Applied Ergonomics on digital technologies and resilience

Webinar series on Resilience Engineering

March 17th, 2025
Time: 15:00 UTC
Duration: 75 mins

This webinar series will showcase cutting-edge research by the IEA Resilience Engineering Committee, highlighting applications in areas such as AI transformation of industrial work, cognitive ergonomics in collaborative robotics, dynamic change in coordination patterns, and advanced brain-computer interface risk management.

Webinars Chair:

Tarcisio Abreu Saurin, Ph.D.
Full Professor at the Industrial Engineering Department of the Federal University of Rio Grande do Sul (Brazil).
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Registration
https://us02web.zoom.us/webinar/register/WN_LfdYCryHSUWi7cwOZxcpMQ

Registration is free to all interested people. The webinar will be recorded and published on YouTube. Registration permits live interaction with the presenters via Q&A

If you are interested in being a presenter for our webinar series, please email antonio.nakhal@unimercatorum.it

IEA is a global federation of Human factors/Ergonomics societies, registered as a nonprofit organization in Geneva, Switzerland.
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Presentations

1. Using a digital data analytic tool to capture dynamic change in coordination patterns: An exploratory study of the Apollo 13 mission

The complex and unpredictable environments in which sociotechnical systems operate require constant adjustments in how teams coordinate to meet rapidly changing demands. Traditional methods for understanding and assessing coordination and resilience often rely on static approaches, which can miss the real-time adjustments that make systems adaptable. This talk will explore how dynamic coordination plays a key role in team resilience and how digital tools can help us better understand and analyze this continuously changing process. Using NASA's Apollo 13 mission as a case study (an exemplary resilient team that managed to sustain operations during a prolonged critical situation with limited resources), we will examine how the team's coordination patterns present during normal operations shifted as the team navigated a crisis. The discussion will present findings derived from THEME, a digital analytical tool designed to visualize and investigate coordination patterns from a multi-layered, time-sensitive perspective. Key insights include the emergence of dynamic role-behavior alignments during crisis, highlighting the importance of adaptive interplay between one-directional and reciprocal patterns, initiative, and role distribution according to situational demands. The talk aims to spark discussions with the audience about the value of temporal, granular analysis for mapping complex processes such as coordination, and how it can inform design for resilient performance. The talk will also invite reflections on other tools and approaches from the audience's perspectives

Early results: https://doi.org/10.1016/j.apergo.2024.104345

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Lida Z. David earned her B.Sc. in Psychology from Royal Holloway, University of London, UK, followed by an M.Sc. in Human Factors and Engineering Psychology (cum laude) from the University of Twente, Netherlands. Following her studies, she worked as a Lecturer in the Department of Cognitive Psychology and Ergonomics at the University of Twente for two years, before pursuing a Ph.D. in the Department of Data Analysis, Learning, and Technology at the same institution. Her research focuses on coordination and team resilience, investigating how dynamic interaction patterns evolve in response to challenging situations. Drawing on a cross-industry perspective spanning aviation, aerospace, and emergency management, her work highlights dynamic coordination as a critical mechanism of team resilience and advocates for a deeper exploration of coordination dynamics through advanced digital tools and analytical techniques. Lida is currently a Human Factors Engineer at Airbus Defence and Space, involved in the design and development of complex human-machine interfaces. Additionally, she serves as the Communications Officer for the Executive Board of the Resilience Engineering Association.

2. **AI and the transformation of industrial work: Hybrid intelligence vs double-black box effect**

It is uncertain how the application of AI technology will transform industrial work. This webinar lecture, based on a recent research publication, addresses this question from the perspective of cognitive systems, which in this case includes considerations of AI and process transparency, resilience, division of labor and worker skills. A task analysis was carried out on glass tempering. The AI solutions considered in this case included a machine vision-based quality control system and an advanced automation process control system. Overall, the following concepts are discussed in the presentation:

- Hybrid intelligence: a human-AI division of labor that supports upskilling and resilience through balanced AI transparency.
- Double black box: in an AI-optimized industrial process, lack of process comprehensibility due to lack of AI comprehensibility from the operator's perspective.
- Fragmented intelligence: the end result of the double black box; the need for a network of experts due to the complexity of the AI-optimized industrial process; implies a lack of resilience at the local level.

It is also discussed, through a comparison with similar conceptualizations, that 'fragmented intelligence' implies that a dichotomous human-machine perspective is not sufficient when considering the division of labor between humans and AI in complex systems.

