



On Land, at Sea, and in the Air: Human-Computer Interaction in Safety-Critical Spaces of Control IFIP WG 13.5 Workshop at INTERACT 2023

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Abstract. In many areas, successfully deploying interfaces with high usability and user experience (UX) is crucial for people's safety and well-being. These include, for example, control rooms for emergency services and energy suppliers, aircraft cockpits, ship bridges, surgery rooms, and intensive care units. Information and cooperation needs are not limited to the users' immediate environment but often involve numerous actors in other places (regulators, field workers, shift supervisors, remote assistance, etc.). The specific aspects of Human-Computer Interaction (HCI) in such spaces of control are the subject of this workshop. This includes understanding and modeling routine and emergency operations, alarm management, human-machine task allocation and automation concepts, interaction design beyond graphical user interfaces, laboratory and field evaluations, and training approaches. In addition to addressing domain-specific issues (e.g., in healthcare, in aviation), cross-domain challenges and solutions will be identified and discussed (e.g., more flexible and cooperative ways of working with the aid of wearable and mobile devices). This workshop is organized by the IFIP WG 13.5 on Human Error, Resilience, Reliability and Safety in System Development.

Keywords: Safety-Critical Systems · Control Rooms · Cockpits · Usable Safety · Usable Security · Resilience · Dependability

1 Introduction

Whether in a fire department control room, on a ship bridge, in an aircraft cockpit or in an operating room, the well-being of many people every day depends

on processes that should run in a structured manner and critical parameters monitored and controlled appropriately by skilled professionals. In such “location[s] designed for an entity to be in control of a process” [4], which will be collectively referred to as control rooms in the following, usable, dependable and safe human-computer interaction (HCI) is crucial.

However, limiting HCI-related research to control rooms, in terms of “place[s] with an associated physical structure, where the operators carry out [...] responsibilities” [12], is not sufficient. External (f)actors can be substantial:

- Field workers can provide data to operators or use mixed-reality solutions to integrate them into on-site operations [5].
- Smart environments, from solutions involving only a few sensors to whole infrastructures (e.g., smart cities), allow access to data and interaction capabilities that can be valuable to control room operators [7,9].
- In crisis situations that affect control rooms (e.g., power outages, technical problems, terrorist attacks), emergency control rooms must be operated or complement actual faulty ones [3]. Today, structures with control room-like functions are set up locally at scenes of an incident [11].
- Operators demand more flexible working models. For example, the German-language professional magazine “BOS-Leitstelle Aktuell” (Rescue Forces Control Rooms up to date) devoted an entire issue to the topic of “Home office & Co - Future Concepts for the Control Room”¹ in 2021.

While “understanding the physical space in which interaction takes place is central to providing a good UX” [1], a broader view and research approach from places to spaces of control seems appropriate. In the other direction, having a precise and detailed understanding of interactions is crucial to design and deploy efficient command and control systems.

Finally, “beyond the control room” [13] should involve looking beyond the actual process control. This is because the people who act and bear responsibility, the operators, have hardly been considered during the design and development of the technical solutions. If any, studies were conducted on hardware ergonomics (e.g., height-adjustable screen, cf. [10]). However, instead of being the “forgotten element[s]” [6] of process control, operators’ health and well-being could be given the priority they deserve. Appropriate sensor technology and wearable devices could form the data basis. Brazier (2010) aptly puts it: “The important things to realize are that control rooms are not defined by their appearance or physical arrangements. Also, they are only a component and not a system in their own right” [2].

This workshop organized by the IFIP Working Group 13.5 on Human Error, Resilience, Reliability, Safety and System Development promotes sharing experiences in designing, implementing, and evaluating interactive systems in safety-critical control spaces. It follows INTERACT 2021 workshop on “Control Rooms in Safety Critical Contexts (CRiSCC): Design, Engineering and Evaluation Issues” [8].

¹ <https://www.skverlag.de/rettungsdienst/meldung/newsartikel/homeoffice-co-zukunftskonzepte-fuer-die-leitstelle.html>.

2 Structure of the Workshop

We propose a full-day workshop divided into 3 phases. Authors of selected contributions are invited to present their work at the workshop's morning session. Participants are invited to comment/discuss these contributions and report similar experiences. This is also intended to promote cross-domain "thinking outside the box."

