Position Paper Supporting Human Factors and Ergonomics Practitioners In Forensics (Revised 19 July 2004)

Human Factors and Ergonomics Society
Forensic Professional Group

Purpose

The purpose of this document is to provide forensic human factors and ergonomics experts, and attorneys for whom they are working, legitimate arguments that rebut challenges to expert human factors or ergonomics testimony and to provide a rationale for such testimony.

Background

From time to time, testimony of human factors and ergonomics experts is challenged by opposing attorneys in personal injury, product liability, workplace injury, transportation injury, or other civil and criminal cases. An attorney may oppose the introduction of human factors and ergonomics testimony because:

1. The attorney has chosen not to use the services of a human factors or ergonomics expert for his own case presentation. That attorney then realizes, near trial, that the testimony of the opposition's human factors or ergonomics expert likely will be effective and thereby harmful to the attorney's interests and positions.

2. The attorney believes that the human factors and ergonomics discipline provides information that jurors would know based on their own experience or "common sense," and, therefore, challenges its utility in assisting judicial decisions.

3. The attorney, citing the "Daubert" decision giving judges more responsibility in admitting evidence based on their opinion of scientific credibility and acceptance, challenges the acceptance of the human factors and ergonomics discipline and its scientific credibility. The United States Supreme Court case *Daubert v. Merrell Dow Pharmaceuticals Inc.*, 113 S. Ct. (1993) defined boundaries for acceptable expert testimony. The Supreme Court decided that the trial judge, in federal cases, is responsible for ensuring the relevance and reliability of expert testimony. The Supreme Court provided four factors that can be considered by a federal judge when evaluating expert testimony:

- Can the theory be offered by the expert be (and has it been) tested? Are the statements made by the expert capable of empirical testing?
- Has the basis of the expert's testimony been subjected to peer review or publication?
- What is the reliability (i.e., the known or potential rate of error) of the scientific evidence offered by the expert?
- Has the theory or subject matter of the expert's testimony achieved "general acceptance" in the scientific community?

4. The attorney considers that human factors and ergonomics testimony will "invade the province" of the jury.

In addition to these challenges directed at the human factors and ergonomics discipline, the attorney may also challenge the qualifications (background, education, experience, and training) of the individual expert. Each individual human factors and ergonomics expert must be prepared to establish why she or he is a qualified, credible expert.

Arguments Supporting Human Factors and Ergonomics Expert Testimony

1. Human factors and ergonomics is an established, internationally recognized scientific discipline and systems-design profession.

Overview:

The human factors and ergonomics discipline has roots stemming from engineering, psychology, physiology, and pedagogy, and serves a unique system design function. More than 60 years ago, military and industrial systems designers recognized that traditional approaches of selecting and training operators and maintenance personnel did not ensure acceptable or safe system performance. Consequently, a new body of knowledge and skills began to form to determine human capabilities and limitations. Later this evolving body of knowledge was extended to include equipment and system design. Knowledge about human capabilities and limitations, and skill in applying it to system design, is the basis for the human factors and ergonomics profession. Human factors and ergonomics professionals serve to ensure that systems and equipment are designed to be compatible with known human biomechanical, physiological, psychological, information processing, and anthropometric characteristics. In the design of consumer products, medical devices, complex aircraft and spacecraft, transportation systems, manufacturing facilities and processes, office environments, and a multitude of other applications, human factors and ergonomics professionals are noted for contributing to increased human productivity, comfort, health, and safety.

Professional Societies:

Professional societies are serving the needs of human factors and ergonomics professionals in over 50 countries. Based on estimates from the International Ergonomics Association, there are more than 25,000 people working as human factors and ergonomics professionals around the world. The first professional society serving the ergonomics discipline, The Ergonomics Society, was established in 1949 in Great Britain.

