Special Issue on Human Performance and Decision-Making in Complex Industrial Environments

Complex industrial systems are inarguably subjected to major hazards, which are of great concern to businesses, governments, communities, and wider stakeholder groups. Accordingly, efforts are increasingly made to control these hazards and to manage risks, supported by advanced computational technologies and the application of sophisticated safety and reliability models.

Recent events, however, have revealed that apparently rare or seemingly unforeseen scenarios, involving interactions between human factors, technologies, and organizations can trigger major accidents and lead to catastrophic consequences. For instance, the investigation of the Rio-Paris Flight 447 crash, which resulted in 228 fatalities, highlighted human-related issues as pivotal to the disaster. Factors such as poor communication, human failures to interpret some information, delays to perceive undesirable signals, performance variability, and management issues were found to have interacted with engineering systems to produce these undesirable outcomes.

The understanding of human behavioral characteristics, interlaced with current technology aspects and organizational context, seems to be of paramount importance for the safety and reliability field, in particular human reliability analysis and the role of soft skills for communication, leadership, and decision-making to establish risk awareness.

This Special Issue on "Human Performance and Decision-Making in Complex Industrial Environments" aims to contribute for increasing scientific awareness and for discussing approaches to predict and assess human performance, and anticipate critical issues.

This special issue consists of 15 papers. Despite the uniqueness of the works, these pieces of interdisciplinary research tackle the scope of the Special Issue in a wide range of interconnected perspectives.

Paper by Laumann and Rasmussen illustrate the challenges associated with the collection of empirical data from the literature, incident reports, operational data, and training to inform human reliability analysis. Then, Taylor describes a comprehensive data collection effort from safety management audits, accident and incident investigations, and emergency training exercises to develop a method (Organizational Failure Analysis) to identify organizational deficiencies and failures that can lead to accidents.

A human reliability analysis-based approach is combined with Probabilistic Risk Assessment by Sakurahara et al., to fill gaps in current probabilistic risk assessment methods that evaluate manual fire protection functions performed by first emergency responders in nuclear power plants.

When normal operations are replaced by abnormal plant states, workload transition occurs. Cepin paper focuses on this important issue, discussing differences in human failure probabilities under full power operations and in low power and shutdown conditions, for core damage scenarios in a nuclear power plant. Ahmed and Demirel approach the workload transition problem by introducing an early design human-performance assessment in normal and emergency situations for the aviation industry.

The three next papers build upon the identification of potential human errors, failure modes of engineering systems, and events' propagation in earlier stages of design. First, Soria et al. uses a functional basis framework to identify system-user interactions before the development of prototypes, aiming at the improvement of the overall design process. Then, the Human Error and Functional Failure Reasoning framework is applied by Irshad et al. to some aircraft design issues, comparing the outcomes from modeled critical subsystems with the actual sequence of events leading to the Air France 447 flight crash, to validate the approach developed for assessing early design stages. An effort to estimate human error probabilities from data from major accident investigation reports is made by Morais et al., applying Bayesian Networks to an accident dataset.

Corrado and Sega inaugurated a series of works related to decision-making and human-performance issues. Bui et al. developed a Geographic Information System-based simulation environment to interchange space and time information between fire hazard propagation models and responders, incorporating physical and social decision-making aspects to assess human performance. The improvement of the work environment to enhance overall human performance and operational productivity is approached by Weatherly, focusing on the interfaces between circadian rhythm and lighting technologies. Yiannis and Tzioutziou examined the impact of human factors and of the attribution of weights in decision-making problems.

Risk communication and stakeholder management are relevant dimensions of human factors. Otegui explored these important issues in a thought-provoking case study concerning the development of gas fields in the Peruvian Amazon.

The review article by Kilskar et al. presents a comprehensive literature review approaching the need for addressing sense making in safety-critical scenarios in the maritime domain, to reduce risks. The relationship between sense making and resilience is presented and discussed. Then, the paper by Steiro and Ose analyses the development of resilience in an onshore drilling support center to offshore rigs. These are examples of technology transformations in the maritime and oil and gas industry, increasingly dependent on collaboration and communication between distributed teams located in different places and with dissimilar risk exposure levels, completely changing the landscape for decision-making.

These contributions to science highlight the interest and relevance of decision-making processes and human performance in Complex Industrial Environments. Important topics such as human reliability analysis, human factors in design, resilience, and risk communication were covered to reach a well-balanced Special Issue.

We hope many insightful discussions will be raised and new ways of seeing human factors will be inspired by this Special Issue.

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