from Research to Reality

Summer 2007

Liberty Mutual Research Institute for Safety

Manual Materials Handling: A Closer Look

From Modest Beginnings to State of the Art

How Much Is Too Much? Applying the Science to the Task

Vol. 10 No. 2

Manual Materials

•A waiter carries an overloaded tray and strains his back.

•A warehouse worker lifting a heavy box twists into an awkward position and injures her back.

•A construction worker lifts a large stack of two by fours and sprains his shoulder.

What do all of these unfortunate situations have in common? In each scenario, the worker was involved in a manual materials handling activity at the time of injury.

Manual materials handling (MMH) refers to tasks that involve the movement or manipulation of objects using human effort. Although modern advances in automation, such as power lifts, power tuggers, carts, and other mechanical handling equipment, have reduced the need for human exertion in some jobs, manual materials handling tasks will continue to be an integral part of the workplace for the foreseeable future. Millions of workers from restaurants, warehouses, construction sites, and other industries perform, and will continue to perform, these tasks every day.

Why should businesses be concerned about manual materials handling? According to a 1999 Liberty Mutual Research Institute study, five basic manual materials handling tasks – lifting, lowering, pushing, pulling, and carrying – account for more than a quarter of all compensable work injuries. The majority of these injuries are musculoskeletal disorders, such as strains, sprains, and back pain. Whether sudden or gradual, musculoskeletal disorders typically occur when the job requirements exceed a worker's physical capabilities. Overexertion, a consequence of workers exceeding their physical capabilities, is the longstanding number one cause of disabling work-related injuries in the United States (*2006 Liberty Mutual Workplace Safety Index*). The majority of overexertion injuries are related to manual materials handling.

"Understanding the underlying risk factors that can lead to overexertion is the first step in reducing manual materials handling injuries," states Y. Ian Noy, Ph.D., director of the Liberty Mutual Research Institute. "Weight is not the only factor that determines if a job can be performed safely. There are so many other elements, such as handling frequency, task duration, individual worker differences, and postures, which can increase the risk of overexertion. It is important to look at all of these factors when assessing a task and to evaluate their total impact on job task safety."

For more than 50 years, the Liberty Mutual Research Institute for Safety has conducted laboratory and field studies to investigate various factors associated with manual materials handling tasks. Findings have been used to develop guidelines, products, and ergonomic recommendations to help protect workers from injury.

Today, Institute research scientists continue to conduct cutting-edge research with the aim of refining existing standards and advancing knowledge on the causes and prevention of manual materials handling injuries. "The more we can understand about the factors that contribute to manual materials handling injuries, particularly the underlying biomechanical, physiological, and environmental mechanisms, the better we can help businesses protect their workers," concludes Noy.

Handling

From Modest Beginnings to State of the Art

R-r-r-ing…A man dressed in scrubs lifts a bin weighted with steel shot from the floor while a researcher takes some observational notes. The man reaches up and places the bin on a shelf. Sh-sh-oop… The shelf automatically lowers back to floor height. The man patiently waits. R-r-r-ing … the man again lifts the bin, reaches up, and places it on the shelf. Sh-sh-oop…the shelf returns. Feeling a bit fatigued, he removes some of the steel shot. R-r-r-ing…and the process continues – all in a day of simulated work in the manual materials handling laboratory at the Liberty Mutual Research Institute for Safety.
(Continued next page)

Factors Impacting MMH

Task Demands

Material
- Dimensions
- Coupling
- Symmetry

Task/Workplace
- Frequency
- Distance moved
- Work height
- Obstructions

Environment
- Heat • Cold
- Vibration

Organization
- Paced work
- Autonomy
- Medical services

Worker Capacity

Personal
- Height • Weight
- Age • Smoking
- Injury history

Biomechanical
- Spinal strength
- Joint strength

Psychological
- Coordination
- Psychosocial perceptions

Physiological
- Physical work capacity
- Conditioning

Fatigue
Discomfort
Injury
Quality
Performance

The ratio of task demands to worker capacity during manual materials handling influences the occurrence of potential undesireable effects, such as fatigue, discomfort, and injury, as well as productivity and quality.

