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EDITORIAL

Guest Editorial: Selected Papers from The International Conference on Industry 4.0 and Smart Manufacturing 2019 (ISM @SMM)

Industry 4.0 (I4.0) is vastly changing a complete range of industrial operations. Companies are facing new challenges but also taking advantage of the multiple opportunities offered by the Fourth Industrial Revolution. The new work environments are characterised by novel technologies and forms of organisation. When adopted, traditional models often do not provide reliable descriptions of these systems.

Digitalisation, enabling technologies such as machine learning, augmented and virtual reality, collaborative robots, and new forms of lean and smart manufacturing require new production and organisational models to predict and control the performance of I4.0 production systems. The availability of a great amount of data from the work environment offers the opportunity to define dynamic models that can interact with the physical environment, thus providing reliable prediction of system development and allowing for effective fulfilment of continuous improvements. The same line of reasoning applies for external environments (logistics) in the cases of both freight and human transport.

The adoption of new technologies and forms of organisation has the potential to spread collaborative intelligent production systems and generate circular economic processes characterised by higher levels of sustainability than those of traditional systems.

This Special Issue is made up of selected papers that were presented at the first International Conference on Industry 4.0 and Smart Manufacturing 2019, organised by the Modelling & Simulation Center Laboratory of Enterprise Solutions, Department of Mechanical, Energy and Management Engineering of University of Calabria in Rende (Cosenza), Italy, in November 2019. The conference, attended by scientists, researchers and company managers working in smart manufacturing and I4.0, provided opportunities for attendees to network, create new synergies and collaborations, and develop new ideas for research and business. The wide range of topics covered in the conference included invited papers, tutorials and poster sessions chosen through a peer review process.

Following the successful conclusion of the conference, a select collection of papers from the conference were chosen for this Special Issue in *IET Collaborative Intelligent Manufacturing*. This Special Issue is dedicated to exploring the state of the art in research and development on the adoption of enabling technologies of I4.0 in collaborative and intelligent production contexts. Papers were selected on the recommendation of a panel of experts and the authors were invited to submit their manuscripts to the journal. After extensive and independent peer review, eight significant manuscripts were accepted for publication.

The selected papers deal with three main topics: logistics; production systems, data-driven modelling, and support; and technological and organisational innovations for sustainability. Although the range of papers covers a variety of I4.0 topics, two common themes arise from those selected—the attention paid to effective management of the substantial volume of data coming from smart systems; and the focus on sustainability obtained or improved through the adoption of I4.0-enabling technologies in both production and logistics environments. The following is a summary of the accepted papers.

The first three papers focus on Logistics 4.0. The first paper, 'Industry 4.0 in the logistics field: a bibliometric analysis', by Bigliardi *et al.*, provides an overview of state-of-the-art of applications of I4.0 in logistics. The authors perform an analysis and review of the scientific literature from 2013 to 2020 related to I4.0 applied to the logistics field. The results of that analysis allow for identification of the most investigated application fields within the manufacturing, automotive, and fashion sectors. Moreover, their work identifies both the relevant (I4.0, IoT, cyber-physical systems, and radio frequency identification) and emerging topics within this research area (4D printing, Industry 5.0, artificial intelligence and drones). The fashion sector is the application field of the second paper, 'Optimisation of goods relocation in urban store networks with an incentive strategy', by Silvestri *et al.* In their paper, the authors investigate the IoT-based relocation activities of urban fashion stores and define a collaborative win–win strategy for retailers and customers of

urban fashion stores that allows for direct costs and externalities to be minimised through relocation activities among stores in the same urban area. The strategy is based on a delivery game approach and an incentive mechanism, and its potential effectiveness is shown through simulation case studies. The third paper, 'Defining maritime 4.0: reconciling principles, elements and characteristics to support maritime vessel digitalisation', by Sullivan *et al.*, focuses on maritime digitalisation technologies and provides a descriptive definition of principles that reflect the objectives of Maritime 4.0 to support the development of next-generation vessels that are potentially able to improve the safety, resilience and profitability of the maritime industry. In their work, the authors adopt the outcome of industry interviews to supplement current state-of-the-art scientific literature and highlight critical research areas and research supporting digitalisation in maritime development. Moreover, the maturity of maritime digitalisation and related challenges are thoroughly investigated.

The next three papers deal with production systems. The fourth paper, 'Digital Twin models in industrial operations: state-of-the-art and future research directions', by Melesse *et al.*, carries out a systematic literature review on Digital Twin models in industrial operations. Records retrieved from public databases (Scopus and Google Scholar) for the 2016–2020 period allow the authors to identify the most relevant contributions to Digital Twin models in the fields of production, predictive maintenance and after-sales services. The potential benefits of adopting Digital Twins in industrial operations, as well as related challenges and solutions, are discussed. A highly significant role for Digital Twins is recognised in the advancement of industrial operations, especially production and predictive maintenance, whilst their still-limited role in after-sales services is observed. In the fifth paper, 'Continuous improvement and adaptation of predictive models in smart manufacturing and model management', by Bachinger *et al.*, the authors investigate the performance and adaptation of predictive models in smart manufacturing by identifying typical causes of concept drift and highlighting the importance of continuous monitoring and adaptation of models. The authors highlight the use of model management systems in the continuous improvement and adaptation of predictive models. A model management system for smart manufacturing is discussed, and generalisable recommendations for continuous model improvement are provided. Moreover, the successful application of two model adaptation strategies is shown. The sixth paper, 'Cloning and training collective intelligence with generative adversarial networks', by Terziyan *et al.*, deals with artificial (cloned) collective intelligence applied to digital transformation of business processes in industry. The authors highlight the role of collective intelligence as a powerful decision-making tool to manage complexity and uncertainty within I4.0 processes and present a new model to design and train the digital cognitive clones of groups of decision-makers. The concept of cellular collective intelligence is introduced and discussed. Also provided are the results of tests of cloned collective intelligence under actual scenarios (secure supply chain, IoT middleware, and collaborative work management at an academic portal).

The final two papers focus on technological and organisational innovations for sustainability. In the seventh paper, 'An interdisciplinary framework to define strategies for digitalization and sustainability: Proposal of a "digicircular" model', by De Felice and Petrillo, the challenges to achieving circular economies and bioeconomies in a digital era ("digicircular" economies) are discussed. An integrated and interdisciplinary framework is proposed to prioritise the digital capabilities that are needed for the digicircular economy's implementation. The authors propose an interdisciplinary and multicriteria tool to support companies in implementing the digicircular business model. The tool is based on Bloomberg's environmental scores and the key performance indicators of the *Corporate Knights'* global sustainability score prioritised through the adoption of an analytic hierarchy process. The effectiveness of the tool proposed is illustrated through two full-scale case studies. In the eighth paper, 'Technological innovations for green production: the Green Foundry case study', by Saetta and Caldarelli, the authors investigate the modification of complex production processes to achieve better and more sustainable performance. The study is based on a full-scale case study in the foundry sector and highlights the technological innovations and necessary changes in operations management necessary for increased sustainability of production processes. In developing the case study, the authors observe that for the effective introduction of a single green technological innovation to complex production processes, changes must be made in nearly all of the processes.

DATA AVAILABILITY STATEMENT
Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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