandez (graduated; Advisor – Sommerich, Committee Member - Woods)
Olivia was involved in research through her master's thesis. She chose a topic that was concerned with performance safety. The project title and abstract are provided just below:

Title: The Next Generation of Medication Dispensing Devices

Abstract: Medication self-management is a complex and challenging issue. There have been many different methods and mechanisms created to assist individuals who manage their own medications. Pill boxes, new icons for medication labels, automated pill dispensers, and even phone calls reminding patients to take their prescriptions have all fallen short in the quest to help people appropriately self-medicate. This study looks at how the addition of tele-presence to a dynamic automated medication dispensing device can benefit individuals, and help them to better administer their medications. Through the tele-presence, patients can easily be connected to a variety of caregivers, including family members and the patients' doctors. The main goals for this device are to allow patients to remain independent longer, to enhance understanding of the medications the patient is taking, to keep caregivers informed of the patient's current status, to allow improved continuity of care, to better respond to the dynamic nature of health, to improve quality of life, and to provide peace of mind for not only the patients but also for their caregivers.

A revised manuscript from this thesis is being prepared for resubmission to a peer-reviewed journal, having received favorable and addressable comments in the first round of reviews (Hernandez *et al.* in press).

Olivia was offered a position with the Army's ECBE Safety and Health Office (ECBE is a research, development, and engineering facility within the Army that addresses chemical and biological defense issues). For personal reasons, Olivia chose to remain in Columbus. She currently works for JPMorgan-Chase and is participating in their information Technology Analyst Development Program, wherein she employs her training in cognitive engineering.

Laura Czuba (graduated; Advisor – Sommerich, Committee Member - Lavender)
Laura was involved in research through her master's project. She chose a topic that had personal relevance to her and which is quite timely – occupational risk factors encountered by home health aides. The project title and abstract are provided just below:

Title: Ergonomic and Safety Risk Factors in Home Health Aides: Assessment and Intervention

Abstract: The home healthcare industry is one of the fastest growing segments of businesses in the United States. Unfortunately, injury rates of home health aides are similar to those of nurses. While hospitals and nursing homes are increasingly incorporating patient handling equipment to reduce staff exposure to risk factors for musculoskeletal injuries, the home healthcare industry presents a unique risk profile because of the uncontrollable environment of the patient's home. The goals of this project were to (1) improve understanding of risk factors that may lead to injury and increased turnover in home health aides, with an intention towards discovering unexplored opportunities for intervention, and (2) test those intervention ideas for potential effects, feasibility, and acceptance by home health aides and employers. A method for categorizing patients based on transfer, bathing, and mobility assistance requirements was developed and explored. The percentage of time that aides

worked with patients in higher needs categories was found to be related to fatigue and pain at the end of the day. A schedule that limits assignments of higher needs patients may be a feasible measure that home health care companies can employ to control the exposure of their employees to risk factors for musculoskeletal injuries.

A manuscript has been submitted to a special issue of *Work* on the topic of health care providers (Czuba *et al.* accepted for publication).

Laura Czuba now works for Interim Healthcare; she was hired by the company to implement the workload distribution system she developed through her safety practicum project conducted while she held an internship with the company.

Rafael Farfan (graduated; Advisor – Sommerich, Committee Member - Lavender) Rafael was involved in research through the research practicum and through his safety practicum. A report was provided to the sponsor of the project and a manuscript is being prepared for submission to a peer-reviewed journal (Sommerich *et al.* submitted for review). For his safety practicum Rafael chose to investigate injuries that occur in a specific group of agricultural workers in Ohio (members of the Ohio Farmers Union). The project is described below:

The objective of the project is to identify leading causes of injury within the Ohio Farmers Union (OFU), an organization that represents family farmers, as a starting point for identifying interventions to reduce or prevent those injuries, and to compare numbers and rates of injuries in members of the Ohio Farmers Union to the rest of agriculture in Ohio. This project is being conducted with support from the Ohio Bureau of Workers Compensation.

Rafael obtained an internship with the Ohio BWC in the summer of 2010. His safety practicum project was an extension of the work he performed during his internship. A final report was delivered to the Ohio BWC, which contained both data analysis and recommendations for interventions to reduce exposure to injury-related risk factors.