P.G. Dempsey, "A Critical Review of Biomechanical, Epidemiological, Physiological, and Psychophysical Criteria for Designing Manual Materials Handling Tasks," *Ergonomics*, Vol. 41, No. 1, pp. 73-88, 1998

Since its beginnings, the Research Institute has simulated jobs that involve manual materials handling – lifting, lowering, pushing, pulling, and carrying – to study the dynamics of these tasks with the goal of improving worker safety. For industry, manual materials handling is the most frequent and costly category of loss, comprising more than one fourth of all compensable work injuries. The majority of these injuries involve low back pain. Further, the annual Liberty Mutual Workplace Safety Index reports that overexertion – injuries most often caused by manual materials handling – is the leading cause of disabling workplace injury. In 2006, the Index estimated $13.6 billion in direct U.S. workers compensation costs due to disabling overexertion injuries.

A Look Back in Time

The Research Institute has played an integral role in the development of industry guidelines and assessment tools used by ergonomists to reduce manual materials handling risks. As far back as the 1950s, under the direction of Willem S. Frederik, M.D., Ph.D., Liberty Mutual researchers studied some of the physiological aspects of manual materials handling tasks. These inaugural investigations examined how various task factors, such as pushing forces and repetitions, impacted human fatigue. During simulated industrial work tasks, researchers measured oxygen consumption using custom-designed equipment, including the Differential Flameoxymeter. This device, developed by Frederik, enabled researchers to measure continuous oxygen consumption. It was a hallmark of the time.

The Psychophysical Approach Emerges

In 1962, Stover H. Snook, Ph.D., joined the Institute staff as a project director and continued Frederik's work. In his first study, Snook investigated a common industrial lifting task to determine the maximum number of lifts per minute that workers could perform without excessive fatigue. The study produced the concept of "group work capacity" – the percentage of workers that can perform a task without showing physiological signs of fatigue. In the lab, Snook and colleagues measured oxygen consumption and heart rates from a sample of industrial workers to estimate the group work capacity for different lifting frequencies, heights, and weights. This novel, ergonomic-centered approach focused on designing the task to fit the worker, versus prior methods of selecting the worker to fit the job. With this methodology, the goal was to design tasks that could accommodate up to 90 percent of all workers.

"After completing the first experiment, I became concerned that we were only looking at part of the problem," recalls Snook, who is now retired. "Certainly, I recognized task frequency as an important component, especially for repetitive lifting tasks. But, I also knew that weight was at least as, if not more important, for the intermittent lifting tasks common in industry." Consequently, Snook began to explore the use of psychophysics – an established method used in experimental psychology – to investigate industrial manual materials handling tasks. Psychophysics examines the relationships between physical stimuli and sensory perception. Scientists had successfully used this method to develop the decibel scale and the effective temperature scale. Snook was convinced that he could use this same approach to develop a scale of maximum acceptable weights and forces for manual materials handling tasks. "Psychophysics allowed us to evaluate manual handling tasks more thoroughly and better assess injury risk, whereas other approaches had limitations," notes Snook.

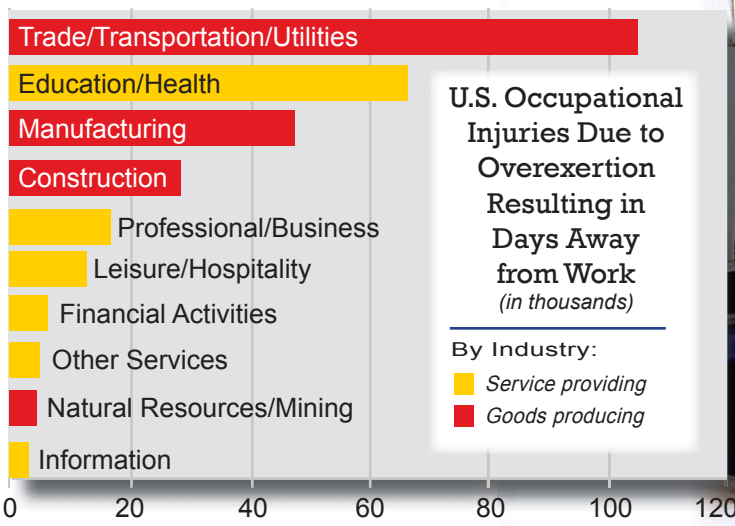
Using psychophysics, Snook and his colleagues refined their earlier experiments by allowing study participants to control the weight of the handled objects. The researchers instructed subjects to lift as much as possible without straining themselves or becoming un-

