Editorial

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Marcello Pellicciari is an Associate Professor at the Department of Engineering 'Enzo Ferrari' of the Università degli Studi di Modena e Reggio Emilia. He accumulated extensive experience in integrated design of robotic and mechatronic manufacturing systems through the systematic use of virtual prototyping and simulation. He co-founded the Laboratory of Integrated Design and Simulation, where researchers collaborate with industrial robotics system integrators in the development of innovative industrial applications based on emerging research findings. His research interests are: virtual prototyping of mechatronic systems, virtual commissioning, and industrial robotics engineering design methods. He coordinated the AREUS project about sustainable manufacturing (http://www.areus-project.eu).

1 Introduction

Sustainability is one of the key requirements for manufacturing industry to be competitive and long term. Despite the numerous attempts towards the creation of sustainable manufacturing systems, there is an urgent need for effective methods to implement sustainable processes in industry. Indeed, sustainable manufacturing pushes companies to consider three complex challenges at the same time: ecological challenge (reducing environmental impact and resource consumption), economical challenge (improving overall process efficiency and reducing global costs), and social challenge (increasing social effectiveness and reducing human-related impact). As a consequence, other than the more conventional firm performance objectives of cost, quality, speed, flexibility and dependability, today there are new requirements for firms to deliver on sustainable objectives. In this context, manufacturing companies are seeking new ways to integrate economic, environmental and social practices to develop unique capabilities to

improve their sustainable competitiveness. In particular, novel agile methods for integrated sustainable manufacturing are welcome to support companies to move from theories into practices.

In the recent years, several methods have been proposed for ensuring that the industrial sector fits well with the current uncertain environment and to respect the sustainability principles. However, some issues are still open: on one hand, the ever-increasing need for industrial efficiency is pushing towards automation along with a continuous improvement of the innovative technology; on the other hand, the rapid increase of waste and the analysis of the social aspects (i.e., the impact on 'humans' and society) present a global challenge pursuing sustainability and are still unsolved. Such scenario is definitely transdisciplinary and includes all the main engineering area. Furthermore, it requires the integration of an engineering and business perspective to find feasible solutions, to be successfully implemented in the real practice. To tackle such challenges, new approaches and agile methods are necessary to find a balance among the different aspects in order to implement effective sustainability processes. This topic perfectly fits the main scopes of the *International Journal of Agile Systems and Management*, especially for its multidisciplinary character and the need of a social-technical management philosophy that encompasses multiple disciplines. Indeed, sustainability is quickly being regarded as a competitive necessity in most industries, but it has rarely been part of the decision-making. To help the integration of sustainability factors, assessing economic, social, and environmental benefits for firms and their customers and suppliers network is mandatory (Theyel, 2012). For instance, Peruzzini and Germani (2014) explored how to design for sustainability in product-service systems, defining a methodology to identify a set of sustainability indicators to compare different use scenarios and adopting a holistic approach to assess sustainability on the basis of the impact on the three sustainability areas (i.e., environmental, economical and social). Furthermore, focusing on increasing the manufacturing productivity by emphasising on the elimination of waste, and increasing the value-added activities as well as the workers' wellbeing, is one of the key point of agile production and lean manufacturing (Yusup et al., 2015). As a result, it can be stated that having high performance in sustainability practices is directly linked to the increase the company productivity and the improvement of the operations management. However, this can be achieved only if companies are open to novel approached and demonstrate the ability to adapt the sustainability practices with their inner processes in order to positively influence the economic and environmental performance, the level of competency in managing the company operations, and the level of social wellbeing (Yan et al., 2015).

