Chapter 8
The Human Engine of Industry 4.0:
A Psychological Framework for Digital Transformation in Manufacturing

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ABSTRACT

This study explores the psychological factors influencing the adoption of Industry 4.0 technologies in manufacturing. Moving beyond a purely technological perspective, it introduces a psychological framework based on the Precaution Adoption Process Model and Resource Dependence Theory. The study identifies seven key psychological barriers: acceptability, resistance, readiness, motivation, cognizance, funding, and commitment to change. Findings show that while organizational resources affect

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perceived competence, this does not necessarily reduce risk perception. The paper emphasizes the importance of human-centric design, emotional intelligence, and employee engagement in facilitating digital transformation. It highlights the role of cognitive ergonomics, motivation strategies, and adaptive skill development in shaping workforce readiness. Addressing challenges such as technological anxiety and change resistance requires inclusive leadership, continuous training, and feedback mechanisms.

1. INTRODUCTION

Through its ability to integrate core production, core service and development processes, the implementation of Industry 4.0 technologies provides competitive advantages. This study aims to develop an understanding of the interplay among the psychological barriers affecting the adoption of Industry 4.0 in the manufacturing sector. Grounded on the precaution adoption process model and resource dependence theory, a research model is proposed to assess the interplay between seven psychological barriers. Data obtained from 305 manufacturing organisations was analysed using the partial least squares structural equation modelling approach. The findings show that both the availability and the assessment of organisational resources affect the existence of perceived competences. Surprisingly, perceived competences do not hinder risk perception. This study contributes to the literature by revealing new insights into the adoption of the Industry 4.0 phenomenon from a psychological barrier's perspective. The findings also provide implications for both researchers and practitioners, who can benefit from an articulate understanding of the interplay between the psychological barriers of the adoption of Industry 4.0 (Mahmood et al., 2021). In the case of successful adoptions of the Industry 4.0 phenomenon, the production engineering design will combine intelligent products, smart machines, knowledge-based processes, and fully connected "digital" supply chains. On this new stage, new digital products and services, greater integration of automation equipment, new design methodologies and technologies, new organisation of logistics, production and VAL processes, as well as new forms of collaboration and business models will arise. As a result, the perceived benefits with respect to operational excellence, strategic reorientation, and sustainable development will be achieved. These, in turn, will have strong implications on competitiveness. (Kapp, 2018) concludes that the technological and institutional transition towards Industry 4.0 differs by regional conditions and presents global implications for public policy. In reply to the question of "What would Industry 4.0 be?" indicates that digital technology advances, cyber-physical systems, internet of things, and big data analytics are four notable aspects of this phenomenon.