Exploring Industrial Low Back Pain

During the late 1970s and 1980s, the Research Institute began looking more closely at occupational low back pain. A key investigation included a comparative field study of three methods used by industry to reduce the incidence of industrial low back pain, namely selection, training, and job design. Working with Liberty Mutual's Loss Prevention department, researchers gathered and analyzed data on 191 real-world, industrial, low back injuries to determine the effectiveness of each method. The study findings, published in the *Journal of Occupational Medicine* in 1978, indicated that selection and training approaches were not effective in reducing low back injuries. However, with respect to job design, the findings indicated that jobs designed for less than 75 percent of the working population resulted in three times as many back injuries compared to jobs designed for 75 percent or more.

usually tired, weakened, overheated, or out of breath. As study participants varied the weights of the objects to acceptable levels, researchers recorded physiological and performance data. From these investigations, Snook published seminal papers that reported the effects of age and physique on continuous work capacity and de ned maximum weights and workloads that were acceptable to industrial populations.

With the continued prevalence of manual materials handling injuries, the Research Institute expanded its psychophysical research throughout the 1960s and 1970s to include studies of pushing, pulling, and carrying tasks. Special instrumentation and software programs were developed for data analysis. And, unlike other research programs, which often used young, healthy college students as study participants, the Research Institute only recruited experienced industrial workers to re ect the real worker population.



As the leading cause of work-related disability, overexertion impacts nearly all industries. The majority of these injuries can be attributed to manual materials handling.

Adapted from Bureau of Labor Statistics Table R64, 2005

A New Metric: The Manual Materials Handling Tables

In 1969, Vincent M. Ciriello, Sc.D., joined the staff. Together, Ciriello and Snook broadened the manual materials handling research to include females and to incorporate increased lift distances and frequencies. In 1978, Snook and Ciriello combined the results of seven key studies into a series of tables. That same year, Snook was invited to present this work at the Ergonomics Society's annual keynote lecture in Cran eld, England. The resulting paper, "The Design of Manual Handling Tasks," revolutionized the occupational safety and health community. "The paper was signi cant because it provided a metric for assessing manual materials handling risk," says Ciriello, who continues his work as a Research Institute scientist to the present day. According to Ciriello, manual materials handling guidelines were somewhat arbitrary prior to the tables. "Most guidelines simply recommended a single maximum weight. The tables, which incorporated individual differences and various task parameters, allowed safety professionals to determine the maximum acceptable weights for different percentages of the population. This information gave practitioners a rm basis for identifying and recommending ergonomic solutions."

Refining Research

Throughout the late 1970s and into the 1980s, Ciriello and Snook expanded their psychophysical investigations of manual materials handling tasks. They conducted four key studies to examine various object sizes and handle types, additional frequencies, extended reaches, and task combinations. The studies incorporated larger subject samples and more females. The results, presented in the 1991 *Ergonomics* paper, "The Design of Manual Handling Tasks: Revised Tables of Maximum Acceptable Weights and Forces," provided industry with an improved manual handling task evaluation tool. In addition, the National Institute for Occupational Safety and Health (NIOSH) incorporated some of the study results into the 1993 Revised NIOSH Equation for the Design and Evaluation of Manual Lifting Tasks, a tool that is widely used by U.S. industry.

Biomechanics: New Investigative Technologies

In the early 1990s, the Research Institute began applying biomechanical methodologies to manual materials handling investigations. The availability of sophisticated motion analysis equipment and biomechanical modeling methods enabled researchers to observe, quantify, and analyze the underlying biomechanical mechanisms involved in these tasks. Research Institute scientists continue to use these technologies to observe workers in the laboratory as they perform simulated tasks using various workstation setups and work conditions. Over the years, they have collected extensive data on postures and the associated joint stresses imposed on the worker during the simulated tasks.

Using data collected in early biomechanical experiments, Liberty Mutual researchers set out to advance eld-based data collection capabilities. In the mid-1990s, they identi ed several key postures that, when applied to existing biomechanical simulation models, could successfully approximate the forces and stresses on the body throughout an entire lift cycle. With this information, they developed a computerized video posture coding method to identify key lifting postures and joint angles. This method formed the basis of VidLiTeC™, short for Video-Based Lifting Technique Coding System. "VidLiTeC made it possible to evaluate manual materials handling tasks in actual industrial settings," says Research Scientist Chien-Chi Chang, Ph.D.

