

Chapter 15

Knowledge Transfer and Introduction of Industry 4.0 in SMEs: A Five-Step Methodology to Introduce Industry 4.0

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ABSTRACT

Industry 4.0 is for most companies and especially for small and medium sized enterprises (SMEs) one of the major challenges after the wave of lean management. The aim of this chapter is to provide a methodological guidance for the practical use of the Industry 4.0 vision and principles in production system design in the specific context of SMEs. Based on the analysis of literature, a procedure model for the target-oriented introduction of Industry 4.0 principles in SMEs is proposed. A first practical evaluation of the approach is carried out based on two industrial case studies. The experiences made in the industrial cases show that Industry 4.0 is not limited to the application in large enterprises but is very suitable also for SME. This chapter contributes, with its case-study-based methodology, to the existing sparse knowledge on the introduction of Industry 4.0 in SME production systems.

DOI: 10.4018/978-1-7998-8548-1.ch015

INTRODUCTION

Many companies in various industries have reorganised their production in the recent past, following the principles of lean production or even taking advantage of novel production strategies such as agile manufacturing and mass customisation (Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M., 2014), and thereby increasing flexibility and achieving significant progress in productivity and in readiness for delivery. However, the demands are growing: the trend towards individualisation of products is increasing, efficiency-enhancing serial or even mass-production concepts are increasingly being pushed back, and classic approaches to automation are failing in the demand for a production up to the 'lot size 1'. Industrial production is faced with a profound change and the question of the quadrature of the circle: *Is automation of individuality possible?* (Matt D. T., Rauch E., & Fraccaroli D., 2016). A popular term, 'Industry 4.0' is currently broadly debated both by researchers and practitioners as a visionary concept that promises to resolve this conundrum. Industry 4.0 technologies also facilitate the fabrication of customised products and, thus, the concept of mass customisation (Matt & Rauch, 2017). However, the majority of small and medium-sized enterprises (SME) are still quite sceptical regarding this vision and many of them doubt the benefits (Matt D. T., Rauch E., & Fraccaroli D., 2016). Industry 4.0 represents a special challenge for businesses in general and for SMEs in particular. The readiness of SME to adapt to Industry 4.0 concepts and their organisational capability to meet this challenge exists only in part. The smaller SMEs are, the higher the risk that they will not be able to benefit from this revolution (Sommer, 2015). SMEs are conscious about the knowledge in adaption deficits and this opens the need for further research and action plans for preparing them for Industry 4.0.

This chapter proposes a methodology for an efficient transfer of knowledge in the context of Industry 4.0 and the related cyber-physical production systems, and is derived from a careful literature research and evaluated through two industrial case studies, wherein Industry 4.0-relevant knowhow and concepts were transferred from research into the industrial practice of small and medium-sized enterprises. The case analysis shows that Industry 4.0 is not only accessible for large high-tech-enterprises. However, the implementation must be gradual along a clearly defined strategy. Thus, the purpose of this chapter is to propose a methodological guidance from a focused knowledge transfer to the practical implementation of the Industry 4.0 vision and principles in production system design and in the specific context of small and medium-sized enterprises. It should serve as a starting point for broader and more detailed study regarding research on how to implement Industry 4.0 in industrial enterprises and, especially, in SMEs.

The chapter is structured as follows: after the initial introduction in Section 1, the authors analyse the state of the art in the implementation of Industry 4.0 principles and the Smart Factory concept in SMEs. Section 3 describes the research methodology, the objectives of this research and the proposed implementation approach consisting of five successive steps. In Section 4, the authors describe the application of the 5-step implementation approach in two industrial case studies. In Section 5, a critical discussion follows and shows the advantages, but also the current limitations, of the proposed approach. This section addresses future direction for further research. Finally, the chapter ends with a brief summary and conclusion.

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