Bryan Hennessey, Emma Alder, and Gelter Vergeldedios began the program in fall 2010. They were/are supported by funds from the training grant. They all completed the CITI (human subjects) training. Though not specifically related to research, Bryan and Gelter teamed up with one of Dr. Marras' MS students to participate in a national annual design competition sponsored by Auburn Engineers, in which they tied for third place. The Ergonomics Student Design Competition provides an opportunity for undergraduate and/or graduate level student teams to assess, design, and present their solutions to a challenging problem in ergonomics. Nicholas Boyd joined the program in Winter 2011. He was supported for two quarters, but has opted for a teaching assistantship for the current academic year. He continues to follow the program's curriculum. Nick has contributed to the program by facilitating a meeting with one of the principals of the engineering design firm where he is co-oping this quarter. That meeting, in turn, paved the way for a visit and tour for the students in Winter 2011, during which they had the opportunity to discuss the effects of design on the safety of users, both at work and in the home (Crown, the maker of fork lift trucks, and Midmark, a maker of patient examination tables, are two of the client companies of the design firm). Bryan and Emma had valuable internship/safety practicum experiences this summer (2011) with Abrasive Technologies (Delaware OH) and Battelle Memorial Labs (Columbus), respectively. This is a direct quote from the chief compliance officer at Abrasive Technologies, regarding the internship experience from their perspective:

"...our senior leadership as well as myself are extremely pleased with Bryan and our OSU intern experience. They have requested to attend Bryan's presentation to show support... We would like to continue our successful efforts with collaboration with OSU.

Our newest addition is Kailyn Cage. She is our first student with a learning disability; OSU offers a high level of support to students with disabilities through the Office of Disability Services, and it offers a support network through the STEM Ability program. Kailyn designed her own program of undergraduate engineering study at the University of Maryland, where she was also a two sport varsity athlete and an entrepreneur.

Students not supported through Training Grant funds. Rajiv Gumpina and Radin Zaid Radin Umar are two students who were not supported directly with funds from the training grant, but who also undertook the occupational safety and ergonomics learning emphasis in their MS programs, so are categorized as "trainees". Rajiv participated as a member of a team of OSU students in providing Detroit Diesel Remanufacturing East (DDRE), a Daimler Company, with information they needed to understand the impact on worker performance (e.g. safety, quality, and productivity) of upgrading existing mercury vapor lamps to energy-efficient, T5 florescent lamps in their facility. Rajiv was supported as a GRA and worked on an industry-funded research project focused on right angle torque tools (Ay *et al.* 2010a, b). Rajiv also participated in the research practicum experience with Dawn Chandler (Sommerich *et al.* 2009). After graduation, Rajiv was interested in pursuing a PhD. He is currently working and looking for a funded research position in order to continue his studies. His current job involves extensive use of the statistical training that he availed himself of during his MS program. Radin has played a role in research projects concerning material handling in warehouse operations (Lavender *et al.* 2010), students' use of computers, and development of interventions for imaging technologists (NIOSH R01-OH009253). Radin's master's thesis, concerned the development of one of the imaging technologist project intervention concepts to working prototype stage. Radin is continuing on at OSU for his PhD.

The faculty in the ISE department who participate in the training grant program have also advised and graduated MS students, during the project period, who took many of the same courses as (and with) the training grant-supported students. Four of those MS students focused more on physical ergonomics and ten focused more on cognitive engineering. Each of the faculty members advise PhD students, as well, some of whom have continued on from the MS program in ISE. Training grant-supported students benefit from interacting in courses as well as outside of courses with graduate students at both the MS and PhD levels and those pursuing various options and variations of HF/E/safety graduate plans of study within the department.

Effects of the Program

The program has had a direct effect on the curriculum. In particular, the Accident Prevention course was been substantially revised in part because of the involvement of Advisory Board members and other professionals who participate through guest lectures or through advice provide to the program director regarding content. The safety practicum is a new course that did not exist prior to the program. The program has strengthened our ties to the Environmental Health Sciences program in the School of Public Health, through required and elective courses that are part of our training program. The program has also expanded and strengthened our ties with local professionals, who provide the students with internships, safety practicum experiences, facility tours, and generally share their safety expertise with the students. The program has also had some synergy with certain lines of research in which the faculty are engaged. Dr. Sommerich has been involved with research

related to torque tools for several years, and different aspects of that line of research have been enhanced by and have involved training grant students. Another example of synergy between a line of research and the program occurred while Laura Czuba was studying home health aids and Drs. Sommerich and Lavender were at the same time conducting a study investigating unpaid care; each project benefited from the knowledge that was acquired through the other. The R01 imaging technologist project has benefited greatly from the involvement of Radin Zaid Radin Umar in the project. While he is not supported by the training grant, the curriculum associated with the training grant is what attracted him to OSU. If the ISE program with a learning emphasis in Occupational Safety and Ergonomics had not existed when he was researching graduate programs, he might not have considered applying to OSU and that would have been our loss.