This on-site data collection capability gave researchers and ergonomists the ability to estimate, with reasonable accuracy, low back compression forces (at the L5/S1 joint) in addition to the stresses involved at other major joints during industrial lifting and lowering tasks. "In the past, this type of data could only be acquired using complex motion analysis equipment, which was extremely dif cult to apply in industrial settings," explains Chang. "VidLiTeC enabled ergonomists and researchers to acquire this information easily and effectively at the work site with only minimal disruption to workers and work processes."

Into the New Millennium

Today, Institute researchers continue to investigate manual materials handling tasks, while seeking to develop new models to better correlate with today's changing workplace. Jobs involving these tasks have become more complex and often include a variety of combined tasks. In addition, the population itself has changed, as illustrated by ndings from a Research Institute experiment conducted during the late 1990s. The experiment, which focused on re ning the data on lowering tasks with respect to distances, different size boxes, and frequencies, also revealed an interesting secular trend. Despite the same psychophysical instructions and experimental set up as used in prior studies, the more recent study indicated that modern-day workers were selecting dramatically lower weights than their predecessors. To test the trend, Institute researchers collected extensive task data from 52 industrial workers between the years 2002 and 2006. An analysis of the data veri ed that current study populations selected weights up to 41 percent lower than previous study populations, depending on the task. "This nding has signi cant implications for eld evaluations of manual materials handling tasks," says Ciriello, noting that further research is needed to better understand the reasons behind this unexpected result.

As part of this same study, researchers took a more comprehensive look at some of the physiological costs imposed on workers. Using the latest technologies, researchers observed and measured subjects' heart rates, oxygen uptake, and muscle oxygenation during simulated work tasks. Today, researchers are using these data to develop improved models for estimating the physiological costs associated with manual materials handling tasks in the workplace.

"For more than half a century, the Institute's scienti c innovation and excellence in manual materials handling research has de ned new, robust approaches to controlling risks," states Y. Ian Noy, Ph.D., director of the Research Institute. "Our research continues to impact today's workplaces. As we break new ground in biomechanical and physiological research, we continue to update and re ne our manual materials handling studies to re ect the realities of the 21st Century global work environment. I am con dent that we will build upon and add to our rich legacy."

Publication Highlights

Chang, C.C., Hsiang, S.M., Dempsey, P.G., and McGorry, R.W., "A Computerized Video-Based Biomechanical Analysis Tool for Lifting Tasks," *International Journal of Industrial Ergonomics*, **Vol. 32, No. 4, pp. 239-250, 2003**

Ciriello, V.M., "The Effects of Box Size, Vertical Distance, and Height on Lowering Tasks," *International Journal of Industrial Ergonomics*, **Vol. 28, pp. 61-67, 2001**

Dempsey, P.G., "A Survey of Lifting and Lowering Tasks," *International Journal of Industrial Ergonomics*, **Vol. 31, pp. 11-16, 2003**

Dempsey, P.G. and Hashemi, L., Analysis of Workers Compensation Claims Associated with Manual Materials Handling, *Ergonomics*, **Vol. 42, No. 1, pp. 183-195, 1999**

Snook, S.H., The Design of Manual Handling Tasks, *Ergonomics*, **Vol. 21, No.12, pp. 963-985, 1978**

Snook, S.H., Campanelli, R.A., Hart, J.W., "A Study of Three Preventative Approaches to Low Back Pain," *Journal of Occupational Medicine*, **Vol. 20, No. 7, pp. 478-481, 1978**

Snook, S.H. and Ciriello, V.M., "The Design of Manual Handling Tasks: Revised Tables of Maximum Acceptable Weights and Forces," *Ergonomics*, **Vol. 34, No. 9, pp. 1197-1213, 1991**

Visit www.libertymutual.com/researchinstitute for more Research Institute publications.

How Much Is Too Much? Applying the Science to the Task

Reduce accidents, lost-time, absenteeism, turnover, and costs, while at the same time improving productivity, quality, and worker health and safety – sound impossible? Not so, says Wayne Maynard, C.S.P., C.P.E, ergonomics and tribology product director at the Liberty Mutual Research Institute for Safety. "Ergonomics in the workplace is good for both the worker and the employer," states Maynard. "The goal is to obtain a good match between the worker and the job. In manual materials handling, ergonomics is designing the job or task to t the worker."

