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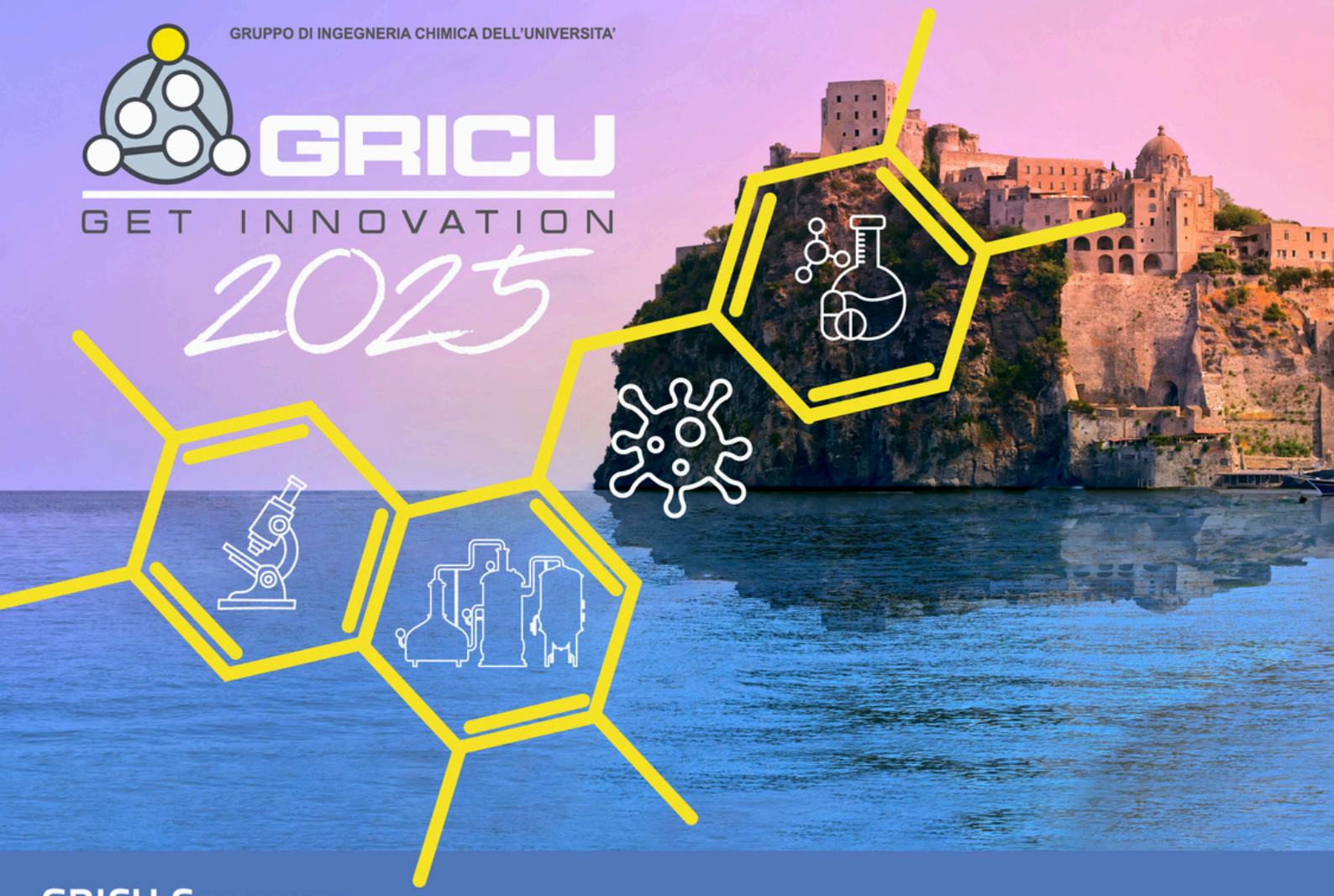

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ABSTRACT BOOK

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Rione Sirignano, 5 - 80121 Napoli

info@mcmcongressi.it - www.mcmcongressi.it

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Advancements in Resilience Modelling for Industrial Infrastructures: A Multi-Hazard Comprehensive Approach

David J. Castro Rodriguez[a], Morena Vitale[a], Antonello A. Barresi[a] & Micaela Demichela[a]

[a] Department of Applied Science and Technology (Politecnico di Torino, Corso Duca Degli Abruzzi 24, 10129 Torino, Italy)

E-mail: david.castro@polito.it

The historical development of the process industry has been marked by a lamentable record of catastrophic accidents involving hazardous materials, caused by complex interactions between technical and external factors. The multi-hazard nature of these interactions requires holistic interventions to cope with the unique risks generated by the interplay of industrial entities and the neighbouring environment. This research presents the advancements in resilience modelling for industrial critical infrastructures within multi-hazard contexts through a comprehensive approach divided into three stages: awareness, preparedness, and recovery. Firstly, the awareness stage is structured around two complementary procedures based on the theoretical function-location approach. On the one hand, the "multi-scale spatial characterization of vulnerability procedure" leverages a customized tool to support informed risk management decisions around industrial infrastructures across different territorial scales using open data (from the national level to the plant scale). On the other hand, a procedure for modelling the functional vulnerabilities of industrial assets to multiple hazards was implemented based on historical records from open-access industrial accident databases. It enables the likelihood estimation of vulnerable industrial attributes by applying advanced mathematical techniques to manage data gaps. Secondly, this framework introduced a novel approach to enhance the preparedness, including the "comprehensive evaluation of the NaTech potential" with the Industrial Critical Infrastructure Multi-Risk Deployment (ICI-MRD), which was tested on a thermoelectric power plant. This approach considered the impact of multiple natural hazards and their contextualized cascading interaction on industrial components. Furthermore, an enhanced index was developed to assess the potential for major industrial accidents based on the characteristics of hazardous substances. A decision matrix was introduced to assess NaTech potential by combining the individual evaluations of infrastructure from the ICI-MRD results with the factors related to the hazardous substances involved. These outputs support decision-makers by delivering data-driven insights for implementing safety layers based on identified vulnerabilities. This process facilitates the design of robust, context-specific safety systems, reinforces the use of protective barriers, and enables the development of effective emergency response plans. Finally, the recovery phase includes integrating restoration measures and sustainable technological solutions after disruptions, as well as establishing a loop for continuous learning to tackle the evolving challenges presented by multi-hazard scenarios in various case studies. The methodological outcomes of the advancements in resilience modelling achieved until now contribute to enhancing the understanding of resilience in complex industrial systems, promoting their long-term sustainability in the face of natural challenges.
Keywords: *NaTech, multi-risk, industrial infrastructures, resilience, vulnerability.*