

Retracted- The Paradox Between Concept Knowledge and Digital Maturity Level for Industry 4.0: The Portuguese Case

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ABSTRACT

This study examines whether companies' knowledge of the Industry 4.0 concept, geographic location, and size influence the digital maturity of Portuguese industrial firms. Data were collected through a self-assessment questionnaire based on the IMPULS model and analyzed using ordinal logistic regression and chi-square tests to test three hypotheses. The results show that none of these factors significantly affects digital maturity, suggesting that isolated variables do not fully explain digital progress and that broader contextual elements, such as support programs and internal digital strategies, may play a more decisive role. The study meets its objectives and contributes to understanding digital readiness in the Portuguese industrial context. Future research should incorporate additional variables, employ longitudinal or sector-specific approaches, and utilize qualitative methods to enhance the analysis further.

KEYWORDS

Concept Knowledge, Digital Maturity, Industry 4.0, Regional Disparities, Portugal

INTRODUCTION

Modern companies stand out in the new era of digital transformation by using emerging Industry 4.0 technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics in production processes (Jagatheesaperumal et al., 2021). These technologies increase production efficiency, boost competitiveness, and promote economic sustainability across different business models (Ghobakhloo, 2020). Furthermore, they optimize complex systems and improve productivity by applying smart sensors, providing companies a competitive advantage (Javaid et al., 2021).

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Digital maturity has become a critical driver of business competitiveness, as the adoption of digital solutions enables companies to streamline operations, enhance customer experience, and expand their commercial reach (Ghobakhloo, 2020; Verhoef et al., 2021). Opening digital channels increases visibility and allows a 24/7 presence, improving sales potential, customer retention, and Net Promoter Score performance (Lemon & Verhoef, 2016). Moreover, integrating digital technologies into operations enables faster decision-making, process automation, and greater operational flexibility, resulting in measurable gains in productivity and long-term value creation (Bharadwaj et al., 2013; Vial, 2021; Guimarães et al., 2025a). These benefits underscore the importance of accelerating digital transformation efforts and highlight the relevance of assessing digital maturity in the Portuguese context.

Some initiatives related to adopting Industry 4.0, namely in digital transformation, have gained prominence in Portugal, but many companies still face significant challenges (De Jesus & Lima, 2021; Guimarães et al., 2023). Portuguese companies face barriers in implementing Industry 4.0, namely the need for investment and strategic management focused on effective change (Pereira et al., 2023; Guimarães et al., 2024). However, technological challenges persist, and it is necessary to face them to obtain new opportunities to improve production processes, leading to a more efficient use of resources (Rikalovic et al., 2022).

Portuguese companies' digital readiness level for Industry 4.0 remains low, presenting notable weaknesses in areas such as smart infrastructures and data-based services (Guimarães et al., 2023). Portuguese companies' knowledge regarding their preparation level for integrating Industry 4.0 is considered moderate. To increase this level, it is necessary to consider some critical success factors, such as strategy, leadership, and customer experience (Da Fonseca et al., 2024).

This research explores an existential paradox in the relationship between knowledge of the Industry 4.0 concept and Portuguese companies' digital maturity level. This paradox is particularly troubling given that leaders play a critical role in developing strategies, adopting digital technologies, and making company decisions. It is essential to analyze the knowledge of entrepreneurs and leaders about the concept of Industry 4.0 with perceptions about the level of digital maturity of their companies for different regions of Portugal, various sectors of economic activity, and different sizes of companies.

This research also allows us to identify and analyze existential disparities regarding theoretical knowledge of the concept of Industry 4.0, which can influence business practices, causing barriers and loss of opportunities in accelerating the digital transition of companies. This research also highlights the influence of investments in digital technologies on increasing productivity, flexibility, employee well-being, and international competitiveness. Furthermore, this research analyzes the empirical results to create strategic directions to improve the level of digital readiness for Industry 4.0 of Portuguese companies. It can become a reference for other studies in other European countries in similar contexts.

Although digital transformation challenges in Portugal have been widely discussed, little empirical research has examined whether conceptual knowledge of Industry 4.0 is reflected in companies' actual digital maturity. Existing studies identify barriers and readiness gaps (De Jesus & Lima, 2021; Guimarães et al., 2023; Pereira et al., 2023; Guimarães et al., 2025b, 2025d) but do not analyze whether theoretical awareness translates into adoption. International reviews also note that awareness does not guarantee implementation, and empirical evidence linking the two dimensions remains limited (Ghobakhloo, 2020; Vial, 2021). This study addresses this gap by empirically testing this paradox and providing new evidence on how knowledge aligns with digital readiness.

We first provide an introduction to relevance. Next, we detail our research motivation and hypotheses development and review the literature. Then, we describe the research methodology before we analyze and discuss the results. Finally, we present conclusions, practical implications, and future research directions.

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