CURRICULUM VITAE
DAVID D. WOODS, Professor
Dept. of Integrated Systems Engineering

The Ohio State University
1971 Neil Ave, Columbus, OH 43210
woods.2@osu.edu 614-946-0123

EDUCATION:

Ph.D. Purdue University, 1979, Cognitive Psychology
M.S. Purdue University, 1977, Experimental Psychology
B.A. (cum laude) Canisius College, 1974, Psychology

PROFESSIONAL EXPERIENCE:

The Ohio State University:

Professor,	1996 to present	*Appointments:*
Associate Professor,	1990-1996	Industrial and Systems Engineering,
Assistant Professor,	1988 to 1990	Industrial Design, Anesthesiology,
		Institute for Ergonomics

Westinghouse Research & Development Center, Pittsburgh, PA. 1979 to 1988, Senior Engineer

Created and managed a research program which studied human performance and error, control room design, human-computer interaction and the development of intelligent support systems. Principal investigator in external (sponsors included Electric Power Research Institute, Electricite de France, US Nuclear Regulatory Commission) and internal research projects. Five patents.

President, Resilience Engineering Association, 2011-2013.

President, Human Factors and Ergonomic Society, 1998-1999

Summary

For 36 years, studied the interaction of people and technology in complex, high performance, risk-critical settings across in crisis response, nuclear power emergencies, in pilot-automation teams, in anomaly response in space shuttle mission operations, in critical care medicine, in replanning military missions, and in professional information analysis. He has investigated accidents in these areas including acting as an advisor to the Columbia Space Shuttle Accident Investigation Board.

Frequently asked to advise government and industry organizations on pressing societal needs at the intersection of people and technology. Recent examples include FAA Human Factors and Cockpit Automation Team (2013), and the Defense Science Board Task Force on Autonomy (2012), US National Academy committee on Autonomy in Civil Aviation (2014). He has received many awards including the Ely Award for best paper in the journal Human Factors (1994), a Laurels Award from Aviation Week and Space Technology (1995) for research on the human factors of highly automated cockpits, the Jack Kraft Innovators Award from the Human Factors and Ergonomics Society (2002),

His current work focuses on building resilience to create proactive safety management. He identified the problem of brittleness in systems of people and automated and intelligent machines, first in the mid-1980's. He has been President of the Resilience Engineering Association and of the Human Factors and Ergonomics Society. His results on resilience in action and the dangers of brittle systems can be found in the books *Resilience Engineering: Concepts and Precepts* (2006), *Resilience Engineering in Practice* (2011). He is also the author of *A Tale of Two Stories: Contrasting Views of Patient Safety* (1998), *Joint Cognitive Systems: Foundations of Cognitive Systems Engineering* (2005) and *Joint Cognitive Systems: Patterns in Cognitive Systems Engineering,* 2006), and *Behind Human Error* (first edition 1994; second edition 2010).

Achievements

Resilience engineering for safety in complex systems 2000—present

Proposed and began to develop Resilience Engineering beginning in 2000-2003 as part of the response to several NASA accidents. Led first international meeting and first book on Resilience Engineering. His results on resilience in action and the dangers of brittle systems can be found in 20 papers and book chapters on resilience in socio-technical systems which have been cited over 3,000 times.

• Invited talk, NASA Invited Testimony to US Congress, Senate Committee on Commerce, Science and Transportation on safety at NASA and the need to develop Resilience Engineering, "Future of NASA", Washington DC, October 29, 2003.

• Co-organizer, First International Symposium on Resilience Engineering, October 20-25, 2004 Söderköping, Sweden. (22 + participants from 12 countries).

• Invited talk, Resilience as a Paradigm for Safety Management, NASA Ames Research Center, February 15, 2005.

• Co-editor and author of 7 chapters, *Resilience Engineering: Concepts and Precepts,* Ashgate*,* 2006, cited over 1400 times.

• Co-organizer, International Seminar on Resilience Engineering, Rio de Janeiro Brazil, December 12-13, 2006.

• Since 2008, taught course on Resilience Engineering: Introduction to the concept of "resilience" in systems engineering and its application to design and management problems in safety, risk management, and sustainability. Examines models and measures of adaptive capacity and multi-agent layered networked systems.

• Keynote address, International Symposium on Resilient Control Systems, Idaho National Laboratory/ IEEE, Idaho Falls, August 11-14, 2009.

• Lead, OSU Initiative on Complexity in Natural, Social and Engineered Systems, 2009 to 2014.

• Advisory Board, Resilient Control Systems Group, Idaho National Laboratory, 2010-2013.

• Keynote address on Resilience Engineering, Annual Meeting of the Société d'ergonomie de langue française (SELF), Liege, Belgium, 9-13-10, 2010.

• **President**, Resilience Engineering Association, 2011-2013.

• Invited speaker, Workshop on Building a Resilient Workforce. See Woods, D. D. (2012). High-Reliability Organizations and Complex Adaptive Systems. In H. M. Colvin and R. M. Taylor (eds.), *Building a Resilient Workforce: Opportunities for the Department of Homeland Security - Workshop Summary*, National Academies Press, pp. 63-69.

• Invited speaker, Ideas to Innovation (I2I) workshop on "Stimulating Collaborations in the Application of Resilience Engineering to Healthcare, University-Industry Demonstration Project, National Academy of Science, June 13-14, 2013.

• Co-Organizer (Head, Organizing Committee, Program Committee), 5th Symposium on Resilience Engineering, 'Resilience Engineering: Managing trade-offs'. 24-27 June, 2013, Soesterberg, The Netherlands (140 participants from 20 countries, 67 papers, 8 workshops).

• Presidential Address, The State of Resilience Engineering: Progress and Challenges. 5th Symposium on Resilience Engineering, 25 June, 2013.

• Led a 4 hour workshop on Foundations of Resilient Control Systems jointly with Professor John Doyle of the California Institute of Technology during the 5th International Symposium on Resilient Control Systems, San Francisco CA, August 14, 2013.

• Invited Plenary Speaker, Workshop on Analytical Support for Societal and Regional Resiliency in Support of National Security, Decision and Information Sciences Division, Organized by Argonne National Laboratory and Military Operations Research Society (MORS), Argonne IL, September 10 to 12, 2013.

• Co-organizer and speaker, Powering the Drive for Resilient Societies and Enterprises: The Fundamental Science and Engineering for Building Resiliency, Panel of presentations for Transatlantic Science Week, Washington DC, November 13, 2013.

• Invited Seminar on Resilience Engineering, Systems Integration Division, National Institute of Standards and Technology (NIST), "Brittleness and Resilience: A Challenge for Modern Complex Systems and Networks," Gaithersburg, MD, February 20, 2014.

• Invited Keynote Address, Reaching Resilience. Velocity: Web Operations and Performance, O'Reilly Media, NY, NY, September 15-18, 2014.

• Co-Organizer, 6th Symposium on Resilience Engineering, 'Resilience Engineering: Managing resilience, learning to be adaptable and proactive in an unpredictable world,' 22-25 June, 2015, Lisbon, Portugal.

• Co-organizer, Resilience Engineering: 10th Anniversary Seminar. Abbaye Sorreze, France, October 29-31, 2014.

• Electronic course on Resilience Engineering, produced January-March 2015: http://csel.org.ohio-state.edu/ResilienceEngineering.html

• Invited Speaker, "Reaching Resilience," 30th Emerging Issues Forum: Innovation Reconstructed, North Carolina State University, Raleigh, NC, February 9-10, 2015.

Patient safety in health care 1996—present

Following a series of a publicized and severe patient injuries and deaths due to medical mistakes, helped US health care leaders strategize how to make patient safety a national priority and launch the patient safety movement. Helped health care translate and transfer results/best practices from other areas (human factors in aviation, crisis management, and process control).

• In 1996 invited contributor to the First Conference On Patient Safety, Annenberg Center For Health Sciences, Palm Springs California February 6, 2015 and helped plan sessions at the Second Conference "Enhancing Patient Safety and Reducing Errors in Health Care" in 1998.

• Helped to launch the National Safety Patient Foundation in 1996 including Board Member and Executive Committee, 1996 to 2002 and invited contributor at symposium to plan the foundation's patient safety agenda, February 21, 1997.