The principle professional society representing the needs of human factors and

ergonomics professionals in the United States is the Human Factors and Ergonomics Society (HFES), established as the Human Factors Engineering Society of America in 1957. There are about 5000 members of HFES, representing 47 countries, participating in 21 technical and professional groups including Forensics, Safety, Consumer Products, Computer Systems, Environmental Design, Industrial Ergonomics, and others. Approximately 1500 members typically attend annual meetings of the HFES and participate in scientific workshops, panel discussions, symposia, and technical paper presentations that are published in the *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. Other publications of the HFES include the highly respected research journal, *Human Factors*, and a practice-oriented magazine, *Ergonomics in Design*, both published quarterly. Approximately 15% of HFES members report having been engaged in expert witness work at some time in their careers, most often in addition to other employment.

Design Guidelines and Standards:

Human factors and ergonomics professionals have authored many important system and equipment design guidelines and standards accepted and followed throughout the world. The U.S. Department of Defense Military Standard (MIL-STD-1472) on "Human Engineering Design Criteria for Military Systems, Equipment, and Facilities" has been a significant resource for military and non-military system designers for over 30 years. The ANSI/HFES-100 standard for designing hardware related to computer workstations is recognized as the most comprehensive human factors and ergonomics standard to follow when designing computer workstations. Human factors professionals served an important role in evaluating the causes of the 1979 Three Mile Island nuclear power plant incident and in authoring guidelines for designing future process control centers to avoid human-machine interface problems that contributed to that incident.

2. The scientific basis for the human factors and ergonomics discipline is well

established and continues to grow.

Academic Degree Programs:

Highly respected academic programs offering degrees in human factors and ergonomics exist in many countries throughout the world. In the United States, there are approximately 70 programs offering graduate degrees (either MS or PhD level) in human factors and ergonomics. Research conducted in these programs continues to add important new knowledge, tools, and skills upon which the human factors and ergonomics profession is based. Research contributing to our understanding of human response time, sensory and perceptual processes, information processing, and decision making are notable examples of contributions from academic institutions to the scientific basis of the human factors and ergonomics discipline. The majority of human factors and ergonomics practitioners working in the United States have received graduate degrees, either in a program devoted specifically to human factors and ergonomics or in one of the primary disciplines such as engineering or psychology with specialization in human factors/ergonomics.

Government Sponsored Research:

U.S. Government agencies (e.g. Department of Defense, NASA, NIOSH, Department of Energy, Department of Interior, Department of Transportation, etc.) have long records of sponsoring research and contributing significantly to the growing body of human factors and ergonomics knowledge. HFE professionals help to shape research priorities as chairs or members of the many committees and projects of the National Research Council, National Academy of Sciences, and the National Academy of Engineering.

Industrial Research:

A large portion of human factors and ergonomic practitioners are employed by commercial firms creating products or services that compete in the world's marketplaces. Human factors and ergonomics research and development, conducted by these companies in support of their goals, are other valuable contributions to the scientific basis for the discipline.

Scientific Journals and Textbooks:

Considerable information about the human capabilities and limitations applicable to system and equipment design has appeared in peer-reviewed publications over the last 60 years. Examples of the types of knowledge available in this well established and growing database include: data about human physical characteristics (such as body dimensions, weight, strength capabilities, and motor skills), sensory and perceptual processes (such as vision, audition, reaction time, decision making, learning, and information processing), response to physical environmental factors (such as noise, vibration, temperature, acceleration, stress, and lighting), personal factors (such as age, experience, and intelligence) and organizational factors (such as work incentives, workload, and work system design, including safety and health systems).

Notable publications documenting the human factors and ergonomics database include:

Human Factors and Ergonomics Methods edited by N. Stanton, A. Hedge, E. Salas, H.W. Hendrick, and K. Brookhuis, 2004.

Forensic Aspects of Driver Perception and Response, 2nd Edition, by P.L. Olson and E.I. Farber, 2003.