In its quest to improve job design and reduce work-related, manual materials handling injuries, the Liberty Mutual Research Institute for Safety has built a longstanding reputation for providing the research behind the know-how. From the early psychophysical studies to the later biomechanical investigations, the Institute's scienti c ndings and methodologies have formed the basis for recommendations and assessment tools that help the practitioner determine how much is too much.

One of Liberty Mutual's best-known, research-to-practice applications is the Liberty Mutual Manual Materials Handling Tables. This ergonomic assessment tool, based on the Snook and Ciriello Tables (see p. 4), enables practitioners to evaluate lifting, lowering, pushing, pulling, and carrying tasks with the primary goal of supporting ergonomic design interventions. The Tables also provide both the male and female population percentages capable of performing the tasks without overexertion. "The only difference between the Liberty Mutual Tables and the Snook and Ciriello Tables is the output," explains Maynard. "Instead of getting an acceptable weight or force as the result, with the Liberty Mutual Tables, the practitioner begins with the weight or force that the worker may lift, lower, push, pull, or carry to determine the population percentage that is able to perform the task." The tables are available for public use on the Research Institute website.

The Snook and Ciriello Tables also formed the basis of CompuTask™, which was developed by Liberty Mutual in the 1980s. This ergonomic assessment software program is widely used by Liberty Mutual eld consultants to identify the risk factors associated with tasks involving high frequency and moderate weight. CompuTask offers the added bene t of an energy expenditure result with suggested maximum duration based on the NIOSH physiological guidelines. Further, it eliminates the need to manually select table values, thereby reducing human error. In 1990, the original CompuTask was revised and expanded to include three modules – manual materials handling analysis, the 1991 NIOSH Lifting Equation, and repetitive wrist motion. "We've had tremendous success with CompuTask," says Maynard. "It truly provides an objective assessment of the task and reveals areas of risk. With this knowledge, we can help companies control costs through ergonomic recommendations for interventions that t the task to the worker and ultimately reduce injuries."

Manual Materials Handling Guidelines

The following is a list of important considerations for designing jobs that involve manual materials handling:

Injuries – Any job that produces injuries is a good candidate for redesign.

Bending – Any task that begins or ends with the hands below knuckle height presents some degree of risk. The deeper the bending motion, the greater the physical stress on the low back. Frequent bending regardless of weight is not recommended.

Twisting – This motion puts uneven forces on the back thereby presenting additional physical stress. The greater the twist, the more physically stressful the task.

Reaching – The distance that a load is held away from the body greatly affects the forces on the back, shoulders, and arms. The farther the reach, the more physically stressful the task.

One-Handed Lifts – By nature, these tasks place uneven loads on the back and present a greater physical stress than two-handed lifts.

Hand-Holds – The inability to get a good grip on the load presents a greater physical stress.

Catching or Throwing Items – Any tasks involving catching or throwing items are physically stressful and, therefore, are good candidates for redesign.

Extracted from the *Liberty Mutual Manual Materials Handling Guidelines, 2004*.

Visit www.libertymutual.com/researchinstitute to access the Liberty Mutual Manual Materials Handling Tables.

Advances in the Research Institute's biomechanics research during the 1990s resulted in another assessment tool developed by Liberty Mutual. VidLiTeC™, short for Video-Based Lifting Technique Coding System, helps ergonomists and researchers evaluate lifting and lowering tasks involving lower frequencies and heavier weights. The program provides objective information to help companies design tasks to fit the worker. "The beauty of VidLiTeC is that, unlike other motion tracking software, it is straightforward to use in the workplace," notes Maynard. "Simply put, we shoot a video, input height and weight estimations of the worker, and the weight of the item being lifted. From four select video frames – start, closest, highest, and end - we can compute the low back compression forces. The process takes only a few minutes."

To illustrate the benefits of VidLiTeC, Maynard shares a Liberty Mutual loss prevention success story. The customer, a beer brewer and distributor, had experienced growth in product lines and facility expansion. This new growth also brought about an increase in material handling strain and sprain injuries as workers unloaded cases of empty bottles from pallets onto the bottle un-caser machine in-feed belt. Using VidLiTeC to assess the task, the program reported low-back L5/S1 disc compressive force exceeding 1,045 pounds as workers lifted 28 pounds of empty bottles and cardboard cases; however, the maximum disc compressive force limit is 770 pounds. The VidLiTeC evaluation also reported exceeding joint strength limits associated with this same task. Based on this objective information, the company decided to install scissor lifts that automatically lift the pallet, as it is unloaded. In the three years since the lifts were installed, there have been no other sprain and strain injuries from workers unloading pallets.