• Co-Director and organizer, Assembling the Scientific Basis for Patient Safety, Expert Working Group (50 attendees) for the National Patient Safety Foundation, Chicago IL, December 17-18, 1997.

• Invited Member, Executive Session on Medical Error and Patient Safety, Kennedy School of Government, Harvard University, 1998-1999. Harvard Executive Sessions are a forum for generating new ideas to begin organizational change on important public policy issues. The initiative on patient safety consists of 24 members including 10 heads of health care organizations, senior regulators, and a former NASA administrator.

• Led a three year patient safety culture change campaign for the Veterans Health Administration of Ohio:

~ Proposed, set up and executed a Center for Inquiry on Patient Safety that conducted a campaign to build a safety culture in the Veterans Health Administration of Ohio, funded by the national Veterans Health Administration.

~ Served as Associate Director of the Center, 1999 to 2002.

~ Developed and implemented a multi-faceted set of activities to promote a culture of learning about patient safety at all organizational levels for all of the multiple Veterans Health Administration facilities in Ohio. The campaign included a variety of activities such as a role play simulation of an accident investigation with diverse participants from senior management to clinicians in multiple technical areas.

~ Developed in 2000 and delivered several times a distant learning course on patient safety to transfer expertise to medical professionals and adminsitrators. http://csel.org.ohio-state.edu/productions/pex-is/getstarted/index.html

Strategic Directions in R&D

Frequently invited to provide advice to national, government, and industry organizations on pressing societal issues related to socio-technical systems.

Invited Committee Member, Committee on Autonomy in Civil Aviation. National Research Council, Aeronautics and Space Engineering Board, July 2013 to July 2014.

Invited Briefing to board members of the National Transportation Safety Board on Mode Awareness and Aviation Safety, Washington DC, February 21, 2014.

National Research Council (2014). Autonomy Research for Civil Aviation: Toward a New Era of Flight. Washington DC: National Academies Press, , http://www.nap.edu/catalog.php?record_id=18815

Member, CAST/PARC/FAA Flight Deck Automation Working Group, 2013.
Final report: Abbott, K., McKenney, D. and Railsback, P. (2013). Operational Use of Flight Path Management Systems. Final report of the Flight Deck Automation Working Group, Performance-based operations Aviation Rulemaking Committee PARC / Commercial Aviation Safety Team CAST / FAA. http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afs/afs400/parc/parc_reco/media/2013/130908_PARC_FltDAWG_Final_Report_Recommendations.pdf

Member, Defense Science Board Task Force on Autonomy (2010-2012).

Final Report: Murphy R. R. and Shields, J. (2012). The Role of Autonomy in DoD Systems, Task Force Report, Office of the Secretary of Defense, July. http://fas.org/irp/agency/dod/dsb/autonomy.pdf

Invited Committee Member, "Sufficient Evidence? Building Certifiably Dependable Systems." Computer Science and Telecommunications Board, National Academy of Science. Final report: Software for Dependable Systems, National Academies Press, 2007.

Invited Speaker, Symposium on "The Social Life of Machines" honoring Donald A. Norman, the 2006 Benjamin Franklin Medal in Computer & Cognitive Science, Franklin Institute, Philadelphia, PA, April 27, 2006.

Invited panel member, National R&D Agenda for Visual Analytics, National Visual Analytics Center, PNNL and Department of Homeland Security, 2004.

Invited Testimony to Senate Committee on Commerce, Science and Transportation on the "Future of NASA" following the Columbia space shuttle accident. Washington DC, October 29, 2003.

Invited Speaker, Congressional Briefing, The Mechanics of Election Reform: From Registration To Results. Sponsored by American Political Science Association, American Psychological Association and the Consortium of Social Science Associations. Washington DC, March 16, 2001.

Invited Testimony, Technology and the Voting Process Hearing, Committee on House Administration, Longworth House Office Building, Washington DC, May 24, 2001. (www.house.gov/cha/business/business.html)

Organizing Committee and Working Group Leader, NSF/DARPA Workshop on Human-Robot Interaction, San Luis Obispo, CA, September 28-29, 2001.

> Workshop designed to bring together leading roboticists and specialists on human-computer cooperation to develop assessment of the current state and plan future research directions on human-robot interaction.
>
> http://users.csc.calpoly.edu/~erogers/HRI/

Steering Group and Working Group Head, NSF Workshop on Human-Centered Intelligent Systems, Washington DC, February, 1997.

> Planning workshop for a new initiative from the Computer and Information Sciences Directorate to help users cope with the overload of data and complexity in electronic media.

Invited Participant and Working Group Chair, National Science Foundation Workshop on Human Performance in the Complex Workplace: Implications for Basic Research in Cognitive Science, September, 11-12, Alexandria VA, 1992.

> Led one of the working groups to help NSF plan how their research agenda in Cognitive Science can better address the human performance issues important to different government agencies and industries.

Technical Advisor to FAA Human Factors Study Team on Advanced Flight Decks, Fall 1994 to July 1996

> Served as Technical Advisor to a special team of FAA certification personnel set up to make recommendations on safety on highly automated flight deck given accidents that involved breakdowns in team play between the flight crew and the automation. This committee gathered data from all stake holders in the research, development, certification and operations of advanced aircraft (manufacturers, avionics developers, cockpit designers, airline companies, industry groups, and pilots unions in the US and in Europe), and develop a set of recommendation to ensure the highest levels of safety (final report and recommendations published by FAA in July 1996.

Member, Nuclear Safety Research Review Committee, U.S. Nuclear Regulatory Commission, 1990 to 1993.

> This committee provides advice to the Director of the Office of Nuclear Regulatory Research of the Nuclear Regulatory Commission on matters of overall management importance in the direction of the Nuclear Regulatory Commission's program of nuclear safety research. The committee is regularly briefed on NRC research plans and activities, reviews the research and advises the Director on ways that the research program can be more effective.

Executive Committee and Contributor, Workshop on Human Error in Anesthesia, sponsored by FDA and the Anesthesia Patient Safety Foundation, Feb. 26-March 1, 1991.

> Helped to organize international meeting that brought together for the first time researchers on human error and researchers in anesthesia to examine anesthesia safety.

Panel Member, National Research Council panel on Human Behavior and Nuclear Safety, 1987 to 1988.

Developed a research agenda to consider the human contribution to risk and safety in the nuclear power industry.

Research Management Experience

Principal Investigator on over $19 million in sponsored research from 1989 to present at the Ohio State University.

• Leadership team for a 8 year $40 million university/business/government consortium of 14 organizations addressing the topic of Advanced Decision Architectures, sponsored by the Army Research Laboratory, 2001-2009.

Responsible for about 40% of the budget $40 million in research projects which involved collaborations across multiple partnering organizations.

As 1 of 3 technical area leads, responsible for annual program planning for $2-3 million per year in consortium projects on computerized user-centered decision support systems, including robotics, layered sensing, collaboration (CSCW), cognitive models, adaptive systems, surveillance, command, risky decisions (@$18 million). As area lead responsible for oversight of budgets, assessment of project progress, annual re-planning of project goals, reporting program accomplishments, facilitating transfer of results.

Created an effective portfolio of projects coordinating across the partnering organizations to meet multiple goals for different stakeholders: given the scale and visibility of the consortium, the portfolio of projects and results included scientific advances, advanced technology development, and successful transfer of results to end-user organizations.

PI for OSU-led projects in the program which totaled $8.4 million.

Research Impact:

H index (measure of research impact) > 74 (6/22)[1]

work cited > 20K **Among the most influential research on human-machine systems as measured by citations. His books have been translated into Spanish, Japanese, and Italian.**

books / monographs	4 / 2	books, co-editor	4
multimedia productions	15	keynote/plenary addresses	>37
book chapters, total	72	handbook chapters	12
journal articles	88 (since 1983)	patents	5

One paper was named to the top 30 papers in the 50 year history of the journal "Human Factors" (Cooke and Salas, 2009).

Two publications were named to the top 100 papers in the history of the field of Human Factors (Moray, 2005).

One paper reprinted for 30th anniversary of the International Journal of Human-Computer Studies, 1999.

