

Chapter 45

Towards a Framework for Assessing the Maturity of Manufacturing Companies in Industry 4.0 Adoption

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ABSTRACT

The recent introduction of new disruptive technologies aimed at monitoring, controlling, optimizing, and automating production systems is shifting the manufacturing landscape towards a fourth industrial revolution. In this new industrial paradigm, manufacturing companies face complex challenges requiring the development of new organizational and technological capabilities. With this context in mind, this chapter is intended to provide a maturity assessment framework to understand the transformation process in manufacturing companies transitioning to Industry 4.0. The proposed framework is applied to 10 in-depth industrial case studies in Canada and Italy, two countries with increasing awareness of the Industry 4.0 revolution. A comparative case analysis revealed four different standards, or archetypes, for Industry 4.0 adoption, which are discussed and analyzed, highlighting a relationship between a company's manufacturing configuration and its path towards Industry 4.0 adoption.

DOI: 10.4018/978-1-7998-8548-1.ch045

INTRODUCTION

The world is undergoing a new technological revolution, brought about by a convergence of disruptive digital technologies such as intelligent machinery and robotics, big data analytics, Cyber Physical Systems (CPS) and the Internet of Things (IoT). The impact and integration of these new technologies on and within production systems is what drives the fourth industrial revolution, also known as Industry 4.0 (I4.0), Smart Manufacturing or the Industrial Internet of Things (IIoT).

Even though Industry 4.0 is still in its infancy, German and US companies are some steps ahead in the adoption of smart manufacturing technologies, mainly because of the presence of national strategic plans for Industry 4.0 introduction. Other countries are becoming more and more aware of the relevance of Industry 4.0, and catch-up initiatives are emerging, which is the case of Italy and Canada. At the end of 2016, the Italian government officially presented its national plan for investments, productivity and innovation, titled “Piano Nazionale Industria 4.0,” which has been in operation since mid-2017. Although a few Canadian provinces, such as Quebec, Ontario and Alberta, have begun to show an interest in Industry 4.0 via grant programs and research studies, the Canadian Government has not yet devised a national plan. Since Italian and Canadian companies are currently stepping up the pace of Industry 4.0 implementation/adoption, albeit not as fast as would be required, a cross-country study on the introduction of smart systems in manufacturing companies is timely.

The need for an instrument to assess the benefits of the adoption process established by companies in their transition to Industry 4.0 emerged during the problem definition. Accordingly, we designed a framework, the Adoption Maturity Model (AMM), composed of a series of indicators on the requirements and concepts for ideal Industry 4.0 adoption to identify the various maturity stages required.

Prior to the design phase, a comprehensive literature review was performed in order to define the concept of Industry 4.0 and consider its challenges, trends and enablers. The critical comparative analysis of scientific contributions to existing maturity models, determining their strength and weaknesses, helped us build the framework underlying our case studies. This framework served as a basis for developing the interview guide to assess the Adoption Maturity Model applied to 10 industrial organizations, five Italian and five Canadian.

The 10 case studies focused on the adoption of Industry 4.0 in the manufacturing industry through the lens of the framework designed. Lastly, this research performed a comparative analysis of the different approaches developed by the companies selected in order to provide new insights on the introduction of Industry 4.0.

The goals of this chapter are thus to review the emerging literature about Industry 4.0 in order to build a framework to assess the maturity of manufacturing companies as concerns its adoption, and then to test this framework with real in-depth case studies.

To meet these goals, the remainder of the chapter is organized as follows. The next section reviews the literature on Industry 4.0, its definition and the measurement of the maturity necessary for its adoption. Then, the methodological approach used in the research is presented, followed by the discussion of the framework (AMM) developed from the literature review. Afterwards, brief section addresses how the case studies were built. The results from these case studies are then presented and discussed, followed by the chapter’s conclusions.

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