"In industry, a well-designed job can be both efficient and safe," states Maynard. "Proper task evaluation and designing the job based on sound ergonomic principles is a win-win for all and is an approach that Liberty Mutual has long supported through its research and development efforts."

Developed using Research Institute findings, VidLiTeC™ enables our loss prevention consultants to conduct detailed analyses of manual materials handling tasks as they occur.

NEWS

University of Massachusetts-Lowell Fellow Welcomed

The Research Institute is pleased to host Manuel Cifuentes, M.D., M.P.H., Sc.D., a postdoctoral fellow at the University of Massachusetts-Lowell. Dr. Cifuentes joined the Institute as part of the Research Institute's new postdoctoral fellowship program with the University's Department of Work Environment. During his two-year tenure, his work will focus in the area of return-to-work research.

Currently, Cifuentes is collaborating with Research Scientist Barbara S. Webster, R.P.T., P.A.-C., to investigate the variables involved in prescribing opioids for pain management. Speci cally, the researchers are examining more than 8,000 workers compensation claims to better understand geographic variation in early opioid prescribing for acute, disabling low back pain. Cifuentes is also collaborating with Research Scientist Amanda E. Young, Ph.D., to examine the association between residential location and extent of disability in a work-injured population. The investigation aims to determine if variation in work-disability outcomes, which are observed in urban versus rural areas, correlate with differences in patterns of health service utilization.

Cifuentes began his fellowship at the University in 2006. His work involves injury epidemiology; disability, medical utilization, and healthcare management; and research on occupational exposure to work stress and cardiovascular diseases. He received his M.D. from the University of Concepción-Chile, M.P.H. from the University of Chile, and his Sc.D. in Epidemiology from the University of Massachusetts-Lowell. From 2001 to 2005, Cifuentes was involved with a variety of occupational health-related projects as a research assistant at University of Massachusetts-Lowell. Prior to that, he was an assistant professor in the Public Health Department of the University of Concepción-Chile School of Medicine; had a private clinical psychiatric practice in Concepción, Chile; worked as a research consultant for the Mental Health Unit of Province of Concepción Health Service, and the Chilean Ministry of Health; and served as a general physician at a private practice in Santiago, Chile.

Research Institute's 2006 Annual Report Available

The Research Institute's *2006 Annual Report of Scienti c Activities* is now available. The 44-page, full-color report highlights ndings from more than 30 ongoing research projects, including studies of occupational slips and falls, manual materials handling tasks, driver distraction, personal protective eyewear use, return-to-work processes, and low back injury recurrence. The Report also includes a list of accepted and published scienti c peer-reviewed papers, as well as an update of extramural activities, conference presentations, research collaborations, and awards and honors.

To access the Report online, or to obtain a hard copy, visit www.libertymutual.com/researchinstitute.

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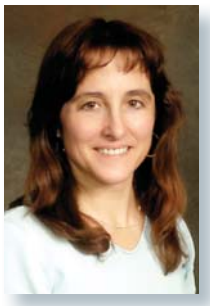
Liberty Mutual-Harvard Program Renewed

The Liberty Mutual Group (LMG) and the Harvard School of Public Health (HSPH) recently announced an agreement to continue support of the Liberty Mutual-Harvard Program in Occupational Safety and Health. Initiated in 1995, the partnership includes funds for joint occupational health and safety research, post-doctoral fellowships, and faculty pilot projects. Pictured left to right: LMG Senior Vice President Karl Jacobson, HSPH Dean Barry Bloom, Research Institute Director Ian Noy, and HSPH Department of Environmental Health Chair Douglas Dockery.

Awards and Honors

Marucci-Wellman Receives Liberty Mutual's Highest Employee Honor

Helen Marucci-Wellman, M.S., a Liberty Mutual research scientist, is the proud recipient of the 2007 Liberty Mutual Chairman's Award. The annual award recognizes a limited number of employees who have made the most unique and inspirational contributions to the company. Of the nearly 40,000 Liberty Mutual employees worldwide, Ms. Marucci-Wellman was one of 15 selected recipients.