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[1] based on Google scholar citation search (5-20-015). H index is the number of publications with at least that number of citations; '40' means 40 papers with at least 40 citations each. See Hirsch J. E., PNAS (2005) http://www.pnas.org/content/102/46/16569 . The #s in parentheses are the # of publications with more than 500/200 citations.

Honors/Awards:

Over his 36 years of R&D in high risk, high performance settings, he has received many awards such as a Laurels Award from Aviation Week and Space Technology (1995).

Jimmy Doolittle Fellow Award for Research on Human Performance, Air Force Association, Central Florida Chapter, 2012.

Best paper award, 5th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2008), Washington DC, May 4-7, 2008.

2008 Google Research Award, Google, Mountain View CA

2005 IBM Faculty Award, Watson Research Center.

2002 Jack A. Kraft Innovator Award, Human Factors and Ergonomic Society, for advancing Cognitive Engineering and its application to safer systems.

1995 Laurels Award, Aviation Week and Space Technology, January 29, 1996, Commercial Air Transport category, for research on cockpit automation.

1994 Ely Award for best paper in Human Factors,for studies of integrated pattern displays.

Fellow, Human Factors and Ergonomic Society, 1994.
American Psychological Society, 1990.
American Psychological Association (Div. 21--Engineering Psychology), 1988.

Best professional paper award, Test & Evaluation Technical Group, Annual Meeting of the Human Factors and Ergonomic Society, 1994.

Outstanding Faculty Award, voted by Alpha Pi Mu undergraduate industrial engineering honorary society, 1990.

Westinghouse Engineering Achievement Award, 1984.

Sponsored Research Projects:

His research has addressed a wide range of risk-critical settings with a wide range of sponsors such as:

Health care--patient safety; critical care; handovers (Anesthesia Patient Safety Foundation, Veterans Health Administration)

Emergency response (Army Research Laboratory, Nuclear Regulatory Commission, EPRI)

Information (intelligence) analysis (Dept. of Defense, ARDA, Army Research Laboratory)

Highly automated flight decks in aviation (NASA Ames Research Center, Federal Aviation Administration, NASA Langley Research Center).

Air traffic management (NASA Ames Research Center, DFS Germany)

Power plant control rooms (Nuclear Regulatory Commission, AECL, Westinghouse, EPRI)

Distributed command and control, Information warfare (Human Effectiveness Directorate AFRL, Army Research Laboratory)

Sensor Networks, Computer Vision and Human Perception (NSF, Air Force Research Laboratory)

Space mission operations centers (NASA Johnson Space Center)

Perceptual and Attentional Technologies for Networks of Sensors, UAVs and Robots, Air Force Research Laboratory, 2008-2016, $1.3 million

A series of projects sponsored by AFRL in conjunction with several defense contractors to develop new technology to extend perception through networks of sensors and robots. Innovated perspective or viewpoint control technology to handle the multiple feed problem, keyhole (or soda straw) problem and other perceptual limitations associated with seeing a distant world through sensors on robots. Developed a computational model of artificial attention that refocuses across feeds from multiple sensors at different spatial and temporal scales.

Advanced Decision Architectures, Army Research Laboratory, 2001-2009, $8.4 million
A university/business/government consortium of 14 organizations with over $40 million in research projects on computerized user-centered decision support systems, including robotics, layered sensing, collaboration (CSCW), cognitive models, adaptive systems, surveillance, command, risky decisions. As an area lead, responsible for annual program planning for about $5 million per year in consortium projects.

Cognitive Systems Engineering for Innovation in Information Analysis and Comprehension, Department of Defense, 2004-2009, $1.7 million
Develop promising new directions to cope with data overload in information analysis and synthesis tasks and demonstrate innovation methods in human-centered design of advanced technologies. Results include studies and measures to assess the rigor of analytic process, studies of adversarial intent, studies of team cognition in analysis, cross-cultural factors, technology forecasting.

Macro-Cognitive Metrics, Air Force Research Laboratory (through SRA), 2006-2009, $.7 million
Develop, evaluate and synthesize promising new measures to assess macro-cognitive functions such as anomaly response, sense making and re-planning, to assess coordination in distributed teams such as synchronization, and to assess the resilience and adaptive capacity of complex systems.

Multi-level, Active Attention Surveillance, National Science Foundation, 2004-2007, $1.3 million (Co-PI)
Collaboration with computer vision researchers to develop layered sensing systems that link smart and decentralized sensing to distributed decision making systems.

US-Brazil Higher Education Consortia Program (FIPSE/CAPES), Department of Education, 2003-2007, $198,980
Undergraduate engineering student exchange program between 2 U.S. and 2 Brazil universities, "Training Industrial Engineers to Manage High-Risk, Complex Systems: Applying Cognitive Engineering to Human Error and Automation."

PI in other Sponsored Research Projects:
- Maximizing Visualization Effectiveness, National Imagery and Mapping Agency, 2002 to 2004.
- Scenario-based evaluation of distributed crew interaction, NASA Johnson Space Center, 2002 to 2003.
- Center for Inquiry on Patient Safety, Veterans Health Administration, 1999 to 2003
- Creating Safety And Reducing Medical Errors With Bar Coding, Veterans Health Administration, 1999 to 2003.
- Orientation For Intervention: Supporting Mission Awareness In Space Operations, NASA Johnson Space Center, 1998 to 2001.
- Aiding The Intelligence Analyst In Situations Of Data Overload, Air Force Research Laboratory, 1996-1999.
- New Concepts for Supporting Anomaly Response, NASA Johnson Space Center, 1995 to 1999.
- Human Interaction Concepts for Cooperating Automation, NASA Johnson Space Center, 1995 to 1998.

• Enhancing Human-Human and Human-Computer Cooperation in Aeromedical Evacuation Planning and Reactive Replanning, Department of Defense, 1995 to 1997.
• Cognitive Factors in the Interface between Flight Crews and Modern Flight Deck Systems, NASA Langley Research Center, 1994 to 1996.
• The Price of Flexibility: Air-Ground Coordination with Digital Communication (DataLink), Federal Aviation Administration, 1993 to 1997.
• Controlling through the Computer: Opportunities and Problems with Soft Controls, AECL Canada, 1993 to 1995.
• New Concepts for Supporting Cooperative Fault Management, NASA Johnson Space Center, 1993 to 1994.
• Anesthesiologist-Technology Interaction in the Operating Room, Anesthesia Patient Safety Foundation, 1993 to 1994.
• How to Make Intelligent Systems Team Players, NASA Johnson Space Center, 1990 to 1994.
• Cognitive Engineering in Aerospace Applications, NASA Ames Research Center, 1989 to 1996.

Professional Service:

President, Resilience Engineering Association, 2011-2013
President, Human Factors and Ergonomic Society, 1998-1999
Executive Council, Human Factors and Ergonomic Society, 1997-2000
Editorial Board, Human Factors, 1993 to 1997
International Journal of Human-Computer Studies, 1991 to 1996
International Journal of Cognitive Ergonomics, 1996 to 2001
Le Travail Humain, 1991 to 2001.
Cognition, Technology and Work, 1999 to present.
Special Issue Editor, IEEE SMC-A, Nov. 2004.
Human Factors, 42(1), 2000.
International Journal of Man-Machine Studies, 27, 1987.
Board Member and Executive Committee: National Patient Safety Foundation, 1996 to 2002.
Associate Director: Center for Inquiry on Patient Safety, Veterans Health Administration, VISN 10, Ohio, 1999 to 2002.

Teaching:

Graduate student advising:
• academic year 14-15: 5 advisees (3 PhD, 1 MS)
• advised: 22 PhD students; 24 MS students; 5 MFA students in Industrial Design

Courses developed:

Behind Human Error: How Complex Systems Fail (originated in 1989): electronic course resource set developed 2001.Uses a case based method to examine the factors that influence human performance, how complex systems fail, how poor design creates predictable forms of error, how hindsight bias blocks organizational learning, how organizations can be resilient or brittle. http://csel.eng.ohio-state.edu/pexis

Designing Visualizations to Escape from Data Overload (originated in 1989)
Based on series of design exercises, class builds skills in visualization and representation design to overcome the penalties of data overload. Human-computer interaction techniques covered include pattern based visualizations, analog representations of complex concepts, navigation in large virtual data fields, and visual thinking.