Early results: https://www.sciencedirect.com/science/article/pii/S0003687024000486?via%3Dihub

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Mikael Wahlström is a senior scientist in the Human Factors team at VTT Technical Research Centre of Finland. He has a Ph.D. in social psychology and is an adjunct professor (title of docent) of social sciences at the University of Helsinki. His research experience in human factors covers various work contexts, including nuclear power plant operations, manufacturing industry, robotic surgery, and marine navigation. His studies on human-technology interaction include autonomous systems, virtual reality, robotics and artificial intelligence. He has first author publications in leading journals in human-computer interaction and design research. He has published a non-fiction book on how the complementarity of human and artificial intelligence is needed to solve wicked problems, with a focus on climate change. This book, written in his mother tongue Finnish, has brought him mainstream media attention in Finland. An updated English version of the book will be published in 2025. His long-term goals and ambitions include the development of hybrid human-machine intelligence in interdisciplinary research projects, both nationally and internationally.

3. **Updating design guidelines for cognitive ergonomics in human-centered collaborative robotics applications: An expert survey**

Collaborative robots enable the development of anthropocentric and adaptable applications of industrial human-robot interaction by prioritizing user needs and preferences, enhancing safety, ergonomics, and production performance. However, due to inherent psychosocial risks, it is essential to design collaborative systems with careful consideration of the specific industrial context and the robotic system's impact on the operator's psychophysical condition, especially in advanced applications. This study presents a systematic methodology for developing and validating a comprehensive set of guidelines aimed at assisting non-experts in human factors and cognitive ergonomics (HF&CE), such as industrial engineers, roboticists, and system integrators, in the early design stages of anthropocentric and collaborative human-robot assembly applications. A systematic literature review was conducted to identify key findings on HF&CE in industrial human-robot interaction. Based on these findings, draft design principles (i.e., guidelines) were developed with consideration for the target audience and end goals. The initial draft underwent evaluation by an independent team of scholars specializing in industrial collaborative robotics, whose feedback informed subsequent revisions. A survey was then designed to gather insights from international experts across various disciplines, enabling a thorough assessment and interpretation of the updated guidelines.

Early results: https://www.sciencedirect.com/science/article/pii/S0003687024000231

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Dr. Luca Gualtieri earned his Ph.D. in Sustainable Energy and Technologies from the Free University of Bolzano, where he is currently a tenure-track assistant professor in the Faculty of Engineering. He also serves as a senior researcher at the Smart Mini Factory Laboratory (SMF) for Industry 4.0 and the Extended Reality Laboratory and Training Center (XR-lab). Additionally, he is the Group Leader for Advanced Technologies for Ergonomics in Industry at the Italian Ergonomics Society (SIE). Dr. Gualtieri's research focuses on ergonomics and safety in advanced industrial human-robot interaction, human-centric manufacturing, assistance systems for training and production, and technology-based social inclusion of vulnerable workers in manufacturing contexts. He has participated in numerous national and European-funded projects as a principal investigator, co-investigator, and team member. Furthermore, he has collaborated with several private companies on industrial projects. Dr. Gualtieri has also delivered various industrial and academic lectures on these topics, sharing his expertise in the field.

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4. **Prospectively identifying risks and controls for advanced brain-computer interfaces: A Networked Hazard Analysis and Risk Management System (Net-HARMS) approach**

The introduction of advanced digital technologies continues to increase system complexity and introduce risks, which must be proactively identified and managed to support system resilience. Brain-computer interfaces (BCIs) are one such technology; however, risks arising from the potentially broad implementation of the technology have yet to be identified and controlled. This presentation will discuss a study which applied a structured systems thinking-based risk assessment method to prospectively identify risks and risk controls for a hypothetical future BCI system lifecycle. The application of the Networked Hazard Analysis and Risk Management System (Net-HARMS) method identified over 800 risks throughout the BCI system lifecycle, from BCI development and regulation through to BCI use, maintenance, and decommissioning. High-critical risk themes include the implantation and degradation of unsafe BCIs, unsolicited brain stimulation, incorrect signals being sent to safety-critical technologies, and insufficiently supported BCI users. Over 600 risk controls were identified that could be implemented to support system safety and performance resilience. Overall, many highly-impactful BCI system safety and performance risks may arise throughout the BCI system lifecycle and will require collaborative efforts from a wide range of BCI stakeholders to adequately control.

Early results: King, B. J., Read, G. J., & Salmon, P. M. (2025). Prospectively identifying risks and controls for advanced brain-computer interfaces: A Networked Hazard Analysis and Risk Management System (Net-HARMS) approach. Applied Ergonomics, 122, 104382. https://doi.org/10.1016/j.apergo.2024.104382

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Brandon King is a Research Fellow at the University of the Sunshine Coast's Centre for Human Factors and Sociotechnical Systems. Brandon gained a PhD in Human Factors from the Centre in 2024 and holds an undergraduate degree in Psychology. Brandon is currently working on a project aiming to develop a new theoretical model of teamwork in human-autonomy teams, led by Professor Paul Salmon. He has been involved in Human Factors and safety research projects in areas such as defense, transport, and healthcare. Brandon's research predominantly focuses on supporting the development and use of safe and effective advanced technologies, including artificial general intelligence and brain-computer interfaces, and enhancing system safety.

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