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## Preface

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**Biographical notes:** Fabio Fruggiero graduated in Mechanical Engineering at the University of Salerno where he conducted his PhD in Optimisation of Industrial Systems. He is currently an Assistant Professor at the University of Basilicata, Italy. He runs courses for both industrial system engineering and operations management. He works as a referee and serves on the editorial board of various international journals, and has been track chair or guest editor for international conferences and special issues. He was responsible for the local research unit of PROMPT and SO4SIMS projects. He is a member of the industrial spin off MONOLETO. He has been engaged in the auto sector for human factor analysis and ergonomic research, scheduling optimisation and production management. His research activity encompasses areas of human factors and corporate strategy, industrial system design processes, simulation and virtual modelling.

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Data mining and system integration, cooperative communication and information processing technologies, simulation and cognitive computing represent some of the key areas in the new global market. They act in an interactive and dynamic environment with the main objective to address flexibility and robustness of the system and to gain value in the service chain. They integrate the human-centric perspective supporting the process and production sustainability. Machine-to-machine and machine-to-person interactivity is a crucial part of the Industry 4.0 perspective. It makes use of technology to get decisions (sometimes decentralised decision) and optimisation, and it is now integrating the designing (and promotion) of product (and process) with interoperable, reusable and service oriented – real time management – capabilities.

In this new circularity era, operators are becoming smart while using tools and technologies to improve efficiency. They directly interact with robots to support the overall effectiveness of tasks in a wide range of domains from manufacturing to health systems. This involves the analysis and elaboration of main rules for perception and comprehension and reaction. They include the cognitive intelligence with its ageing and cobotics implications. Workers, here, are not involved in repetitive tasks but they take decisions to get quality and productivity. This requires analysis of the factors and their causal loop interactions affecting humans at work, using new tools and smart technologies inside the production lines

Integration of smart tools inside the production is improving the amount of information to manage with, consequently, an increased degree of disorder (lack of reliability) or randomness (both property and entropy) in the system. By choosing the correct tool and by selecting the minimum level of data to share, this can decrease the

information processing demand with the ability to boost performances.

Two of the papers in this special issue are theoretically and experimentally reporting about cognitive complexity in assembly tasks. They demonstrate how simulation, integrated by real time data sensors, can optimally support the strategic decisions in the future industrial content. The awareness of choices, integrated by the intelligence of a machine learning approach, and the prediction of paths, supported by the digital visualisation of outcomes, is entering the industrial research panorama. It makes use of principal features extraction (for fast decisions) and design of constrained industrial domains (for result consistency). Virtualisation, in the form of digital shadow (DS) and digital twins (DT), can provide valuable insights on work status, potential issues, training and learning functionalities. It works in a decentralised frame to assist decisions through CPS and IoT.

Clones and immunity training are, then, required to ensuring robustness of machine learning-based models for smart decision. On this topic, the special issue presents an algorithm based on holon and DS approach for training in adversarial conditions of industrial processes.

The consistency of DS-based modelling for optimisation is clearly manifested whenever location and allocation strategies have to be selected. Cloud-based management and e-commerce-based functionalities are analysed (inside one of accepted proposals) with the main objective of selecting an optimal picking strategy in fashion supply markets. That paper remarks the relevance of a multi-objective strategy, while integrating information and data about storage capacity, picking frequency, picking rules, random and dedicated allocation alternatives.

Whenever simulation is able to reproduce the principal mechanism of interaction between industrial resources, whatever modelling perspective we are developing

(dynamics or rule-based or eventually, discretely moving), relevant insight for optimisation can be provided. This is demonstrating in the content of optimal cementing resources selection while implementing call-out strategies.

The supply chain domain is the main content of another proposal in this special issue. It reports about the relevance of information sharing in complex part moving domains. There, the role of a digital portfolio configuration is underlined for primary sustainability content, optimisation of resources and maximisation of outcomes.

In the context of the future, sustainable development, in its environmental and social and technical domains, is gaining value for worldwide ability to support future needs. So, optimisation cannot neglect energy efficiency. That can be used as a metric for the comparison and the evaluation of different manufacturing configurations. One of the proposed readings, in the context of electric gas production

technology, balances energy efficiency and economic optimisation by using simulation-based modelling.

This special issue, entitled ‘Smart interaction for the 4.0 domains: modelling and simulating the content of future’, collected, but was not limited to, the best selected papers submitted and presented at the 2020 International Multidisciplinary Modelling & Simulation Multi-conference (I3M 2020) and at the 2020 International Conference on Industry 4.0 and Smart Manufacturing (ISM2020). It provides a useful and research-inspiring source for industrial benchmarks and future research approaches. The papers have been selected according to their relevance for industrial application. The issue mixes main smart technologies to support circularity and sustainable development. It considers the complexity of product and process and company domain to design strategies and methods to overcome barriers for resource consumption and optimisation.