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Resilience is a concept initially used to describe the material property. Its meaning got extended due to Holling's (1973) famous paper on 'Resilience and Stability of Ecological Systems'. Recent years have seen some more comprehensive definitions of system resilience, a typical example is the one given by The U.S. National Academy of Science - "Resilience is the ability to anticipate, prepare for, and adapt to changing conditions, and withstand, respond to, and recover rapidly from disruptions" (National Research Council, 2012). With a comprehensive definition, resilience, as a concept, may provide an excellent opportunity to integrate process safety and security management in a generic framework. There are quite a few questions laid in front, including:

i) What are the similarity and differences between risk and resilience concepts in the context of process safety and security?
ii) How to characterize the disruptions to process plants, and how do the impacts of disruptions on system functionality and performance variabilities?
iii) How a resilience-based approach can be formed to support decisions in process design and operations?

This special issue collects ten papers to answer the above questions in part. These papers are from research institutions located in Europe, North America, Asia, and Africa.

First, a bibliometric analysis on resilience assessment and management was conducted by Chen et al. (2023) to identify the collaboration of institutions and authors, and development trends. It is worth noting that the analysis was not tailored for process systems or process operations but resilience assessment and management research in general.

Two papers (Tong and Gernay, 2023; Pawar et al., 2022) made their effort to develop resilience assessment methods for process plants and a specific process system, respectively. Both studies adopted the reliability and risk concepts and models in forming their resilience assessment approach. Notably, Tong and Gernay (2023) used Dynamic Bayesian Network (DBN) to account for the interdependencies between process facilities and assess their resilience subject to the uncertain temporal and spatial evolution of domino effects; while Pawar et al. (2022) modeled absorption, adaptation, and recovery capabilities of a process system based on its reliability function to indicate its system performance. Resilience was then quantified using a commonly-accepted way as a ratio of the area under the performance curve to the area under the non-disrupted performance curve over the time from the start of disruption to the end of restoration.

Adaptation is an essential capability for a system to be resilient under the impact of climate change-induced natural disasters. Amer et al. (2023) argued that how resilience is measured affects the efficacy of adaptation strategies. This paper proposes a composite resilience metric incorporating the general risk management principles and integrates system characteristics, social-environmental factors to capture the relationship between adaptation and resilience. Additionally, Osman et al. (2023) state that properly adapting the topological structure of the cyber-physical distribution network may enhance system resilience. A multi-objective optimization method integrated with game theory was proposed to support resilience-oriented microgrids formation in the cyber-physical distribution network.

Two papers have well demonstrated the usefulness of the resilience concept in handling conventional problems such as emergency response to natural gas leakages and explosion accidents. The risk-based paradigm is often applied to these problems. Zhang et al. (2023) adopted the DBN-based resilience assessment method, integrated it with Functional Resonance Analysis Method (FRAM) and Computational Fluid Dynamics for explosion consequence estimation, and applied the method to a real accident case. It demonstrates how resilience assessment can support decision-making in emergency management. Bai et al. (2023) adopted safety barrier-based thinking in developing a dynamic resilience model to support optimizing emergency strategies. Besides, Sun et al. (2023) attempted to establish a resilience-based approach to maintenance planning problem. They argued that conventional reliability-based and risk-based methods focus much on preventive maintenance while system recoverability from unexpected disruptive situations should also be paid attention to. A novel resilience metric is developed. Based on which optimal maintenance cost is planned.

Machine-learning approaches can contribute to designing resilient systems. To make predictive models effective in enhancing system resilience, Vairo et al. (2023) proposed a data-driven approach focusing on strengthening the reliability of the learning process of the Hidden Markov Model coupled with the Baum-Welsh algorithm. Future studies on using machine-learning methods in resilience assessment and management are anticipated.

As a summative work of this special issue, Yang et al. (2023) discussed the quantitative resilience assessment of complex engineered systems. They attempted to propose a general quantitative resilience assessment framework based on a triplet resilience definition consisting of disruption, functionality, and performance. Despite the promise of resilience concept and its modeling approach to improve process safety and security, resilience is still relatively new to the risk management-focused process industry. A recurring complication is the lack of standard taxonomy and execution process.

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