Chapter 9
Towards Industry 4.0: Efficient and Sustainable Manufacturing Leveraging MTEF – MTEF-MAESTRI Total Efficiency Framework

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ABSTRACT

An overview of the work under development within the EU-funded collaborative project MAESTRI is presented in this chapter. The project provides a framework of new Industrial methodology, integrating several tools and methods, to help industries facing the fourth industrial revolution. This concept, called the MAESTRI Total Efficiency Framework (MTEF), aims to advance the sustainability of manufacturing and process industries by providing a management system in the form of a flexible and scalable platform and methodology. The MTEF is based on four pillars: a) an effective management system targeted at continuous process improvement; b) Efficiency assessment tools to support improvements, optimization strategies and decision-making support; c) Industrial Symbiosis paradigm to gain value from waste and energy exchange; d) an Internet-of-Things infrastructure to support easy integration and data exchange among shop-floor, business systems and MAESTRI tools.

INTRODUCTION

The continuous population growth has led to increased concerns regarding the protection of the environment and resource scarcity by our society and economy. In this context, the concept of sustainability was defined in 1987 in a Report of the World Commission on Environment and Development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (U. Nations, 1987). Since then, the interest and concern about such subjects has aroused growing interest and the sustainability concept was never as meaningful and important as it is nowadays (Fercoq et al., 2016). Likewise, the industrial sector has the concept of sustainable manufacturing, which comprehends a significant number of objectives. The most quoted definition is given by the U.S. Department of Commerce: "the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound" (U.S. Department, 2014).

Hence, sustainable development supported by resource efficiency - based on the principle that the efficient and effective material and energy use can reduce natural resource inputs and waste or pollutant outputs, thus avoiding environmental degradation, and eco-efficiency assessments is nowadays a clear priority for the European industry as it is largely dependent on resources imports from international markets. Moreover, European industry is also accounted for more than a quarter of total energy consumption in 2010 in Europe.

Despite the fact that the concept of sustainability might be understood intuitively, yet, its quantitative evaluation for production systems is a complex task and not intuitive. Therefore, in order to improve sustainability and resource efficiency, the appropriate sustainability assessment and performance evolution should be carried out.

Due to the complexity related with sustainability assessment, this has become a rapidly developing topic with a growing number of concepts and tools being developed during the last decades. This has been particularly relevant for manufacturing industries, main consumers of natural resources (Garetti, 2012). The response to these challenges must encompass suitable approaches enabling industries to be supported on capabilities of the novel approaches to improve production processes and to ensure resource efficiency in the delivery of high-value-added products, while maintaining a superior economic and sustainable performance.