



**Human Factors
and Ergonomics
Society**

**Official Written Testimony in Support of
Fiscal Year 2021 Science and Research Funding at the Department of Transportation**

Submitted to the Senate Subcommittee on Transportation, Housing and Urban Development, and
Related Agencies; Committee on Appropriations
United States Senate
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On behalf of the Human Factors and Ergonomics Society (HFES), we are pleased to provide this written testimony to the Senate Appropriations Subcommittee on Transportation, Housing and Urban Development, and Related Agencies for the official record. **HFES urges the Subcommittee to provide robust funding for the Federal Aviation Administration (FAA), specifically the Research, Engineering and Development (RE/D), in the fiscal year (FY) 2021 appropriations process.** Additionally, as the FAA continues its work to address and respond to tragedies caused by the Boeing 737 Max8, **HFES supports robust funding to implement the recommendations of the National Transportation Safety Board (NTSB), the Joint Authorities Technical Review (JATR), as well as additional policies to expand the use of Human Factors research, expertise, and processes in the design, development, manufacturing, and FAA certification processes for new aircraft,** as recommended by HFES's Dr. Mica Endsley in her [testimony](#) before the House Transportation and Infrastructure Committee in December of 2019.

HFES also supports robust funding for the Department of Transportation (DOT) to accelerate the development and deployment of safer, more efficient transportation technologies.

HFES and its members recognize and appreciate the challenging fiscal environment in which we as a nation currently find ourselves. However, we believe strongly that investment in scientific research serves as an important driver for innovation and the economy and for maintaining American global competitiveness. We thank the Subcommittee for its longtime recognition of the value of scientific and engineering research and its contribution to innovation in the U.S.

The Value of Human Factors and Ergonomics Science

HFES is a multidisciplinary professional association with over 4,500 individual members worldwide, comprised of scientists and practitioners, all with a common interest in enhancing the

performance, effectiveness, and safety of systems with which humans interact through the design of those systems' user interfaces to optimally fit humans' physical and cognitive capabilities.

For over 50 years, the U.S. federal government has funded scientists and engineers to explore and better understand the relationship between humans, technology, and the environment. Originally stemming from urgent needs to improve the performance of humans using complex systems such as aircraft during World War II, the field of human factors and ergonomics (HF/E) works to develop safe, effective, and practical human use of technology. HF/E does this by developing scientific approaches for understanding this complex interface, also known as "human-systems integration." Today, HF/E is applied to fields as diverse as transportation, architecture, environmental design, consumer products, electronics and computers, energy systems, medical devices, manufacturing, office automation, organizational design and management, aging, farming, health, sports and recreation, oil field operations, mining, forensics, and education.

With increasing reliance by federal agencies and the private sector on technology-aided decision-making, HF/E is vital to effectively achieving our national objectives. While a large proportion of HF/E research exists at the intersection of science and practice—that is, HF/E is often viewed more at the "applied" end of the science continuum—the field also contributes to advancing "fundamental" scientific understanding of the interface between human decision-making, engineering, design, technology, and the world around us. The reach of HF/E is profound, touching nearly all aspects of human life from the health care sector, to the ways we travel, to the hand-held devices we use every day.

Federal Aviation Administration Research, Engineering and Development

HFES strongly believes that federal investment in FAA RE/D will have a direct and positive impact on the U.S. economy, national security, and the safety and well-being of Americans. With regard to safety, the RE/D program includes specific funding for human factors in air traffic control (ATC) and flight deck maintenance and systems integration, with additional allocations for NextGen Air, as part of the Economic Competitiveness initiative. Additionally, human factors should be an ongoing consideration as FAA invests in research on airline passenger safety including seat width and cabin environments.

Responding to the Tragedies Associated with the Boeing 737 Max8

The objective of Human Factors Engineering is not to assign blame after accidents occur, but rather to prevent accidents from occurring by improving the design of technologies and systems in advance. The recent investigations of the Lion Air and Ethiopian Airlines crashes of the Boeing 737-Max8 aircraft have highlighted the importance of Human Factors in the design, testing, and certification of aircraft, and that federal action is needed to ensure tragedies like these do not happen again. HFES is encouraged by the FAA's proposal, in its FY 2021 budget request, to increase oversight resources explicitly to respond to the tragedies associated with the 737 Max8. We are further encouraged that among the themes the FAA identifies in its response is "integrating human factors considerations more effectively throughout the design process, as aircraft become more automated and systems more complex." We support this request and urge the Committee to support it as well.