How to Study Cognitive Systems in Context (originated in 1989)

Covers field research methods knowledge elicitation, scenario design, direct observation, critical incidents, process tracing, protocol analysis, scaled world simulations, envisioning promising designs, large scale exercises as learning labs, system evaluation. Studies examined demonstrate measures of cognitive work, coordination of distributed activity, and system adaptive capacity.

Human Collaboration with Intelligent and Automated Systems (originated in 1990)

Covers paradigms for cooperative human-machine problem solving and coordination of distributed work over multiple groups. Topics include: how to make automated and intelligent systems team players including human-centered automation, the design of computer based advisory systems, supervisory control, software agents, computers as critics, human-robot interaction.

Introduction to Cognitive Systems Engineering (since 1988)

Origins and foundations of Cognitive Systems Engineering. Applications of concepts and techniques to human error, automation surprises, human-robot interaction, data overload, re-planning, anomaly response, distributed work.

Systems Thinking & Introduction to Complexity (originated in 2006)

Concepts and heuristics in systems thinking and how to apply them to engineer complex projects in aerospace, health care, energy, security and other fields. Systems engineering concepts are ap plied to problems in managing complexity of development projects, reliability of software intensive systems, expanding adaptive control, system of systems design, and coordination of distributed work systems.

Information Analysis and Comprehension (originated in 2006)

Introduction to professional analytics for finding in meaning in massive data fields in engineering, intelligence/security, business, and health care with special focus on factors that make analytical processes shallow or rigorous. Course method: students perform information analysis exercises (energy safety analysis revised for terrorism threats, counter intelligence in asymmetric conflict) and examine cases from finance (fraud detection), space missions (Columbia space shuttle accident and the return to flight decision), intelligence (Yom Kippur war surprise), and security analysis.

Resilience Engineering (originated in 2008):

Introduction to the concept of "resilience" in systems engineering and its application to design and management problems in safety, risk management, and sustainability. Examines models and measures of adaptive capacity and multi-agent layered networked systems.

Special offerings:

Institute for Collaborative Innovation, Summer Institute, 2005, 2006, 2007 and 2009

Uses innovation methods to develop promising solutions to sensemaking and data overload problems in information analysis and comprehension tasks. About 25 people ranging from UGs to visiting professors from 5-6 different disciplines (e.g., design, art&technology, cognitive eng., international security, linguistics, psychology) and multiple universities participate in a 10 week process. It culminates in a show that utilizes complex scenarios (such as the interaction of energy and security issues in multi-organization/cross-cultural settings) to demonstrate design seeds on themes such as uncertainty, culture, rigor, intent, hypothesis exploration, time value of information, visualization, and team cognition.

Design Project Classes:

- 1995 Apple Design Project, Integrating Physical and Virtual Environments, sponsored by Apple Computers.

• 1999 Image Overload, sponsored by Kodak.

Complete Lists of Invited Talks, Keynotes, Advisory Activities

Recent Service To Human Factors/Cognitive Science:

Invited Committee Member, "Sufficient Evidence? Building Certifiably Dependable Systems." Computer Science and Telecommunications Board, National Academy of Science. Final report: Software for Dependable Systems, National Academies Press, 2007.

Invited Speaker, Symposium on "The Social Life of Machines" honoring Donald A. Norman, the 2006 Benjamin Franklin Medal in Computer & Cognitive Science, Franklin Institute, Philadelphia, PA, April 27, 2006.

Invited Testimony to Senate Committee on Commerce, Science and Transportation on the "Future of NASA" following the Columbia space shuttle accident. Washington DC, October 29, 2003.

Invited Speaker, Congressional Briefing, The Mechanics of Election Reform: From Registration To Results. Sponsored by American Political Science Association, American Psychological Association and the Consortium of Social Science Associations. Washington DC, March 16, 2001.

Invited Testimony, Technology and the Voting Process Hearing, Committee on House Administration, Longworth House Office Building, Washington DC, May 24, 2001. (www.house.gov/cha/business/business.html)

Selected Service And Projects For Government And Industry:

Resilience

Keynote Address at Workshop "Anything can happen – Resilience in Crisis Management", SINTEF, Trondheim, Norway, February, 5, 2016.

Invited talk at Workshop on Risk and Resilience in the Face of Global Change, Aspen Global Change Institute, November 30 to December 5, 2015, Aspen CO.
https://vimeo.com/user17601098/review/156865482/5c9737f801

Keynote talk, Pace x pressure: The wisdom of being fast and fresh as anomalies cascade, Financial Systems track, Velocity Conference: Web Operations and Performance, New York, October 12-14, 2015.

Invited Lecture, Is a Comprehensive Theory of Resilience Possible? Resilience Week, Philadelphia PA, August 2015.

Co-Organizer, 6th Symposium on Resilience Engineering, 'Resilience Engineering: Managing resilience, learning to be adaptable and proactive in an unpredictable world,' 22-25 June, 2015, Lisbon, Portugal.

Invited Talk, Resilience in Tangled Layered Networks, International Symposium on Sustainable Systems and Technology, Dearborn, MI, May 2015.

Invited Speaker, 30th Emerging Issues Forum: Innovation Reconstructed, North Carolina State University, Raleigh, NC, February 9-10, 2015.

Lead Speaker, TORC Project Workshop, Paris France, October 27-28, 2014

Co-organizer, Resilience Engineering: 10th Anniversary Seminar. Abbaye Sorreze, France, October 29-31, 2014.

Invited Keynote Address, Velocity: Web Operations and Performance, O'Reilly Media, NY, NY, September 15-18, 2014.

Invited Seminar, Systems Integration Division, National Institute of Standards and Technology (NIST), "Brittleness and Resilience: A Challenge for Modern Complex Systems and Networks," Gaithersburg, MD, February 20, 2014.

Co-organizer and speaker, Powering the Drive for Resilient Societies and Enterprises: The Fundamental Science and Engineering for Building Resiliency, Panel of presentations for Transatlantic Science Week, Washington DC, November 13, 2013.

Invited Plenary Speaker, Workshop on Analytical Support for Societal and Regional Resiliency in Support of National Security, Decision and Information Sciences Division, Organized by Argonne National Laboratory and Military Operations Research Society (MORS), Argonne IL, September 10 to 12, 2013

Led a 4 hour workshop on Foundations of Resilient Control Systems jointly with Professor John Doyle of the California Institute of Technology during the 5th International Symposium on Resilient Control Systems, San Francisco CA, August 14, 2013.

Co-Organizer (Head, Organizing Committee, Program Committee), 5th Symposium on Resilience Engineering, 'Resilience Engineering: Managing trade-offs'. 24-27 June, 2013, Soesterberg, The Netherlands (140 participants from 20 countries, 67 papers, 8 workshops).

Presidential Address, The State of Resilience Engineering: Progress and Challenges. 5th Symposium on Resilience Engineering, 25 June, 2013.

Health Care

Invited speaker, Ideas to Innovation (I2I) workshop on "Stimulating Collaborations in the Application of Resilience Engineering to Healthcare, University-Industry Demonstration Project, National Academy of Science, June 13-14, 2013.

Invited testimony to IOM/NRC Committee on Patient Safety and Health Information Technology, February 24, 2011, Irvine CA.

Invited speaker, Surgical Outcomes Club, In association with Annual Meeting of the American College of Surgeons, Washington DC, October 3, 2010.

Invited speaker, Workshop on Cognitive Complexity and Patient Safety, McDonnell Foundation, Sedona AZ, October 26-28, 2009.

Invited speaker, Ninth Canadian Healthcare Safety Symposium, Montreal, Quebec, October 22-24, 2009.

Invited speaker, Health Care Transformation Through Systems Approaches. MacArthur Foundation Roundtable. The John D. and Catherine T. MacArthur Foundation. Chicago, IL, January 23, 2007.

Invited speaker, Expert Meeting on Healthcare Safety Management, Haute Autorité de Santé, Paris, May 22-24, 2006.

Invited contributor, National Academies Initiative in Health Informatics: Defining Domains for Action, Challenges, and Tasks. Washington DC, May 1-2, 2006.

Invited Committee Member, Engineering the Delivery of Health Care: Priorities For Application And Research, Joint National Academy of Engineering/Institute of Medicine Study Panel, September 2002 to July 2005.

