Chapter 88

Analysis of Challenges Responsible for the Slow Pace of Industry 4.0 Diffusion

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ABSTRACT

The pace of Industry 4.0 adoption in manufacturing industries has been slow as it is accompanied by several barriers, specifically in the emerging economies. The current study intends to identify and understand the landscape of these challenges. Further, this paper prioritizes the challenges on the basis of their relative importance. To achieve this objective, the authors combine the fuzzy delphi approach along with the fuzzy analytical hierarchy process. Additionally, a sensitivity analysis is done to enhance robustness of the findings. The global rankings of the challenges reveal that the most significant factors that hamper the full realization of smart manufacturing include cybersecurity, privacy risks, and enormously high number of technology choices available in the market. The analysis offers insights into the reasons for the slow diffusion of smart manufacturing systems and the results would assist managers, policymakers, and technology providers in the advent of manufacturing digitalization.

1. INTRODUCTION

Industry 4.0, which is the fourth industrial revolution, has become a prominent topic across the global community of academicians, practitioners, and policymakers in recent times (Munirathinam, 2020; Sari, Gules, & Yigitol, 2020). In the era of transformation of business trends, it is necessitated for the companies to embrace the fourth industrial revolution in their operations and broader supply chain networks (Kiel, Müller, Arnold, & Voigt, 2017; Li, 2018; Reischauer, 2018). The realization of this change is marked by the integration of networked manufacturing systems, multiple smart factories, and digital

engineering integration along the product's value chain (Barata, Rupino Da Cunha, & Stal, 2018). The smart factory is a fundamental unit and critical feature of Industry 4.0 (Liu & Xu, 2016). It involves the amalgamation of sensors, simulations, data-dependent models, predictive engineering, computing platforms along with information and communication technology (ICT) (Abed, 2016; Kusiak, 2018; Qu et al., 2016; Tang, Cao, Zheng, & Huang, 2015). Adapting these technologies in processes will help manufacturing firms to gain customer-centricity while improving operational performance (Nigappa & Selvakumar, 2016; Szalavetz, 2019). It will also help to increase employee wellbeing by driving zero-incident production set-up (Luthra, Garg, Mangla, & Singh Berwal, 2018). From the perspective of an emerging economy, smart manufacturing can impel the manufacturing sector and help India become a truly global hub (Luthra, Kumar, Zavadskas, Mangla, & Garza-Reyes, 2020). However, despite the advantages of industry 4.0 as underlined above, the actual pace of smart manufacturing adoption has been slow (Luthra et al., 2018; Deloitte 2019).

Incorporation of industry 4.0 principles in manufacturing requires synchronized and focused action from various stakeholders such as managers, policymakers and members in the supply chain (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). Managers face issues while translating smart manufacturing opportunities into concrete strategies for their business. The literature has outlined the hurdles faced by firms in their decision to move from traditional to smart manufacturing such as lack of willingness of top managers (Luthra et al., 2018; Luthra & Mangla, 2018) and cost of implementation (Gokarn & Kuthambalayan, 2017; Sanders, Elangeswaran, & Wulfsberg, 2016; Sommer, 2015). The realization of smart manufacturing is not contingent upon a few factors but depends upon various factors, often spanning organizational boundaries. Therefore, in the present study, we set out to present a nuanced understanding of challenges from the perspective of the firms that are into the process of digitalization but their pace of this transformation is inhibited by various factors. We make a departure from existing few studies (e.g., Kamble et al., 2018; Sanders et al., 2016) that have highlighted the barriers towards the implementation of smart manufacturing in firms where firms have just started the process or are at the very initial stages of this transformation. This study identifies factors critical for implementation of smart manufacturing where firms have had some experiences with the process. Therefore, we understand that these firms have sufficient funds and willingness to undergo transition; however, they face challenges in transforming their industry 4.0 vision into concrete business outcomes. We underline the challenges faced by these firms by referring to the extant literature and augment them with the help of expert opinions. These challenges are then analyzed for the case of a manufacturing company that is undergoing a transition from traditional to smart manufacturing. Therefore, the purpose of the present work is to seek answers to the following research questions:

- What are the challenges faced by firms undergoing a transition from traditional to smart manufacturing in India?
- How to determine the priority of these challenges, that affect manufacturing digitalization?

In order to address this research objective, set in the context Indian manufacturing industry, important challenges reported in the literature were identified in the comprehensive survey of literature. We incorporate fuzzy Delphi technique to finalize the identified challenges. Fuzzy analytical hierarchy process (FAHP) is applied to establish the relative prominence of the challenges. Since AHP is not sufficient towards managing the uncertainty and vagueness that accompanies human judgments, therefore, fuzzy logic is applied (Kumar et al., 2018).

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