The afternoon sessions are devoted to the issues raised by presentations and discussions in the morning. The work in small groups is moderated by the workshop organizers and supported with creative techniques. Proposed solutions will be compiled and compared. Based on the lessons learned, participants will draft an agenda of future work that can be accomplished.

3 Target Audience and Expected Outcomes

This workshop is open to everyone interested in the aspects related to the design, engineering, evaluation, deployment, training, maintenance, and certification of human-computer interaction in safety-critical spaces of control. We expect high participation of IFIP working group 13.5 members. We invite participants to present position papers describing real-life case studies that illustrate how a new technology would enhance operations in safety-critical spaces of control.

They could also highlight the trade-offs between two or more properties of interactive systems, such as user experience and dependability or usability and security. The way the new technology will be addressing some known or envisioned problem in control should be presented in the contribution. We are also interested in methods, theories, and tools for control room development if they address some user interface properties. Accepted position papers are published in INTERACT 2023 adjunct conference proceedings. We also expect to discuss how to disseminate individual contributions to the community in a special issue in a journal or edited volume at the workshop.

4 Workshop Organizers

Tilo Mentler is a professor of Human-Computer Interaction and User Experience at Trier University of Applied Sciences. His research is focused on human-centered design in safety-critical contexts (e.g. mobile devices and mixed reality in healthcare, novel approaches to critical infrastructure). Currently, he works on control rooms as pervasive computing environments and examines the role of user experience in safety-critical settings. Prof. Mentler chairs IFIP WG "13.5 on Human Error, Resilience, Reliability and Safety in System Development" and the Special Interest Group "Usable Safety & Security" within the German Informatics Society (GI). Furthermore, he is a member of the IFIP Advisory Board of GI, and has been the GI representative in the IFIP Domain Committee on IT in Disaster Risk Reduction.

Philippe Palanque is a Professor in Computer Science at the University of Toulouse 3, leading the Interactive Critical Systems research group. Since the late 1980s, he has been working on developing and applying formal description techniques for interactive systems. He has worked on research projects at the Centre National d'Études Spatiales (CNES) for more than 10 years and on software architectures and user interface modeling for interactive cockpits in large civil aircraft (funded by Air-bus). The main driver of Philippe's research over the last 20 years has been to address usability, safety, and dependability in an even way to build trustable safety-critical interactive systems. As for conferences, he is the TPC co-chair of EICS 2021 and is a member of the ACM CHI steering committee. He is a member of the CHI academy and has been the chair of the IFIP TC 13 committee on Human-Computer Interaction.

Kristof Van Laerhoven is a Professor in Ubiquitous Computing at the University of Siegen, Germany. His research interests span the areas of wearable and distributed sensing systems that focus on machine learning challenges, such as recognizing what human users are doing, what they are focusing on, and how stressed they are. He is co-editor of Springer Adaptive Environments, editor for ACM IMWUT, and general co-chair for ACM UbiComp/ISWC in 2023. More information can be found on <http://ubicomp.eti.uni-siegen.de>.

Margareta Lützhöft is a master mariner trained at Kalmar Maritime Academy in Sweden. After leaving sea, she studied for a Bachelor's degree in Cognitive science and a Master's in Computer Science. In 2004 she received a PhD in Human-Machine Interaction and was associate Professor at Chalmers University of technology and Professor of Nautical Studies at the University of Tasmania, Australia. Presently, she is holding a position as Professor in the MarSafe group at the Western Norway University of Applied Sciences, and leader of the MarCATCH Research Centre. Her research interests include human-centered design and the effects of new technology, and she has published in these and other areas relating to maritime safety.

Nadine Flegel joined the Department of Computer Science at Trier University of Applied Sciences in 2020 as a research assistant in the project "PervaSafe Computing: Pattern-Based Wearable Assistants for Safety-Critical Human-Computer Interaction in Control Rooms" funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation). The project is part of the priority program SPP2199 Scalable Interaction Paradigms for Pervasive Computing Environments. She is doing her PhD in this field in cooperation with the University of Siegen.

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