Special Issue:

Smart manufacturing for sustainability: Trends and research challenges

Valentina Di Pasquale [ID], Chiara Franciosi [ID], Raffaele Iannone [ID], Salvatore Miranda [ID]

Department of Industrial Engineering – University of Salerno (Italy)

vdipasquale@unisa.it, cfranciosi@unisa.it, riannone@unisa.it, smiranda@unisa.it

1. Introduction

Industrial organisations are essential stakeholders for global sustainable development and must shift towards a novel manufacturing paradigm that sheds light on sustainable value creation (Stock Obenaus, Kunz, & Kohl 2018; Sergio, Franciosi & Iannone, 2021). Indeed, manufacturing companies are facing several challenges, such as physical resource depletion, stricter laws and regulations, economic stagnation, and customers' demand for higher product quality (Franciosi, Voisin, Miranda, Riemma & Iung, 2020). The sustainable manufacturing paradigm has attracted a great deal of interest in the last years as an approach that aims to empower companies to cope with these challenges (Eslami, Dassisti, Lezoche & Panetto, 2019) and all business functions and services, such as production, internal and external logistic (Di Pasquale, Nenni & Riemma, 2020; Fahimnia, Sarkis, & Davarzani, 2015) and maintenance processes (Franciosi, Di Pasquale, Iannone & Miranda, 2020), must be involved in this transformation in order to contribute to the sustainable operations.

The Industry 4.0 era makes factories and manufacturing processes more intelligent by the adoption of several technologies, such as highly developed automation, digitalisation processes, sensors, and IT (Lu, 2017), can strongly contribute to sustainable value creation (Stock & Seliger, 2016; de Sousa Jabbour, Jabbour, Foropon & Godinho Filho, 2018). Indeed, to achieve new business solutions for the sustainable industry is not possible without considering new technologies as an integral part of the development.

This special issue aims to explore the current research trends and challenges in the field of smart and sustainable manufacturing across multiple sectors and different industries. In particular, how the several business functions are addressing the integration of new technologies in order to create new sustainable business models and improve their economic, environmental, and social performance. Moreover, this special issue would advance our knowledge and understanding on the impacts of recent technologies enabling Industry 4.0 on operations management.

Under this context, this Special Issue of the Journal of Industrial Engineering and Management (JIEM) gathers six papers, which contributed to deepen knowledge in the sustainable Industry 4.0 domain, through the presentation of studies focused on the adoption of smart technologies, methodologies, artificial intelligence techniques, and optimised strategies for a sustainable management of the factories of the future.

These papers were selected at the 2020 edition of the International Conference on Industry 4.0 and Smart Manufacturing (ISM 2020), organised by the University of Applied Sciences Upper Austria, Austria, and the University of Calabria, Italy, whose mission is to exchange knowledge and discuss theoretical advances, research results and industrial experiences among researchers and practitioners in the field of Industry 4.0 and smart manufacturing for the digital, sustainable and organisational transformation of traditional factories and industrial systems.

2. Overview of the selected papers

The papers chosen for this Special Issue were selected for their technical quality, their originality, their scientific rigor, and their connection with the Special Issue's motto "Smart manufacturing for sustainability". They represent the multidisciplinary character of the conference as well as its international scope. The topics are different, but all refer to problems related to the SI's scope. Specifically, three comprehensive literature reviews and three original articles belong to the special issue.

The first review, titled "**Approaches of Production Planning and Control under Industry 4.0: A Literature Review**" by Jan-Phillip Herrmann, Sven Tackenberg, Elio Padoano and Thilo Gamber, aims to identify and classify current Industry 4.0 approaches for planning and controlling production processes and to reveal researched and unexplored areas. Therefore, the authors proposed a cyber-physical PPC (Production planning and control) architecture, which incorporates current Industry 4.0 technologies, current optimization methods, optimization objectives, and disturbances relevant for realizing a PPC system in a smart factory.

The second review is titled "**Machine learning and deep learning based methods toward industry 4.0 predictive maintenance in induction motors: a state of the art survey**" by Maria Drakaki, Yannis L. Karnavas, Ioannis A. Tziafettas, Vasilis Linardos and Panagiotis Tzionas and, considering the relevance of maintenance and early fault detection and diagnosis of induction motors because they constitute the main power source in the industrial production environment, provides a deep overview on machine learning and deep learning methods for predictive maintenance in the specific field.

The third review, titled "**Optimization strategies for the integrated management of perishable supply chains: A literature review**" by Giovanni Mirabelli and Vittorio Solina, presented an overview on the integration of production, inventory, and distribution activities in perishable supply chains, which are very complex to be managed, highlighting the potentials of Industry 4.0, that are currently little explored. The authors discussed also research trends, gaps, and future challenges in the field.