Associate Director, Center for Inquiry on Patient Safety, Veterans Health Administration, VISN 10, Ohio, 1999 to 2002.

The Center carries out a number of research and organizational activities to promote a culture of learning about patient safety. One production is 'The Day After' – an accident investigation role play simulation that involves about 40 participants for a one and one half day workshop.

Invited contributor, Workshop on Improving Medical Device Safety: Supporting Resilience and Innovation in Healthcare Organizations. University of Chicago, Chicago, IL, September 19-22, 2002.

Invited Member, Executive Session on Medical Error and Patient Safety, Kennedy School of Government, Harvard University, 1998-1999.

Harvard Executive Sessions are a forum for generating new ideas to begin organizational change on important public policy issues. The initiative on patient safety consists of 24 members including 4 Harvard faculty and 10 heads of health care organizations, senior regulators, and a former NASA administrator.

Advisor, National Safety Patient Foundation, Fall 1996 to 2002

- Chair, National Health Care Safety Council, 1996-2002
- Member, Executive Committee and Governing Board, June 1997 to 2002.
- Research Committee, National Safety Patient Foundation, 1996-2001.
- Invited Contributor, National Safety Patient Foundation symposium to plan the foundation's patient safety agenda, February 21, 1997.

Recent invited talks to advise various health care organizations on patient safety:

- Deans Lecture, Vanderbilt Medical Center, January, 15, 2009.
- Invited speaker, Advancing Patient Safety in Surgery Conference, The Royal College of Surgeons of Edinburgh, Edinburgh Scotland, November 15, 2007.
- Keynote address, Conference for Medical Product Safety Network (MedSun), FDA Center for Devices and Radiological Health, Falls Church, VA, March 26–27, 2007
- Invited speaker, Safety of the Third Kind: Making Organization Resilient. Pursuing Perfection Project Workshop, Robert Woods Johnson Foundation and Institute for Healthcare Improvement, Cincinnati, OH, October 3-4, 2006.
- Invited talk, Symposium on Advances in Patient Safety and Medical Simulation, Vanderbilt University Medical Center, February 3, 2006, titled "Engineering High Resilience for Patient Safety."
- Plenary Address, Making Health Care Safer 2004, Royal College of Physicians and British Medical Journal, London, October 16-17, 2004.
- Invited Speaker, Escaping Conflicts between Learning and Accountability in Patient Safety. 10th Annual Clifford Symposium on Tort Law and Social Policy. Starting Over?: Redesigning the Medical Malpractice System. DePaul Law School, Chicago IL, April 15-16, 2004
- Keynote address, Escape from Data Overload, VHA eHealth University, Annual Meeting, Veterans Health Administration, Dallas TX, May 24-25, 2004 (over 1,000 attendees).
- Plenary Address, Second Annual Patient Safety Conference, San Diego Center for Patient Safety, March 19, 2004, San Diego, CA.
- Making Computers Team Players. R. Macklis, organizer, Promoting Patient Safety: Is technology the solution? April 30, 2001, The Cleveland Clinic.
- Creating Safety Under Pressure, L. Diamond Memorial Lecture, Renal Physicians Association, March 26, 2001, Washington DC.
- Testimony on behalf of Human Factors and Ergonomics Society, Research Summit, Agency for Healthcare Research and Quality, September 11, 2000, Washington DC.

• Clinical Quality Improvement Forum, AMA, April 28, 2000, Chicago IL
• Ohio State Medical Association and Ohio Hospital Association, Joint Task Force on Medical Error, March 31, 2000
• National Academy for State Health Policy, March 20, 2000, Boston MA
• Briefing for Senate staff, Human Factors and Patient Safety, February 8, 2000.
• University of Texas Medical Center, Department of Medical Informatics, February 10, 1999, Houston.
• Advisor, Veterans Health Administration on Patient Safety System Design, 1998.
• Advisory Panel Meeting, Washington DC, March 12-13, 1998.
• Work Group Meeting on Patient Safety Reporting, Analysis and Reporting, Dallas TX, June 10-12, 1998.

Aerospace

Led Workshop on Proactive Safety and Resilience, Frankfurt Tower ATC, DFS Deutsche Flugsicherung Safety Department Frankfurt Germany, February, 9, 2016.

Keynote Address, Reaching Resilience, Norwegian Civil Aviation Conference / Luftfartskonferansen, Bodo Norway, February 3, 2016.

Led Workshop on Proactive Safety and Resilience, Norwegian Civil Aviation Conference / Luftfartskonferansen, Bodo Norway, February 3, 2016.

Invited Address, EuroControl Workshop on System Safety & Human Performance, Barcelona, Spain, October, 5-7, 2015.
http://www.skybrary.aero/index.php/Portal:Human_Factors_and_System_Safety_Seminar

Invited Speaker, Workshop on System Safety & Human Performance, EuroControl, ES2-WS3-13, Lisbon, Portugal, September 24-26, 2014.

Invited Committee Member, Committee on Autonomy in Civil Aviation. National Research Council, Aeronautics and Space Engineering Board, July 2013 to July 2014.

National Research Council (2014). Autonomy Research for Civil Aviation: Toward a New Era of Flight. Washington DC: National Academies Press, , http://www.nap.edu/catalog.php?record_id=18815

Invited Briefing to board members of the National Transportation Safety Board on Mode Awareness and Aviation Safety, Washington DC, February 21, 2014.

Led a 2 day workshop on System Safety & Human Performance: Why Things Go Right, with Professors Chris Johnson (Scotland) and Erik Hollnagel (Denmark) for EuroControl, ES2-WS3-13, Dublin, Ireland, September 26-27, 2013.

In Air Traffic Management, developed a partnership with DFS Deutsche Flugsicherung Safety Department to implement Resilience Engineering techniques in their Proactive Safety Management process (including scientific advisor on for their Air Navigation Safety Projects).

Member, CAST/PARC/FAA Flight Deck Automation Working Group, 2013.

Final report: Abbott, K., McKenney, D. and Railsback, P. (2013). Operational Use of Flight Path Management Systems. Final report of the Flight Deck Automation Working Group, Performance-based operations Aviation Rulemaking Committee PARC / Commercial Aviation Safety Team CAST / FAA. http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afs/afs400/parc/parc_reco/media/2013/130908_PARC_FltDAWG_Final_Report_Recommendations.pdf

Invited speaker, Automation and Technology in Aviation, Air Safety Forum, Air Line Pilots Association (ALPA), Washington DC August 9, 2012.

Member, Independent Safety Review Team, Air France, December 2009 to December 2010.

NSF/AUVSI/FAA/DHS workshop on Unmanned Aerial Systems: Research Directions for the National Air Space, San Diego, CA, June, 2008.

Seminar on Resilience Engineering for Safety Management, for NASA Shuttle Program and Shuttle Safety Office, Johnson Space Center, Houston TX, November 30, 2005.

Invited Committee Member, Committee on Aerospace Research and Technology for Vision 2050. National Research Council, Aeronautics and Space Engineering Board. September 2002 to December 2003.

Invited speaker, Safety Symposium on Organizational Factors, Columbia Accident Investigation Board, Houston TX, April 27-28, 2003.

Consultant, Columbia Accident Investigation Board, April-August, 2003.

Plenary Address, NASA Design for Safety Workshop, October 10-12, 2000.

Technical Advisor to FAA Human Factors Study Team on Advanced Flight Decks, Fall 1994 to July 1996

> Served as Technical Advisor to a special team of FAA certification personnel set up to make recommendations on safety on highly automated flight deck given accidents that involved breakdowns in team play between the flight crew and the automation. This committee gathered data from all stake holders in the research, development, certification and operations of advanced aircraft (manufacturers, avionics developers, cockpit designers, airline companies, industry groups, and pilots unions in the US and in Europe), and develop a set of recommendation to ensure the highest levels of safety (final report and recommendations published by FAA in July 1996.

Invited Contributor, NASA Ames Research Center Workshops

• Human and Organizational Risk Management Workshop, NASA Ames Research Center, April 25-27, 2001.

• Plenary Talk, Design for Safety Workshop, NASA Ames Research Center, October 10, 2000.