Marucci-Wellman (pictured at left) was recognized for her contributions to the *Liberty Mutual Workplace Safety Index* (WSI), which is acclaimed as one of the most important measures of the U.S. workplace injury burden to emerge in the last two decades. As the WSI principal investigator, she has generated program ef ciencies, shortened the WSI annual production cycle, and enhanced its technical reliability. She has also developed a string of scienti c research projects to help improve the accuracy of each component of the WSI metric.

Based on her WSI achievements, Marucci-Wellman was appointed lead scientist in the Institute's Vietnam research program. In this role, she designed and implemented the rst major study of workplace injury among Vietnamese workers in collaboration with the Vietnamese National Institute of Occupational and Environmental Health. The study aims to develop a public health model for reporting work-related injuries in Vietnam. Marucci-Wellman has made numerous trips to Vietnam to direct the work of 70 government researchers who are collecting injury data from 2,600 Vietnamese households. On many occasions, she has been called to brief senior Vietnamese government of cials.

"I am very proud and honored to receive this award," says Marucci-Wellman. "It's a privilege to lead the injury burden study in Vietnam. Rarely, does one get the opportunity to affect real lives – real people – real societies, and yet this is exactly what we're doing in Vietnam."

Marucci-Wellman joined the Research Institute in 2000. Currently, she is pursuing her doctor of science degree in epidemiology from the Work Environment program at the University of Massachusetts, Lowell.

Winning Paper Finds Shift Work Lowers Cognitive Performance

A study to examine the long-term consequences of sleep deprivation, speci cally, the in uence shift work has on verbal memory and speed performances, won the 2007 Liberty Mutual Prize. The scienti c paper, "Shift-Work Experience, Age, and Cognitive Performance" (*Ergonomics*, Vol. 48, No. 10, pp. 1282-1293, 2005) is authored by Isabelle Rouch, M.D., Ph.D., and Pascal Wild, Ph.D., from the Department of Epidemiology, French National Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (Vandoeuvre, France) and David Ansiau, Ph.D., and Jean-Claude Marquié, Ph.D., from the Centre National de la Recherche Scienti que, University of Toulouse-le-Mirail (Toulouse, France).

The researchers examined a cross-sectional sample of 3,237 French workers and found that those currently employed as shift workers displayed lower cognitive performance than workers not exposed to shift work. Among the current shift workers, researchers noted a decrease in memory performance with an increase in shift-work duration. The ndings also revealed that workers who ceased shift work more than four years prior displayed an increase in cognitive performance, thereby suggesting a possible reversibility of effects.

"By increasing our understanding of the relationship of shift work and cognitive performance, we can help to improve worker safety," said Rouch (pictured right). "We are honored to receive this award." Ansiau accepted the award on behalf of the research team at the Ergonomics Society Annual Conference held in April at Nottingham University, U.K.

The Liberty Mutual Research Institute for Safety and the Ergonomics Society established the Liberty Mutual Award to promote excellence in safety and health research. The award recognizes the paper published in *Ergonomics* that best contributes to the advancement of the practice of ergonomics.

Conferences

XXIth Congress of International Society of Biomechanics: July 1 to 5, Taipei, Taiwan
Variability in Angular Displacement When Performing Manual Lifting Tasks – *C.C. Chang, Ph.D.* • An In Situ Observation of the Interface Kinematics Between the Footwear and Floor – *W.R. Chang, Ph.D.* • Power Hand Tool Use: Applying a Biomechanical Model to an Ergonomics Issue – *J.H. Lin, Ph.D., C.P.E.* • The Effect of Handle Location and Orientation on Power Grip Force Production – *R.W. McGorry, M.S., P.T.*

4th International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design: July 9 to 12, Stevenson, WA
Does Exposure to Distraction in an Experimental Setting Impact Driver Perception of Cell Phone Ease of Use and Safety? – *A. Garabet, M.A.Sc.* • Awareness of Performance Decrements Due to Distraction in Younger and Older Drivers – *W.J. Horrey, Ph.D.*

18th International Society for Posture and Gait Research Conference: July 14 to 18, Burlington, VT
In uences of Center of Pressure and Body Segment Movements on Perceived Postural Stability – *A.T. DiDomenico, Ph.D., C.P.E.*