Publications¹

- AY, H., SOMMERICH, C., LUSCHER, A. and **GUMPINA, R.**, 2010a, Assessment of arm dynamics in experienced workers while operating right-angle torque tools. *Proceedings of 2010 Annual American Society of Biomechanics (ASB) Meeting*, Providence, RI.
- AY, H., SOMMERICH, C., LUSCHER, A. and **GUMPINA, R.**, 2010b, Biodynamic modeling and physical capacity assessment of human arm response in experienced torque tool operators. *Proceedings of 2010 Annual American Society of Biomechanics (ASB) Meeting*, Providence, RI.
- CZUBA, L.R.**, SOMMERICH, C.M. and LAVENDER, S.A., accepted for publication, Ergonomic and Safety Risk Factors in Home Health Care: Assessment and exploration of alternative interventions. *Work*.
- HERNANDEZ, O.K.**, SOMMERICH, C.M. and WOODS, D.D., in press, The Potential for Tele-Presence to Assist and Aid with Medication Self-Management. *Ergonomics in Design*.
- LAVENDER, S., SOMMERICH, C., JOHNSON, M. and **RADIN UMAR, R.Z.**, 2010, Developing Ergonomic Interventions to Reduce Musculoskeletal Disorders in Grocery Distribution Centers. *Proceedings of 54th Annual Meeting of the Human Factors and Ergonomics Society*, San Francisco: The Human Factors and Ergonomics Society.
- RADIN UMAR, R.Z.**, SOMMERICH, C.M., EVANS, K., LAVENDER, S., SANDERS, E.B.-N., YEN, W.-T., JOINES, S.B. and LAMAR, S., 2011, Ergonomic interventional design of an articulating arm for echocardiography application: front-end design and pilot study. *Proceedings of 55th Annual Meeting of the Human Factors and Ergonomics Society*, Las Vegas: The Human Factors and Ergonomics Society, 980-983.
- SOMMERICH, C.M., **GUMPINA, R.**, ROLL, S.C., LE, P. and **CHANDLER, D.F.**, 2009, Investigating effects of controller algorithm on torque tool operators. *Proceedings of 2009 Industrial Engineering Research Conference*, Miami: Institute for Industrial Engineering.
- SOMMERICH, C.M., LAVENDER, S., **RADIN UMAR, R.Z.**, LE, P., MEHTA, J., KO, P.-L., **FARFAN, R.**, DUTT, M. and PARK, S., submitted for review, A biomechanical and subjective assessment and comparison of three ambulance cot design configurations.

¹ Names of students supported by funds from the training grant are in bold; names of students who followed the program curriculum but were not funded through the training grant are highlighted.

Appendix - Program Faculty

Primary Program Faculty

Carolyn M. Sommerich, PhD serves as the program director. She is an associate professor in the ISE Department. She also has graduate faculty status in the Department of Mechanical Engineering and the School of Allied Medical Professions. Her research focuses on ergonomics, biomechanics, and safety in office, manufacturing, warehouse, healthcare, home, and educational settings. She also conducts basic research into the etiology of distal upper extremity musculoskeletal disorders. She teaches ISE 660 Principles of Occupational Biomechanics and Industrial Ergonomics, ISE 868.02 Advanced Topics in...Upper Extremity Biomechanics, ISE 869.02 Biomechanics Research Practicum...Upper Extremity Biomechanics, ISE 761.02 Practice Oriented Ergonomics...Upper extremity, and ISE 664 Industrial Accident Prevention and Control.