• Air Transportation Management Workshop (Invited Speaker), NASA Ames Research Center, January, 1995.

• Cognitive Modeling Workshop, NASA Ames Research Center, February, 1994.

• Workshop on Philosophies of Automation in Commercial Aviation (planning committee), Carmel Valley, CA, 1989.

Invited Speaker, Boeing Workshop on Human Error, Boeing, Seattle WA December 2-3, 1992.

> Boeing invited 4 leading researchers on human error to help them consider techniques for addressing error in aircraft design and maintenance.

Defense

Invited seminar, Command and Control (C2) Symposium: Learning the lessons from last 20 years of Science and Technology. UK Ministry of Defense, Tidworth, UK, March 4-25, 2015. Address: 35 Years of Picking Up the Pieces after Explosions of Autonomy

http://csel.org.ohio-state.edu/userFiles/balkin/WoodsUKTalk.html

Invited Participant, Test, Evaluation, Verification and Validation for Autonomy Workshop, Air Force Research Laboratory, Wright Brothers Institute Innovation and Collaboration Center, Dayton OH, February 27-29, 2014.

Taught a tele-seminar on Human Supervision of Unmanned Aerial Systems October 16, 2013. Organized by the Ministry of Defense, The Netherlands: Universitair Docent Human Factors en SysteemVeiligheid, Faculteit Militaire Wetenschappen/Kennissectie Militaire Gedragswetenschappen & Filosofie, Nederlandse Defensie Academie, Ministerie van Defensie.

Invited Briefing, "Rigor and Analytic Tradecraft: Applying Studies of Information and Intelligence Analysis to Enhance Expertise." NASIC Chief Scientist Group Meeting, August 8, 2013.

Member, Defense Science Board Task Force on Autonomy (2010-2012).

Final Report: Murphy R. R. and Shields, J. (2012). The Role of Autonomy in DoD Systems, Task Force Report, Office of the Secretary of Defense, July. http://fas.org/irp/agency/dod/dsb/autonomy.pdf

Advisor, Chief Scientist, Human Effectiveness Directorate, 711th Performance Wing, Air Force Research Laboratory. Strategic research workshops on Autonomous Systems, 19/20 October, 9/10 November, and 15/16 December, 2010.

Invited participant, Workshop on Integrated Cognitive Architectures for Understanding Sense-making (ICARUS), IARPA, Arlington VA, July 21-22, 2009.

Invited speaker, Human Robot Interaction Workshop, Army Research Laboratory, Havre de Grace, MD, 19-20 May 2009.

Member, DARPA Information Science and Technology (ISAT) study group, CURIOUS – Continuous User-Oriented Reporting for Interaction Optimizations Using Sensors, 2007.

Keynote address, Commander's Predictive Environment, Air Force Research Laboratory, Fairfax, VA, September, 19-20, 2006.

Seminar on Distributed Work Systems, for Strategic Studies Group, Chief of Naval Operations, Naval War College, Newport RI, November 18, 2005.

Invited panel member, National R&D Agenda for Visual Analytics, National Visual Analytics Center, PNNL and Department of Homeland Security, 2004.

Invited speaker, Friends of the Intelligence Community (FOIC) Meeting, National Institute of Standards and Technology, January 21-23, 2004.

Invited speaker, Workshop on Cognitive Task Analysis of Intelligence Analysis, Sept 4-5 Dayton, OH.

Invited speaker, TTCP Workshop on Coalition Decision Making, Adelphi MD, May 6-8, 2003.

Invited participant, Adversarial Decision Making Modeling workshop, August, 27/28, 2002, Wright-Patterson AFB.

PI, Advanced Decision Architectures: Building Information Superiority in the Army Through User-Centered Decision Support, US Army Research Laboratory Collaborative Technology Alliances, cumulative funding @$8 million, GFY 2001--2009 (DAAD19-00-R-0005): develop computerized user-centered decision support systems as part of university/business/government consortium.

PI, Finding the Decision Support Behind the Visualization, ARDA/NIMA Geo-Spatial Intelligence Information Visualization Program (GI^{2}Vis), Aegis Research Corporation, Prime, cumulative funding @$200K, GFY 2003—2004 (NMA40102): analyze how leading edge visualizations support practitioner decision making.

PI, Aiding The Intelligence Analyst In Situations Of Data Overload, Human Effectiveness Directorate, Wright-Patterson AFB, cumulative funding @$640K, GFY 1996—2000: develop concepts to help practitioners cope with data overload and apply these concepts to Intelligence Analysis applications.

Process Control, Energy and Nuclear Power

Advisory Board, Resilient Control Systems Group, Idaho National Laboratory, 2010-2013.

Invited participant, Advanced Instrumentation & Controls and Human Systems Interfaces: Research Needs and Directions Workshop, OSU, EPRI, INL, 3-19/20-09

Co-organizer, International Seminar on Resilience Engineering, Rio de Janeiro Brazil, December 12-13, 2006.

Keynote address, Lições sobre Confiabilidade provindas da investigação

do acidente com a Nave Columbia, Seminário De Confiabilidade Da Petrobras (PETROBRAS Reliability Seminar), Rio de Janeiro Brazil, December 8, 2003.

Invited Contributor, Workshop on Advanced Human-Machine Interface Research, Electric Power Research Institute, Alexandria, VA, May, 1994.

> Discussion of problems and possible research directions in the area of advanced I&C systems. Workshop developed and recommended a research agenda as input to EPRI's project planning process.

Member, Nuclear Safety Research Review Committee, U.S. Nuclear Regulatory Commission, 1990 to 1993.

> This committee provides advice to the Director of the Office of Nuclear Regulatory Research of the Nuclear Regulatory Commission on matters of overall management importance in the direction of the Nuclear Regulatory Commission's program of nuclear safety research. The committee is regularly briefed on NRC research plans and activities, reviews the research and advises the Director on ways that the research program can be more effective.

Panel Member, National Research Council panel on Human Behavior and Nuclear Safety, 1987 to 1988.

> Developed a research agenda to consider the human contribution to risk and safety in the nuclear power industry.

National Science Foundation

Invited participant, NSF Workshop on Adaptive Human-Centered Engineered Systems, Arlington VA, February 22, 2016.

Organizing Committee/Group Leader/Panelist, National Workshop on Resilience Research (NWRR) for Critical Infrastructure: Current Status and Challenges, NSF, Arlington VA, October 22-23, 2015.

Invited speaker, MIT-NSF Workshop: Smarter Service Systems through Innovation Partnerships and Trans-Disciplinary Research. Cambridge MA, November 20-21, 2014.

Invited speaker, NSF Resilient Infrastructures, Annual Contractors Workshop, Washington DC, December, 7-8, 2009.

Organizing Committee and Working Group Leader, NSF/DARPA Workshop on Human-Robot Interaction, San Luis Obispo, CA, September 28-29, 2001.

> Workshop designed to bring together leading roboticists and specialists on human-computer cooperation to develop assessment of the current state and plan future research directions on human-robot interaction.
>
> http://users.csc.calpoly.edu/~erogers/HRI/

Steering Group and Working Group Head, NSF Workshop on Human-Centered Intelligent Systems, Washington DC, February, 1997.

Planning workshop for a new initiative from the Computer and Information Sciences Directorate to help users cope with the overload of data and complexity in electronic media.

Invited Participant and Working Group Chair, National Science Foundation Workshop on Human Performance in the Complex Workplace: Implications for Basic Research in Cognitive Science, September, 11-12, Alexandria VA, 1992.

Led one of the working groups to help NSF plan how their research agenda in Cognitive Science can better address the human performance issues important to different government agencies and industries.

Human Factors Research

Invited Contributor to Committee on Human Factors, National Research Council panel meetings

Research Needs in Supervisory Control, 1983.

Research needs in Human Performance Models in Computer Aided Engineering, 1988-89.

Human Error I: Models, Woods Hole, MA, 1990.

Human Error IV: Design to Prevent Error, Irvine CA, Feb. 1993.

Briefing to Committee on Human Factors on Human Factors and Patient Safety Movement, May 9, 2000.

Selected Scientific Meetings

Invited Speaker, Symposium: HumanMachine Symbiosis 50 Years Later, 37th Annual Meeting of the Cognitive Science Society, Pasadena, CA, July 2015.