Kodak's Ergonomic Design for People at Work, 2nd. Edition, by Eastman Kodak Co., combines Vol. 1 (1983) and Vol. 2 (1986), 2003.

Macroergonomics: Theory, Methods and Applications edited by H.W. Hendrick and B. Kleiner, 2002.

Macroergonomics: An Introduction to Work System Design by H.W. Hendrick and B. Kleiner, 2001.

Human Factors in Traffic Safety by R.E. Dewar and P.L. Olson. 2001.

Work Design, Industrial Ergonomics, 5th Ed., edited by S. Konz and S. Johnson, 2000.

Warnings and Safety Instructions: Annotated and Indexed, 4th edition, by J.M. Miller, M.R. Lehto, 2000.

Ergonomics Guidelines and Problem Solving edited by A. Mital, A. Kilbom, and S. Kumar, 2000.

Warnings and Risk Communication edited by M.S. Wogalter, D.M. DeJoy, and K.R. Laughery, 1999.

Work-Related Musculoskeletal Disorders: A Review of the Evidence, National Research Council, 1998.

Work Organization and Ergonomics edited by V. Martino, and N. Corlett, 1998.

Human Factors Engineering for Forensic and Safety Specialists by W. Woodson, 1998.

Elements of Ergonomics Programs, DHHS (NIOSH) Publication 97-117, 1997.

Fitting the Task to the Human, 5th Ed., by K.H.E. Kroemer and E. Grandjean, 1997.

Handbook of Human Factors edited by G. Salvendy, 1987; 1997.

Managing the Risks of Organizational Accidents by J. Reason, 1997.

Stress and Human Performance edited by J. Driskell and E. Salas, 1996.

Evaluation of Human Work by J.R. Wilson and E.N. Corlett, 1995.

Research Techniques in Human Engineering edited by J. Weimer, 1995.

Work Related Musculoskeletal Disorders (WMSDs): A Reference Book for Prevention edited by I. Kuorinka and L. Forcier, 1995.

A Guide to the Ergonomics of Manufacturing by M. Helander, 1995.

Work Design by S. Konz, 1995.

Human Factors in Engineering and Design, 7th Edition, by M.S. Sanders, 1993.

Work Practices Guides for Manual Lifting, NIOSH, 1981; 1993.

Ergonomics Program Management Guidelines for Meatpacking Plants, OSHA, 1993.

Human Factors Design Handbook, 2nd edition, by W.W. Woodson, B. Tillman, and P. Tillman, 1992.

Engineering Psychology and Human Performance by C.D. Wickens, 1990.

Handbook of Human Vibration by M.J. Griffin, 1990.

Human Error by J. Reason, 1990.

Human Performance Engineering, 2nd Ed., by R. Bailey, 1989.

Engineering Data Compendium: Human Perception and Performance edited by K.R. Boff and J.E. Lincoln, 1988.

Dreams—Design and Destiny. *Human Factors,* 29(1), 111-121, by R.J. Hornick, 1987.

Human Engineering Guide to Equipment Design by H.P. Van Cott and R.G. Kinkade, 1972.

Manager's Guide to Workplace Ergonomics, Business Legal Reports, Inc. (periodically updated).

National Safety Council Accident Prevention Manual for Industrial Operations: Engineering and Technology (periodically updated with new editions).

National Safety Council Accident Prevention Manual for Industrial Operations: Administration and Programs (periodically updated with new editions).

Some notable peer-reviewed scientific journals in which human factors and ergonomics data are recorded include:

Accident Analysis and Prevention
Applied Cognitive Psychology
Applied Ergonomics
Ergonomics
Human Factors
IEEE Transactions on Systems, Man and Cybernetics
IIE Transactions
Information Display
International Journal of Ergonomics in Manufacturing
International Journal of Industrial Ergonomics
International Journal of Man-Machine Studies
International Journal of Occupational Safety and Ergonomics
Journal of Applied Psychology
Journal of Experimental Psychology
Journal of Sound and Vibration
Journal of the Acoustical Society of America
Journal of the Optical Society of America
Theoretical Issues in Ergonomics Science
Vision Research

In addition to the above, many important papers are published in the *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* and in journals published by

professional ergonomics societies around the world, including those in Europe and the Pacific Basin.

