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Editorial

Special Issue on Advanced Design and Manufacturing in Industry 4.0

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1. Introduction

Industry 4.0 (I4.0) is the term used in the manufacturing world to denote the fourth industrial revolution [1], characterized by the use of cyber–physical systems [2]. The main topics are directly related to the concept of the "Smart Factory", outlining a new vision in which the traditional factory evolves into a fully automated, digitized, flexible, and connected system capable of learning and adapting to new scenarios [3]. A smart factory works by integrating machines, people, and Big Data into a single, digitally connected ecosystem [4]. The rapid developments of modern I4.0 technologies related both to information technology (IT) and operational technology (OT), such as artificial intelligence (AI), additive manufacturing (AM), augmented reality (AR), digital twin (DT), Internet of Things (IoT), big data analytics, etc., have led to the conception of a more modern production plant, in which the various systems can interact and communicate with each other to support real-time decision-making with effective and reliable responses. In more detail, the smart system interprets data sets to forecast trends and events and to implement smart manufacturing workflows and automated processes. This leads to continuous procedural improvement, with the smart factory gradually becoming more resilient, safe, and productive, while respecting environmental sustainability.

The impact of I4.0 exceeds the frontiers of industrial production and can affect all industrial sectors [5].

Furthermore, I4.0 not only revolutionizes the idea of the factory, but it can also have a decisive impact on the way in which products and services are designed. In these terms, it is possible to introduce the concept of the "fourth design revolution", i.e., a new way of developing the design of smart and connected products [6] that allows for continuous interaction between the designer and the product.

2. Advanced Design and Manufacturing in Industry 4.0

This Special Issue emphasized Industry I4.0 and, in particular, the advancement of design and manufacturing. Some of the topics covered include modern manufacturing techniques, advanced tools for the analysis and mechanical design, efficient and flexible product design and manufacturing strategies, traditional and innovative materials pertaining to the smart design concept, engineering of industrial products and their life cycle, sustainable production, etc. Full papers were invited and 23 papers were received. Based on several rounds of the review process, 16 papers (1 review and 15 original articles) were accepted (i.e., a 70% acceptance rate). They are arranged as follows.

In the paper titled "Industry 4.0 Technologies for Manufacturing Sustainability: A Systematic Review and Future Research Directions", Jamwal et al. [7] provided a systematic literature review to find out the current research progress and future research potential of Industry 4.0 technologies to achieve manufacturing sustainability.

Wang et al. [8], in the paper titled "Cloud-Edge Collaboration-Based Knowledge Sharing Mechanism for Manufacturing Resources", illustrated a mechanism for knowledge

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sharing where the learning process between devices is realized by effectively screening, matching, and combining the existing knowledge primitives contained in the knowledge base deployed in the cloud and the edge.

Zoubek et al. [9], in the paper titled "Industry 4.0 Maturity Model Assessing Environmental Attributes of Manufacturing Company", studied a maturity model dealing with environmental manufacturing processes in a company applying value stream mapping (VSM) to identify core processes with environmental potential. This paper provides an understanding of the role of environmental manufacturing in the era of the fourth industrial revolution.

In the paper titled "Evaluation of the Level and Readiness of Internal Logistics for Industry 4.0 in Industrial Companies", Zoubek et al. [10] proposed a methodology by which to evaluate the logistics processes and company readiness for automation and digitization.

In the paper titled "The Effect of Training in Virtual Reality on the Precision of Hand Movements", Martirosov et al. [11] proposed a methodology by which to reap the benefits virtual reality, specifically concerning the precision of hand movements in specific settings, and then evaluated its effects for the transfer of the results to the real world.

Kwak et al. [12], in the paper titled "A Study on Semantic-Based Autonomous Computing Technology for Highly Reliable Smart Factory in Industry 4.0", proposed a methodology for the autonomous control of a smart factory on a digital twin. A smart factory was designed by a convergence of monitoring technologies, autonomous control technologies, and semantic web technologies.

Ko et al. [13], in the paper titled "Anomaly Segmentation Based on Depth Image for Quality Inspection Processes in Tire Manufacturing", introduced and implemented an efficient training method for deep learning-based anomaly area detection in a depth image of a tire.

In the paper titled "Smart Design of Portable Indoor Shading Device for Visual Comfort—A Case Study of a College Library", Xue et al. [14] studied innovative solutions for indoor visual comfort and made suggestions for future indoor household designs.

In the paper titled "Digitalization in Open-Pit Mining: A New Approach in Monitoring and Control of Rock Fragmentation", Koteleva et al. [15] proposed an informational and analytical model of the processes of mining enterprises extracting minerals by open-pit mining, as well as an algorithm for determining the lumps' forms and obtaining their distribution in the rock mass.

Koteleva et al. [16], in the paper titled "A Simulator for Educating the Digital Technologies Skills in Industry. Part One. Dynamic Simulation of Technological Processes", focused on the creation of a digital training simulator for the industry and the development of a dynamic process model. The process chosen is flotation, as it is one of the most common mineral processing methods.

De Beelde et al. [17], in the paper titled "Wireless Sensor Networks for Enabling Smart Production Lines in Industry 4.0", presented a hybrid network architecture for providing Quality of Service (QoS) in an industrial environment where guaranteed minimal data rates and maximal latency are of the utmost importance for controlling devices and processes.

In the paper titled "Proposal of a Tool for Determining Sub- and Main Dimension Indicators in Assessing Internal Logistics Readiness for Industry 4.0 within a Company", Poor et al. [18] described the issue of readiness models for the Industry 4.0 concept, which are commonly used as tools for conceptualizing and measuring the maturity of an organization or process related to a specific target state.

In the paper titled "Peak Energy Reduction in Flow Shop including Switch-Off Policies and Battery Storage", Renna et al. [19] studied simulation models to investigate the potential application of the energy storage system with switch-off policies to reduce the energy costs related to the use over the peak power constraint.

Cordero-Guridi et al. [20], in the paper titled "Design and Development of a I4.0 Engineering Education Laboratory with Virtual and Digital Technologies Based on ISO/IEC TR 23842-1 Standard Guidelines", described the development of a virtual/augmented reality (VR/AR) laboratory to support learning, training, and collaborative ventures related to additive manufacturing for the automotive industry.

Lee et al. [21], in the paper titled "OPC-UA Agent for Legacy Programmable Logic Controllers", proposed the design of an open platform communications (OPC) unified architecture (UA) agent to enable UA information services and client functionalities in legacy programmable logic controllers (PLCs).

In the final paper, titled "Development of an Algorithm for Determining Defects in Cast-in-Place Piles Based on the Data Analysis of Low Strain Integrity Testing", Koteleva et al. [22] described the results of creating an algorithm for the recognition and localization of defects in cast-in-place piles.

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