Invited Talk, Reaching Resilience, 12th International Naturalistic Decision Making Conference, June 2015.

Keynote address, Annual Meeting of the Association of Canadian Ergonomists (ACE), Kelowna, British Columbia, Canada, 10-5-2010.

Keynote address, Annual Meeting of the Societe de Ergonomie de la Langue Francais (SELF), Liege, Belgium, 9-13-10, 2010.

Keynote address, International Symposium on Resilient Control Systems, Idaho National Laboratory/ IEEE, Idaho Falls, August 11-14, 2009.

Plenary Speaker, Workshop on Trust in CyberDomains, Air Force Research Laboratory, Pensacola FL, July 15-16, 2009.

Invited address, Experience Laboratory, Mediamatics and Industrial Design Engineering, Technical University, Delft,The Netherlands, May 13, 2008.

Invited participant, Research Methods Symposium, Observing and Measuring Behaviour: Non-Technical Skills in the Operating Theatre. Royal College of Surgeons of Edinburgh and University of Aberdeen, Edinburgh, Scotland 11-16-07.

Invited participant, Merging Cognitive Systems Engineering and Systems Engineering Workshop, Pensacola FL, October 16-17, 2007.

Keynote address, Measuring How Design Changes Cognition at Work, 20TH ACM UIST Symposium (User Interface Systems and Technology, Newport, Rhode Island, October 7, 2007 (see http://www.acm.org/uist/uist2007/ and http://www.acm.org/uist/uist2007/program/keynote1.html).

Invited address, Creating Safety by Engineering Resilience, Almaden Institute 2007, Navigating Complexity, IBM Almaden Research Center, April 11-12, 2007. (see http://www.almaden.ibm.com/institute/

and http://csel.eng.ohio-state.edu/productions/ibm).

Plenary Address, Human-Robot Interaction Conference HRI'06, Salt Lake City, UT, March 2-4, 2006.

Co-organizer, Workshop on Intelligent Decision Support, August 31—September 2, 2005, Siena Italy (42 + participants from 15 countries).

Co-organizer, International Symposium on Resilience Engineering, October 20-25, 2004 Soderoping Sweden. (22 + participants from 12 countries).

Invited talk, Hindsight bias and traffic accident causal analysis, Transportation Research Board, 84th Annual meeting, Washington DC, 1-12-2005.

Invited talk, Resilience as a Paradigm for Safety Management, NASA Ames Research Center, February 15, 2005.

Keynote Address, Interaction between Humans and Autonomous Systems over Extended Operation, 2004 AAAI Spring Symposium, James Gunderson and Cheryl Martin, Co-chairs, March 22-24, 2004, Stanford CA.

Keynote address, Laws that Govern Cognitive Work. Accidentes em Sistemas Complexos, Conferencia Internacional, Federal University of Rio de Janeiro, Rio de Janeiro Brazil, December 9, 2003.

Plenary Address, Cognitive Systems Engineering Consortium Workshop, Dayton OH, October, 29-31, 2003.

Invited Speaker, Biannual Conference on Naturalistic Decision Making (NDM):

NDM VII (Plenary Address), Amsterdam, The Netherlands, June 15-17, 2005.
NDM VI (Plenary Address), Pensecola FL, May 2003.
NDM IV (Keynote Address), Washington DC, May 1998.
NDM II (Panel Chair), Dayton OH, June 1994.
NDM I Dayton OH, 1989

Invited contributor, Workshop on Improving Medical Device Safety: Supporting Resilience and Innovation in Healthcare Organizations (Third 'Clambake' Conference on Human Error), Convened by the Developing Center for Patient Safety at the University of Chicago and the Food and Drug Administration (FDA), Chicago, Illinois, September 19-22, 2002.

Keynote Address, Psycho-Technology Thematic Track, Annual Meeting of American Psychological Association. Chicago, IL, August 24, 2002.

Plenary Address, Annual Meeting of the Cognitive Science Society, Fairfax, VA, August 10, 2002.

Invited Address, Louis H. Diamond Lecture, 2001 Annual Meeting of the Renal Physicians Association, Washington DC, March 24, 2001.

Plenary Address, 44th Annual Meeting of the Human Factors and Ergonomics Society and International Ergonomic Association, August 1, 2000.

Keynote Address, National Symposium on Building Health Care Systems that Do No Harm: Advancing Patient Safety Through Partnership and Shared Knowledge. June 28 – 30, 2000, Dallas.

Keynote Address, Society for Technology in Anesthesia, Seventh Annual Meeting, Tucson, NM, January 15, 1998.

Invited Contributor, organized and spoke in panel on Incident Reporting, Enhancing Patient Safety and Reducing Errors in Health Care, Annenberg Center for Health Sciences, November, 1998.

Co-Director and organizer, Assembling the Scientific Basis for Patient Safety, Expert Working Group (50 attendees) convened under the auspices of the National Health Care Safety Council of the National Patient Safety Foundation, Chicago IL, December 17-18, 1997.

Invited contributor, NATO and Office of Naval Research Workshop on Cognitive Task Analysis, Washington DC, October, 1997.

Invited Contributor, Examining Errors in Health Care: Developing a Prevention, Education and Research Agenda, Annenberg Center for Health Sciences, October, 1996

Invited Address, Annual Meeting of the Joint Council Initiative in Cognitive Science and Human-Computer Interaction. London, England, March 1995.

Keynote Address, Annual Meeting of the Cognitive Science Society, Atlanta, GA, August, 1994.

Invited Speaker, Society for Intravenous Anesthesia, Third Annual Meeting, San Francisco, CA, October, 1994.

Keynote Address, Conference on Automation Technology and Human Performance, Washington DC, April 1994.

Plenary Address, International Workshop on Intelligent User Interfaces, ACM, January, 1993.

Executive Committee and Contributor, Workshop on Human Error in Anesthesia, sponsored by FDA and the Anesthesia Patient Safety Foundation, Feb. 26-March 1, 1991.

> Helped to organize international meeting that brought together for the first time researchers on human error and researchers in anesthesia to examine anesthesia safety.

Publications: David D. Woods

Books and Monographs

1. Hollnagel, E., Paries, J., Woods, D.D., and Wreathall, J., Eds. (2011). *Resilience Engineering in Practice*. Ashgate, Aldershot, UK.
   Japanese translation: JUSE Press Limited, 5-4-2, Sendagaya, Shibuya-ku, Tokyo, 151-0051, Japan, expected December 2013.

2. Woods, D.D., Dekker, S.W.A., Cook, R.I., Johannesen, L.L. and Sarter, N.B. (2010). *Behind Human Error (2nd Edition)*. Ashgate, Aldershot, UK.
   Italian translation: Hirelia Edizioni, Milano, IT, 2012.

3. Woods, D.D. and Hollnagel, E. (2006). *Joint Cognitive Systems: Patterns in Cognitive Systems Engineering*. Boca Raton FL: Taylor & Francis.

4. Hollnagel, E., Woods, D.D. and Leveson, N., Eds. (2006). *Resilience Engineering: Concepts and Precepts*. Ashgate, Aldershot, UK.
   Spanish translation: Ingenieria de la Resiliencia: Conceptos y preceptos. Modus Laborandi, 2010. http://www.moduslaborandi.com/index.php?page=resiliencia
   Japanese translation: JUSE Press Limited, 5-4-2, Sendagaya, Shibuya-ku, Tokyo, 151-0051, Japan, 2012.

5. Hollnagel, E. and Woods, D.D. (2005). *Joint Cognitive Systems: Foundations of Cognitive Systems Engineering*. Boca Raton FL: Taylor & Francis.

6. Cook, R.I., Woods, D.D. and Miller, C. (1998). *A Tale of Two Stories: Contrasting Views on Patient Safety*. National Patient Safety Foundation, Chicago IL, April 1998 (available at http://csel.eng.ohio-state.edu/woods/medicine/patientsafety/npsf_rpt.pdf

7. Woods, D.D., Johannesen, L. L., Cook, R.I. and Sarter, N. B. (1994). *Behind Human Error: Cognitive Systems, Computers and Hindsight*. Human Systems Integration Information and Analysis Center, WPAFB, Dayton OH.