3. Certification of human factors and ergonomics professionals and accreditation of human factors and ergonomics academic degree programs are established.

Another measure of the professional status of a discipline is achieved when certification of practitioners and accreditation of academic degree programs have been established. Two independent organizations based in the United States, the Board of Certification in Professional Ergonomics (BCPE) and the Oxford Research Institute (ORI), have been providing certification and professional development services to human factors and ergonomics practitioners since 1992. Similar certification boards exist in Europe for the European Union, as well as in Canada, Japan, Australia, and New Zealand. The Human Factors and Ergonomics Society has an ongoing accreditation process for graduate level academic programs in the United States. Certification of practitioners and accreditation of academic programs, although relatively recent developments, demonstrate the continuing advancement of the human factors and ergonomics profession.

4. The utility and value of the human factors and ergonomics discipline have long been recognized by government and corporate groups that support the discipline's growth.

There are many human factors and ergonomics practitioners employed throughout academia, government, and industry. Some notable entities that have recognized the utility and value of their human factors and ergonomics practitioners are:

U. S. Government

National Aeronautics and Space Administration (NASA)
National Transportation Safety Board (NTSB)
National Institute for Occupational Safety and Health (NIOSH)
Office of Science and Technology
U.S. Air Force
U.S. Army
U.S. Navy
U.S. Department of Interior
U.S. Department of Labor
U.S. Department of Transportation
U.S. Federal Aviation Administration
U.S. Coast Guard

Standards Organizations

American National Standards Organization (ANSI)
American Society for Testing and Materials (ASTM)
International Standards Organization (ISO)
Society of Automotive Engineers (SAE)

Industry

Apple Computer
AT&T Corporation
Chrysler Corporation
Deere & Company
Eastman Kodak Company

Industry (continued)

Exxon Mobil Corporation
Ford Motor Company
General Motors Corporation
Herman Miller Corporation
Hewlett-Packard Company
Hughes Aircraft Company
IBM Corporation
Intel Corporation
Liberty Mutual Insurance Company
Lockheed Martin
McDonnell Douglas/Boeing
Microsoft Corporation
Oracle Corporation
Steelcase Corporation
3M Corporation
Xerox Corporation

Summary

The purpose of this document is to present legitimate arguments that rebut typical challenges to expert human factors and ergonomics testimony. Although detail could be given for each of the arguments, it is clear even with this brief presentation, that, in fact:

1. Human factors and ergonomics is an established, internationally recognized scientific discipline and system design profession.
2. The scientific basis for the human factors and ergonomics discipline is well established and continues to grow.

3. Certification of human factors and ergonomics professionals and accreditation of human factors and ergonomics academic degree programs are established.
4. The utility and value of the human factors and ergonomics discipline are recognized by government and corporate groups that support the discipline's growth.
5. The objectives of the civil and criminal justice systems are well served by a greater scientific basis for evaluating human behaviors and potential in court deliberations and judgments.

This document was prepared by members of the Forensic Professional Group (FPG) of the Human Factors and Ergonomics Society in 1996 and revised in July 2004. The FPG is concerned with applying ergonomics and human factors knowledge, data, and techniques to "standards of care" and accountability established within legislative, regulatory, and judicial systems. The FPG serves to provide a scientific and technical focus on issues being interpreted by legal theory and procedures. The FPG was established in 1984 and has approximately 270 members in 2004.

(This revision was prepared by J.R. Duncan, H.W. Hendrick, R.J. Hornick, M.S. Wogalter, and R.A. Olsen, who also coordinated the effort.) 9/04