However, the challenges stemming from automation in transportation and other complex systems will not go away, and there is more the federal government must do to address these issues. Congress and the federal government can enact policies that will build up the FAA's and industry's capacity and expertise to better understand and address issues pertaining to alerting systems and human-automation interaction that are crucial to avoiding future catastrophic accidents in the nation's transportation and infrastructure. HFES recommends that Congress:

1. Increase funding for Human Factors research at the FAA in order to understand the effects of multiple alerts and the "design of aircraft system diagnostic tools that improve the prioritization and clarity of failure indications (direct and indirect) presented to pilots to improve the timeliness and effectiveness of their response." This is in line with NTSB's recommendations in its Safety Recommendation Report: "Assumptions Used in the Safety Assessment Process and the Effects of Multiple Alerts and Indications on Pilot Performance."
2. Develop "robust tools and methods for use in validating assumptions about pilot recognition and response to safety-significant failure conditions as part of the design certification process," as recommended in NTSB's Safety Recommendation Report.
3. Develop effective methods, displays, and training for supporting human oversight and interaction with automated systems. This could include support for the FAA's NextGen – Air Ground Integration Human Factors program's efforts around Human Error mitigation research, as well as the Flightdeck/Maintenance/System Integration Human Factors program, and NASA's Crew Systems and Aviation Operations program.
4. Build tools to support human factors and safety assessments in the certification process, as recommended in FAA JATR's Boeing 737 Max Flight Control System Observations, Findings and Recommendations.

In addition to other recommendations to prevent future accidents laid out in Dr. Ensley's testimony in front of the House Transportation and Infrastructure Committee, HFES recommends that the Committee and FAA take the following actions:

- a. Encourage Boeing, and other aviation manufacturers, to incorporate Human Factors processes and personnel into the analysis, design, development, testing, manufacturing, and maintenance of aircraft systems in order to comply with certification requirements. HFES is encouraged by FAA's proposal to enact this recommendation in its FY 2021 budget request and encourages the Committee to support this action.
- b. Direct the National Academies of Science Board on Human Systems Integration (NAS BOHSI) to conduct a study on human interaction with artificial intelligence, autonomy, and advanced automation technologies: enhancing safety and effectiveness. Such a study could bolster the knowledge and understanding of the many complex issues involved and provide important directions for the nation as it develops and implements these technologies across the coming decade.

The science and practice of Human Factors Engineering is well established, with roots going back to the earliest days of aviation. Aviation is highly dependent on the design and

development of safe, effective flight decks for pilot control. Achieving this goal is highly dependent on the early incorporation of Human Factors in the analysis, design, testing and certification processes. While this is true in general, it is even more important with automated systems and as use of artificial intelligence and system autonomy increases. The lessons learned from the tragic accidents of the 737-Max8 should be leveraged to improve the safety of our aviation system and to guard against similar problems in other safety critical systems.

Autonomous Vehicles and Automated Driving Systems

Additionally, the Society supports robust investments in DOT for research on autonomous and intelligent transportation technologies. These technologies, if designed and developed with HF/E considerations in mind, have the potential to significantly decrease traffic fatalities and make the American transportation system safer and more efficient. Specifically, HFES supports funding for and the consideration of HF/E research in NHTSA's Autonomous Vehicles Pilot program and the Federal Highway Administration's (FHWA) Intelligent Transportation Systems program (ITS), which are invaluable to the safe deployment of next generation transportation technologies. It is vital that we continue to perform and expand research on automated vehicles not only to drive innovation but to support the development of informed regulation of these emerging technologies.

Conclusion

Given FAA's critical role in supporting fundamental research and development across transportation and engineering disciplines, HFES supports robust funding for the FAA, specifically RE/D, in the FY 2021 appropriations process. HFES also supports robust funding for DOT to accelerate the development and deployment of safer, more efficient transportation technologies.

On behalf of HFES, we would like to thank you for the opportunity to provide this testimony. Please do not hesitate to contact us should you have any questions about HFES or HF/E research. HFES truly appreciates the Subcommittee's long history of support for scientific research and innovation.