This special issue addresses the three areas of sustainability from an industrial and engineering research perspective. It includes invited papers selected from contributions to the 23th ISPE Inc. International Conference on Transdisciplinary Engineering held in Curitiba, Brazil, on 3–7 October 2016 (Borsato et al., 2016). The authors come from traditional manufacturing countries, such as Germany, Italy and Sweden in Europe, as well as Australia and new emerging countries, such as Brazil and Malaysia, to demonstrate how the attention to sustainable manufacturing is widespread and commonly shared among industry and academia. They all present novel approaches to deal with sustainability in manufacturing, from different perspectives, from agile approaches for sustainability assessment, to strategies for the evaluation of recycling processes, predictive methods to design and assess sustainability in different contexts or emerging strategies which focus on the configuration of robot work to promote sustainability, until

approaches to incorporate sustainability practices into business strategy. All works emphasises the search for a balance in the economic, social and environmental perspectives to achieve sustainable manufacturing processes.

Rauch et al. present the actual state of the art in distributed manufacturing. Sustainability oriented reasons for a trend towards distributed manufacturing networks is explained and evolutionary stages in the development of factories are represented describing their characteristics at every stage. Finally, a framework of possible network models for distributed manufacturing networks of smart and agile mini-factories is provided and enforced by examples from industrial practice. The paper closes with a discussion of the proposed network model framework and an outlook on future needs in research.

Peruzzini and Pellicciari highlights the need of predictive methods to design human-centred smart manufacturing systems from the early design stages. The paper defines a model to early assess human factors to be integrated with other existing models to evaluate manufacturing process sustainability. The proposed integrated method can be fruitfully used to support the design of sustainable manufacturing systems by taking into account also the impact on workers. An industrial case study focusing on packaging machines design is presented to demonstrate the validity of the proposed method and its adoption to propose re-design action promoting sustainability.

Kai et al. contribute a study to match some of the characteristics of a sample of companies with sustainability strategy. A multinomial logistic regression analysis was used for the collected data. Data from five companies' characteristics were used as independent variables and related to 15 aspects of corporate strategy and sustainability practices as dependent variables. The results show that sustainability is definitively in the strategic agenda; it has an important influence in the competitive strategy of the studied companies.

Stjepandić et al. draw a concept for the use of 3D PDF in a workflow for disassembly and recycling within the product creation process. An analysis of law regulations, existing use cases and associated processes has been conducted. After having identified a distinctive field of studies with the help of the model, a new use case has been derived. Subsequently, a new workflow has been developed and, finally, a prototypical example of the 3D PDF document for disassembly and recycling has been implemented.

Pabolu et al. investigate the manufacturability of welded components for engineer to order businesses including manufacturing feasibility, manufacturing cost, manufacturing difficulties along with the sustainability aspects. The work is focused on the weldability assessment, based on available weld methods and the weld capabilities of the company. To keep the knowledge transparent, traceable and updatable it is managed by a novel software called Howtomation© Suite which is a forward chaining inferencing engine. The proposed framework enables a weldability index and welding cost guide to be derived, helping the designers choose appropriate weld method in early design stages.

Osman et al. have evaluated the configuration of robot work cells since their ever-increasing adoption and the current manufacturing trends towards the automation along with a continuous improvement of the innovative technology. Configuration forms a very important section of the manufacturing industry as it greatly affects the system performance. Additionally, a configuration strategy along with all the details regarding its phases and frameworks has been proposed which may assist in the development of flexible configuration system in future. The primary purpose of this work is to propose a

strategy with a methodology of robot work cell configuration for addressing few sustainability issues such as to improve configuration time, to optimise human and expert involvement and to capitalise available resource for investment.

Hamid and Ito report a new methodology for an automatic vertices coordinate extraction from a dental wire CAD model in IGES format and CNC code generation for the desired bending machine. The procedure is carried out in MATLAB environment through some developed functions to support wire design technique in CAD by means of 3D line segmentation. In this approach, the design of the wire shape is constructed from multiple 3D line segments in reference to the 3D teeth scan image (STL file).

Vast areas like the coastline of Australia require a great deal of resources and costs hundreds of million dollars to protect. Due to decisions at different times, the patrol boat bases are located at the east side of Australia while most illegal activities are at the north west, which is located a vast distance from where the asset is. Mo et al. review methodologies commonly used in enterprise systems design and outlines a system model that captures elements of the support system and improves the processes of developing a viable solution to the problem.

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