The first original article, titled "**Burnishing of AM materials to obtain high performance part surfaces**" by Michela Sanguedolce, Giovanna Rotella, Maria Rosaria Saffioti and Luigino Filice, provides a flexible solution to include additive manufacturing into a process chain complying with Industry 4.0 pillars, overcoming major drawbacks in terms of reliability and experimental effort. The paper contributes to current research on the application of the burnishing process, an easy way to implement an environmentally friendly post-processing method to improve the performance of AM products, by providing a unique perspective integrating a reliable simulation model.

The second original article, titled "**Additive Manufacturing and Supply Chain configuration: modelling and performance evaluation**" by Marta Rinaldi, Mario Caterino and Roberto Macchiaroli, compares the performance of different supply chain configurations adopting Additive Manufacturing, through a discrete event simulation model developed in order to reproduce the behaviour of the players according to their role in the supply chain. Many scenarios have been tested and the outcomes obtained allow deriving some useful guidelines, which could help practitioners to identify a suitable application of the additive technology.

Finally, the last original article, titled "**Discrete event modelling for evaluation and optimisation of power utility energy demand**" by Megashnee Munsamy and Arnesh Telukdarie, develops a holistic energy determination model for the entire business requiring minimum inputs for energy re-calculation, when aspects of the business change, and adopting a quantitative approach enabled through a Discrete Event Model. A coal-fired power generation business has been simulated to evaluate the baseline electrical energy demand and associated CO_2 emissions, shedding light on energy savings obtained with the adoption of Industry 4.0 technologies of Internet of Things, Big Data Analytics, mobility, and automation.

It is important to note that the selected articles of this Special Edition are only a sample of the great opportunities that exist for research and practice in Smart Manufacturing towards the achievement of sustainable operations.

References

de Sousa Jabbour, A. B. L., Jabbour, C. J. C., Foropon, C., & Godinho Filho, M. (2018). When titans meet–Can industry 4.0 revolutionise the environmentally-sustainable manufacturing wave? The role of critical success factors. *Technological Forecasting and Social Change*, 132, 18-25. https://doi.org/10.1016/j.techfore.2018.01.017

Di Pasquale, V., Nenni, M. E., & Riemma, S. (2020). Order allocation in purchasing management: a review of state-of-the-art studies from a supply chain perspective. *International Journal of Production Research*, 58(15), 4741-4766. https://doi.org/10.1080/00207543.2020.1751338

Eslami, Y., Dassisti, M., Lezoche, M., & Panetto, H. (2019). A survey on sustainability in manufacturing organisations: dimensions and future insights. *International Journal of Production Research,* 57(15-16), 5194-5214. https://doi.org/10.1080/00207543.2018.1544723

Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. *International Journal of Production Economics*, 162, 101-114. https://doi.org/10.1016/j.ijpe.2015.01.003

Franciosi, C., Di Pasquale, V., Iannone, R., & Miranda, S. (2020). Multi-stakeholder perspectives on indicators for sustainable maintenance performance in production contexts: An exploratory study. *Journal of Quality in Maintenance Engineering,* 27(2), 308-330. https://doi.org/10.1108/JQME-03-2019-0033

Franciosi, C., Voisin, A., Miranda, S., Riemma, S., & Iung, B. (2020). Measuring maintenance impacts on sustainability of manufacturing industries: from a systematic literature review to a framework proposal. *Journal of Cleaner Production*, 260, 121065. https://doi.org/10.1016/j.jclepro.2020.121065

Lu, Y. (2017). Industry 4.0: A survey on technologies, applications and open research issues. *Journal of Industrial Information Integration*, 6, 1-10. https://doi.org/10.1016/j.jii.2017.04.005

Sergio, M., Franciosi, C., & Iannone, R. (2021). A model for the economic assessment of disassembly-line integration in traditional manufacturing processes. *Procedia Computer Science*, 180, 308-317. https://doi.org/10.1016/j.procs.2021.01.168

Stock, T., & Seliger, G. (2016). Opportunities of sustainable manufacturing in industry 4.0. *Procedia Cirp*, 40, 536-541. https://doi.org/10.1016/j.procir.2016.01.129

Stock, T., Obenaus, M., Kunz, S., & Kohl, H. (2018). Industry 4.0 as enabler for a sustainable development: A qualitative assessment of its ecological and social potential. *Process Safety and Environmental Protection*, 118, 254-267. https://doi.org/10.1016/j.psep.2018.06.026

To cite this article: