



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

# Journal of Loss Prevention in the Process Industries

journal homepage: [www.elsevier.com/locate/jlp](http://www.elsevier.com/locate/jlp)

## Special issue: Process safety in times of a pandemic

Since February 2020, all the world has been facing an unprecedented global pandemic scenario. The industry is striving to cope with business continuity, health and safety of workers, and protection of local communities from process hazards and hazards related to pandemics. The impact of COVID-19 spread on the operation of chemical companies is complex and multifaceted, ranging from forced shut-downs to understaffing, to the need of revising procedures and substitute components that become unavailable. Process hazards and the ensuing risk to process plants do not go away with the reduced staffing levels that might be brought about during or shortly after a pandemic. New challenges arise while existing issues remain ever-present, leading to higher complexity in the management of safety and risk. Planning for and tackling such an event requires a good understanding of best practices to limit the virus spread, the unique operating changes that may be caused by an outbreak, and challenges faced by both the operators and the management team. Research may have a crucial role in contributing to answering such new needs and in supporting the effort to develop and implement new management approaches to reduce and control risks in this new framework.

This special issue contributes to the worldwide efforts to manage the current COVID-19 crisis and prepare for a similar future crisis. The issue collects a total of nine papers addressing different aspects of the impact of the pandemic on process safety and, by converse, of the contributions that process safety methods may provide to the management of the pandemic risk.

More specifically, the impact of pandemic spread on the chemical and process industry is discussed by (Bragatto et al., 2021), which provides a detailed case study addressing the impact of the COVID-19 pandemic on the Italian Seveso sites (industrial facilities falling under the obligations of “Seveso-III” Directive, 2012/18/EU). The features of the Safety Management System (SMS) were assessed with respect to its resilience, and an innovative organisational resilience model is proposed, aiming at the development of a higher capability to face future new crises.

Also, the paper of (Ashraf et al., 2022) addresses SMS, reporting the analysis of the impact of a pandemic situation on the implementation of selected elements of process safety management systems related to the identification and evaluation of the risks of major accidents and their control.

To quantify the pandemic-specific impact with respect to the risk related to the chemical industry (Sun et al., 2020), propose a novel risk analysis method, based on joining the “window of opportunity” theory to qualitative and quantitative risk analysis.

A systems-theoretic approach of the two-stage emergency risk analysis based on the systems theory is proposed by (Meng and Xing, 2021),

highlighting the importance of emergency to normal risk analysis. Based on the results obtained, provide recommendations for decision makers in preventing and controlling industrial accidents during the spread of COVID-19.

When coming to the safety and protection of workers during the pandemic spread, the study of (Ambarwati et al., 2022) addressed human resource risk control to support employee productivity during the COVID-19 pandemic, by a combination of Failure Mode Effect Analysis (FMEA) and Bow Tie to identify, measure, and anticipate the risk of COVID-19 transmission in the company, providing recommendations in the evaluation of risk control and preventive measures for COVID-19 in manufacturing companies. The paper of (Briggs et al., 2021) faces a similar issue, addressing the additional safety protocols for process safety, construction & maintenance, and personal protective equipment requirements, and the additional costs related to the adoption of such equipment.

Further contributions addressed the possible use of methods and techniques derived from process safety to assess, control and limit the spread of the pandemic. The paper of (Alauddin et al., 2020) adopts an advanced mechanistic model and utilizes tools for process safety to propose a framework for risk management for the current pandemic, applying it to the effect of non-pharmaceutical interventions on pandemic risk and providing valuable insights to practitioners in both the health sector and the process industries to implement advanced strategies for risk assessment and management.

The paper of (Portarapillo and Di Benedetto, 2021) and of (Kennedy et al., 2021) both address the modelling of aerosol transmission of COVID-19 in closed environments. More specifically (Portarapillo and Di Benedetto, 2021), propose a methodology to perform risk analysis of the virus spread based on the coupling of CFD modelling of bioaerosol dispersion to the calculation of the probability of contact events. In order to build the SARS-CoV-2 effect zones and to adequately assess safety distances (Kennedy et al., 2021), apply a specific software package to analyze the transient behavior of facilities during normal and off-normal conditions to the problem of SARS-CoV-2 virus transmission in single- and multi-room facilities.

Significant growth of chemical production because of increased demand during the COVID-19 pandemic has pushed global chemical manufacturers and oil and gas producers to quickly acquire their production capacities while not compromising process safety. Overall, the special issue contains several studies providing significant contributions to more effective future management of pandemic spread, and to an overall more robust safety management of the chemical and process industry and, by converse, of our everyday life.

<https://doi.org/10.1016/j.jlp.2022.104746>

Available online 29 January 2022

0950-4230/© 2022 Elsevier Ltd. All rights reserved.

## References

- Alauddin, M., Islam Khan, M.A., Khan, F., Imtiaz, S., Ahmed, S., Amyotte, P., 2020. How can process safety and a risk management approach guide pandemic risk management? *J. Loss Prev. Process. Ind.* 68 (September), 104310. <https://doi.org/10.1016/j.jlp.2020.104310>.
- Ambarwati, R., Yuliasri, D., Sulistiyowati, W., 2022. Human resource risk control through COVID-19 risk assessment in Indonesian manufacturing. *J. Loss Prev. Process. Ind.* 74 (February 2021), 104665. <https://doi.org/10.1016/j.jlp.2021.104665>.
- Ashraf, A.M., Imran, W., Véchet, L., 2022. Analysis of the impact of a pandemic on the control of the process safety risk in major hazards industries using a Fault Tree Analysis approach. *J. Loss Prev. Process. Ind.* 74 <https://doi.org/10.1016/j.jlp.2021.104649>. May 2020.
- Bragatto, P., Vairo, T., Milazzo, M.F., Fabiano, B., 2021. The impact of the COVID-19 pandemic on the safety management in Italian Seveso industries. *J. Loss Prev. Process. Ind.* 70, 104393. <https://doi.org/10.1016/j.jlp.2021.104393>.
- Briggs, B., Friedland, C.J., Nahmens, I., Berryman, C., Zhu, Y., 2021. Industrial construction safety policies and practices with cost impacts in a COVID-19 pandemic environment: a Louisiana DOW case study. *J. Loss Prev. Process. Ind.* 76 (October 2021), 104723. <https://doi.org/10.1016/j.jlp.2021.104723>.
- Kennedy, M., Lee, S.J., Epstein, M., 2021. Modeling aerosol transmission of SARS-CoV-2 in multi-room facility. *J. Loss Prev. Process. Ind.* 69, 104336. <https://doi.org/10.1016/j.jlp.2020.104336>.
- Meng, H., Xing, J., 2021. A systems-theoretic approach for two-stage emergency risk analysis. *J. Loss Prev. Process. Ind.* 72, 104582. <https://doi.org/10.1016/j.jlp.2021.104582>. June 2020.
- Portarapillo, M., Di Benedetto, A., 2021. Methodology for risk assessment of COVID-19 pandemic propagation. *J. Loss Prev. Process. Ind.* 72 (June), 104584. <https://doi.org/10.1016/j.jlp.2021.104584>.
- Sun, H., Wang, H., Yang, M., Reniers, G., 2020. On the application of the window of opportunity and complex network to risk analysis of process plants operations during a pandemic. *J. Loss Prev. Process. Ind.* 68 (September), 104322. <https://doi.org/10.1016/j.jlp.2020.104322>.

Valerio Cozzani\*

Laboratory of Industrial Safety and Environmental Sustainability, DICAM,  
University of Bologna, Bologna, Italy

Ming Yang

Safety and Security Science Section, TU Delft, Delft, the Netherlands

\* Corresponding author.

E-mail address: [valerio.cozzani@unibo.it](mailto:valerio.cozzani@unibo.it) (V. Cozzani).