William S. Marras, PhD is one of the primary members of the program faculty. He is a full professor in the ISE Department. He has joint faculty appointments in OSU's Department of Physical Medicine, Department of Biomedical Engineering, and Department of Orthopaedic Surgery. He is the Director of the Biodynamics Laboratory, Director of the Center for Occupational Health in Automotive Manufacturing (COHAM), and the co-Director of OSU's Institute for Ergonomics. He has no training program administrative duties, other than keeping relevant records for his courses and student-trainees. He participates fully in the program in terms of interacting with students through teaching courses, advising students, chairing student committees, and involving students in his active research program which focuses on back injury, spine biomechanics, and manual materials handling. He and Dr. Sommerich alternate teaching ISE 660; he teaches ISE 868.01 Advanced Topics in...Spine Biomechanics, and ISE 869.01 Biomechanics Research Practicum...Spine Biomechanics.

Steven A. Lavender, PhD another primary member of the program faculty. He is an associate professor at OSU with appointments in ISE and the Department of Orthopaedic Surgery. He has no training program administrative duties, other than keeping relevant records for his courses and student-trainees. He participates fully in the program in terms of interacting with students through teaching courses, advising students, chairing student committees, and involving students in his active research program which focuses on back injury etiology, prevention, and recovery, spine biomechanics, and manual materials handling intervention research. He teaches ISE 761.01 Practice Oriented Ergonomics...Spine biomechanics and ISE 665 Analysis and Design of Workplace Environments.

There are several ways in which the NIOSH-sponsored trainees may become involved in ongoing faculty research: research appointments during the summer months; developing an independent project by following a thread from a faculty-sponsored project; shorter-term involvement during the academic year, in order to experience both laboratory and field data collection. Trainees who are not supported by the grant may be supported as GRAs on a faculty member's sponsored research project.

Supporting Faculty

These individuals teach core or elective courses in the program, and/or are likely to serve as advisor or committee member for some trainees. From ISE: **Philip J. Smith, PhD** (relevant research interests: cognitive systems engineering; research focuses on issues

concerned with design of cooperative problem-solving systems to support people in performing complex tasks; teaches ISE 770 Cognitive Engineering), **David Woods, PhD** (relevant research interests: patient safety; resilience engineering and management; how complex systems fail; fault diagnosis; cognitive factors behind human error; teaches ISE 700 Systems Thinking, ISE 875.01 Human Error and the Human Contribution to Systems Failure), **Blaine Lilly, PhD** (relevant research interests: engineering education; design for manufacturing; teaches ISE 682 Design for Manufacturing). From the College of Public Health: **John R. (Jay) Wilkins III, DrPH** (relevant research interests: occupational risks to young people, including farm children; agricultural health and safety; occupational safety and health; teaches PUBH-EPI 711, 712 Epidemiology I & II, and PUBH-EPI 713 Epidemiology in Environmental Health) and **John (Mac) Crawford, PhD** (relevant research interests: health risks to fire fighters and police officers; neurotoxin exposure in farmers; teaches PUBH-EHS 830 Principles of Occupational Health). From the College of Medicine: **Eric Schaub, MD** (specialty is occupational medicine). From the Institute for Ergonomics: **W. Gary Allread, PhD** (extensive experience in consulting and training; recently awarded a Susan G. Harwood Targeted Topic Training Grant that will provide training to hotel housekeepers and their managers).

Some of the faculty members in the program have interacted for over two decades and continue to interact in their current research efforts. Examples of these interactions include Drs. Marras and Lavender's recent project to develop a method for quantifying back motion, hand load moments, and spinal loads in warehouse distribution facility workers. Drs. Sommerich and Lavender have several sponsored research projects in common, including ones that address intervention research with imaging technologists and warehouse workers, and a project that is investigating the etiology of work-related carpal tunnel syndrome. Dr. Lilly has been involved in the imaging technologist project. Drs. Lavender and Crawford are currently investigating several patient handling interventions for EMS workers. Drs. Lavender, Crawford, and Sommerich have conducted some research internal to OSU regarding the introduction of ceiling lifts in one of the departments within the Medical Center. Dr. Wilkins conducts research on injuries to farm children with Dr. Gary Allread (Program Director of OSU's Institute for Ergonomics), and also serves on the Institute's Advisory Board. The three primary faculty and the supporting faculty frequently interact through student thesis or exam committees, as well. Dr. Crawford has provided assistance and advice quite recently, in one instance with regards to the most recent research practicum, and in the other with regards to a student's safety practicum.