8. E. Hollnagel, G. Mancini, and D.D. Woods, Eds. *Cognitive Engineering in Complex, Dynamic Worlds*. Academic Press, London, 1988.

9. E. Hollnagel, G. Mancini, and D.D. Woods, Eds. *Intelligent Decision Support in Process Environments*. Springer-Verlag, New York, 1986.

Multimedia/Web Productions & Publications

Zelik, D., Woods, D. and CSEL (2010). Cognitive Systems Engineering for Innovation in Information Analysis: Topic Landscape: http://csel.eng.ohio-state.edu/productions/intelligence/
http://csel.eng.ohio-state.edu/productions/intelligence/Woods_CSEforInnovation_CSEL-2010-TR-01.pdf

Woods, D. D. (2009). Fundamentals to Engineer Resilient Systems: How Adaptive Systems Fail and the Quest for Polycentric Control Architectures. Plenary Address at International Symposium Resilient Control Architectures, Idaho National Laboratory, August 2009. https://secure.inl.gov/isrcs2009/showvideo.aspx

Woods, D. D. (2007). Creating Safety by Engineering Resilience, Invited address, Almaden Institute 2007, Navigating Complexity, IBM Almaden Research Center, April 11-12, 2007. (see http://www.almaden.ibm.com/institute/ and http://csel.eng.ohio-state.edu/productions/ibm).

Woods, D. D. Reducing the Risk of Shallow Information Analysis. Google Tech Talks, Mountain View, CA., April 10, 2007. http://video.google.com/videoplay?docid=3049239277254163324

Zelik, D. and CSEL (2007). Understanding Rigor in Information Analysis. Multi-Media Topic Landscape. http://csel.eng.ohio-state.edu/zelik/rigor/index.html.

Voshell, M. et al. (2006). Coping with Overload and Narrowing in Intelligence Analysis. DigitalTopicLandscape. Cognitive Systems Engineering Laboratory, Institute for Ergonomics, The Ohio State University, Columbus OH.

Woods, D. D., Voshell, M., Roesler, A., Phillips, F., Feil, M. and Tittle, J. (2006). The Law of Stretched Systems in Action: Exploiting Robots. Podcast available at http://csel.eng.ohio-state.edu/podcasts/woods/

Tuzar, D. and Woods, D. D. (2006). Reorientation in Dynamic Situations. MediaPaper. Cognitive Systems Engineering Laboratory, Institute for Ergonomics, The Ohio State University, Columbus OH. url: http://csel.eng.ohio-state.edu/woods/metrics/reorientation-mepa-v7.pdf

Schoenwald, J., Trent, S., Tittle, J.,and Woods, D. D. (2005). Scenarios for Collaborative Envisioning of New Sensor Technology in Military Urban Operations. Cognitive Systems Engineering Laboratory, Institute for Ergonomics, The Ohio State University, Columbus OH. url: http://csel.eng.ohio-state.edu/productions/xcta

Woods, D. D., Tinapple, D. Roesler, A. and Feil, M. (2002). Studying Cognitive Work in Context: Facilitating Insight at the Intersection of People, Technology and Work. Cognitive Systems Engineering Laboratory, Institute for Ergonomics, The Ohio State University, Columbus OH at url: http://csel.eng.ohio-state.edu/productions/woodscta/

Roesler, A., Tittle, J. and Woods, D. D. (2002). View Tracks: 3-D Virtual Displays are Viewpoint Dependent. MediaPaper CD. Cognitive Systems Engineering Laboratory, Institute for Ergonomics, The Ohio State University, Columbus OH, April 2002.

Woods, D. D. and Grossman, J. (2002). Performance Experts in Safety (PEXiS): Behind Human Error. Electronic course designed to help people see past typical misunderstandings about how systems fail and how people contribute to both success and failure. The trial version available at url: http://csel.eng.ohio-state.edu/productions/pexis

Woods, D.D. Roesler, A., Feil, M. and Tinapple, D. (2002). Steering the Reverberations of Technology Change on Fields of Practice: Laws that Govern Cognitive Work. Multimedia Production at url: http://csel.eng.ohio-state.edu/productions/laws/

Tittle, J., Roesler, A., and Woods, D. D. (2001). The Role of 2-D and 3-D Task Performance in the Design and Use of Visual Displays. MediaPaper CD. Cognitive Systems Engineering Laboratory, Institute for Ergonomics, The Ohio State University, Columbus OH, November 2001.

Roesler, A., Feil, M. and Woods, D. D. (2001). Design is Telling (Sharing) Stories about the Future. MediaPaper CD. Cognitive Systems Engineering Laboratory, Institute for Ergonomics, The Ohio State University, Columbus OH, December 2001 at url: http://csel.eng.ohio-state.edu/animock

E.S. Patterson, D.D. Woods, D. Tinapple, and E. M. Roth. (2001). Using CTA to Seed Designs Concepts for Intelligence Analysts Under Data Overload. Cognitive Systems Engineering Laboratory, Institute for Ergonomics, The Ohio State University, Columbus OH, Multimedia Production at url: http://csel.eng.ohio-state.edu/productions/analystoverload/

D.D. Woods and D. Tinapple. W^3: Watching Human Factors Watch People at Work. Presidential Address, 43rd Annual Meeting of the Human Factors and Ergonomics Society, September 28, 1999. Multimedia Production at url http://csel.eng.ohio-state.edu/productions/hf99/

Book Chapters

1. Woods, D.D. (in press). Origins of Cognitive Systems Engineering: Personal Reflections. In P. Smith and R. Hoffman (Eds.) *Cognitive Systems Engineering: A Future for a Changing World*. Taylor and Francis.

2. Woods, D. D. (2016). Resilience as Graceful Extensibility to Overcome Brittleness. *Resource Guide on Resilience*. EPFL International Risk Governance Center. v29-07-2016 (IRGC), Lausanne, Switzerland. https://www.irgc.org/wp-content/uploads/2016/04/Woods-Resilience-as-Graceful-Extensibility-to-Overcome-Brittleness.pdf

3. Stephens, R. J., Woods, D.D. and Patterson, E. S. (2015). Patient Boarding in the Emergency Department as a Symptom of Complexity-Induced Risks. In R.L. Wears, E. Hollnagel, J. Braithwaite, (Eds.), *Resilience in Everyday Clinical Work*. Farnham, UK: Ashgate, pp. 129-144.

4. Morison, A., Woods, D.D. and Murphy T. B. (2015). Human-Robot Interaction as Extending Human Perception to New Scales. In R. R. Hoffman, P. A. Hancock, M. Scerbo, R. Parasuraman and J. R. Szalma (Eds.), *Handbook of Applied Perception Research*, *Volume 2*, Cambridge University Press, NY, pp. 848-868.

5. Flach, J. M., Bennett, K. B., Woods, D. D. and Jagacinski, R. J. (2015). Interface Design: A Control Theoretic Context for a Triadic Meaning Processing Approach. In R. R. Hoffman, P. A. Hancock, M. Scerbo, R. Parasuraman and J. R. Szalma (Eds.), *Handbook of Applied Perception Research*, Cambridge University Press, NY, pp. 647-668.

6. Woods, D. D. and Cook, R.I. (2012). Mistaking Error. In B. J. Youngberg (Ed.) *Patient Safety Handbook* (second edition), Jones and Bartlett, Sudbury MA, pp. 99-110.

7. McGuirl, J. M., Sarter, N. B. and Woods, D. D. (2011). See is Believing? The Effects of Real-Time imaging on Decision-Making in a Simulated Incident Command Task. M. E. Jennex (Ed.), *Crisis Response and Management and Emerging Information Systems: Critical Applications*. IGI Publishing.

8. Woods, D. D. (2011). Resilience and the Ability to Anticipate. In E. Hollnagel, Paries, J., Woods, D.D., and Wreathall, J., Eds., *Resilience Engineering in Practice*. Ashgate, Aldershot, UK, pp. 121-125.

9. Woods, D. D. and Branlat, M. (2011). How Adaptive Systems Fail. In E. Hollnagel, Paries, J., Woods, D.D., and Wreathall, J., Eds., *Resilience Engineering in Practice*. Ashgate, Aldershot, UK, pp. 127-143.

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