12th International Conference on Human-Computer Interaction: July 22 to 27, Beijing, China
Health and Performance Consequences of Of ce Ergonomic Interventions Among Computer Workers – *M.M. Robertson, Ph.D., C.P.E.*

International Conference on Slips, Trips, and Falls 2007 - From Research to Practice: Aug. 23 to 24, Hopkinton, MA
Determinants of Ladder Shoe Related Available Coef cient of Friction – *C.M. Brunette, M.S., A.E.P.* • The Effect of Contact Area on the Friction Measured with the Brungraber Mark II – *W.R. Chang, Ph.D.* • Multiple Locomotor Adjustments Required During Goal-Directed Walking – *A.T. DiDomenico, Ph.D., C.P.E.* • Reliability of Visual Cues in Predicting Judgments of Slipperiness and the Coef cient of Friction of Floor Surfaces – *M.F. Lesch, Ph.D.* • Circumstances of Occupational Same-Level Falls and Risk of Hip Fracture in Women Over 45 Years of Age – *S.K. Verma, M.P.H., M.B.B.S.*

6th International Scienti c Conference on Prevention of Work-Related Musculoskeletal Disorders: Aug. 27 to 30, Boston, MA
Overexertion Injuries Due to Work in the Fields of Vietnam: The Effect of Exposure Time on Incidence Rate Calculations – *H. Marucci-Wellman, M.S.* • An Of ce Ergonomics Training and Workplace Design Intervention: Longitudinal Effects on Work-Related Musculoskeletal Discomforts - *M.M. Robertson, Ph.D., C.P.E.* • How to Engage and Develop Supervisor Competencies to Improve Return-to-Work Outcomes – *W.S. Shaw, Ph.D., P.E.* • Relationship Between Early Opioid Prescribing for Acute Occupational Low Back Pain and Disability Duration, Medical Costs, Subsequent Surgery, and Late Opioid Use – *B.S. Webster, R.P.T., P.A.-C.* • Work Disability and Costs Caused by Recurrence of Low Back Pain: Longer and More Costly than in First Episodes – *R. Wasiak, Ph.D.* • Measuring Return to Work – *A.E. Young, Ph.D.*

Publications

Chang, C.C., Li, Z., Cai, X., and Dempsey, P.G., "Error Control and Calibration in Three-Dimensional Anthropometric Measurement of the Hand by Laser Scanning with Glass Support," *Measurement*, Vol. 40, No. 1, pp. 21-27, 2007

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A Message from the Director…

Y. Ian Noy, Ph.D.
Vice President
and Director

Dear Readers,

It is with great pride that I present this issue of *From Research to Reality*, which chronicles the Research Institute's rich history of manual materials handling research. For more than ve decades, Liberty Mutual scientists have investigated this area, and for good reason. Manual materials handling tasks, which are present in practically all industries, account for more than a quarter of all compensable work injuries. Our scienti c ndings, translate into practical applications and recommendations that help countless companies minimize job risks and control costs. In this way, our manual materials handling research helps to ful l Liberty Mutual's longstanding commitment to help people live safer, more secure lives.

The news section of this issue highlights another pillar of the Research Institute's research program — our global collaborations. This spring we renewed our longstanding agreement with the Harvard University School of Public Health. The renewed Liberty Mutual-Harvard Program in Occupational Safety and Health builds upon more than 70 years of collaboration in research, teaching, and service, and places a new emphasis on postgraduate fellow research. We also launched a postdoctral fellowship program in partnership with the University of Massachusetts-Lowell, Department of Work Environment. Through these, and our other collaborative partnerships, we seek to advance occupational safety and health and expand our view of workplace safety as it impacts not only the U.S., but also other parts of the world.

We hope you find this issue interesting and valuable, and as always, we welcome your feedback.

from Research to Reality

Liberty Mutual Research Institute for Safety
71 Frankland Road
Hopkinton, MA 01748
USA

From Research to Reality™ is a publication of the Liberty Mutual Research Institute for Safety, an internationally recognized occupational safety and health research facility. Through its broad-based investigations, the Institute seeks to advance scienti c, business-relevant knowledge in workplace and highway safety and work disability. The Institute's ndings are published in the open, peer-reviewed literature and often serve as the basis for recommendations, guidelines, and interventions used by industry to help reduce workplace injury and related disability.

Telephone: 1-508-497-0257
E-mail: researchinstitute@libertymutual.com

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