

# Challenges and opportunities of Industry 4.0 enabling technologies in Micro, Small, and Medium-sized Companies

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**Abstract.** Micro, small, and medium-sized enterprises are crucial in generating employment and income, serving as significant drivers of the Brazilian economy. Industry 4.0 and its enabling technologies have the potential to provide competitive advantages for these enterprises by reducing costs and enhancing productivity. Before implementing these technologies, individuals involved in decision-making must be prepared and aware of possible challenges and barriers associated with investment projects in Industry 4.0 enabling technologies. Managers also need to understand the benefits and opportunities that investing in these technologies can bring to their companies. Therefore, this work seeks to systematically find and analyze articles identifying challenges and opportunities in digital transformation processes in micro, small, and medium-sized enterprises. A systematic literature review was conducted based on the ProKnow-C methodology (Knowledge Development Process – Constructivist) to achieve this objective. As a result, 14 articles were found and analyzed, in which authors presented various barriers and opportunities involved in digital transformation processes.

**Keywords:** Challenges, Opportunities, Industry 4.0.

## 1 Introduction

Like in many other countries, Micro, Small, and Medium Enterprises (SMEs) play a significant role in the Brazilian economy. Only Micro and Small Enterprises (MSEs) account for about 30% of the economy, showing notable growth from 1985 to 2017. Moreover, they play a crucial role in job creation, responsible for approximately 23.2 million of the country's about 35.1 million formal jobs (SEBRAE, 2020, 2023). These MSMEs and businesses of various sizes are being or will be impacted by the arrival of Industry 4.0. The importance of MSMEs to the country's economy is evident, making it crucial to find ways to improve their performance. The enabling technologies of Industry 4.0 can be utilized for this purpose.

"Industry 4.0" emerged in 2011, invoking the three previous industrial revolutions (SCHUH et al., 2020). Recognized as the fourth industrial revolution, Industry 4.0 is driven by innovative technologies, establishing a scenario where data, people, industrial assets, resources, processes, services, and systems intricately intertwine (GHOBAKHLOO, 2019). Its distinction from conventional production systems, which treat each machine as an isolated entity, lies in the ability to connect machines interactively and collaboratively, autonomously, and intelligently. This achievement is realized by applying advanced predictive tools, enabling continuous processing of large volumes of data in decision-making based on real-time information availability (HRBIĆ; GREBENAR, 2022).

Implementing Industry 4.0 driving technologies is a complex process with uncertainties related to

technological requirements, benefits, and organizational impacts, making investment decisions challenging (ALMEIDA et al., 2022). The integration of Small and Medium Enterprises (SMEs) with the context of Industry 4.0 promises a significant metamorphosis in the Brazilian business landscape, given their substantial representation. This integration empowers these companies to manage their operations more effectively, using the tools offered by Industry 4.0, thus enhancing their competitiveness in the market (FÉLIX et al., 2021; SAFAR et al., 2018).

The importance of Industry 4.0 and its technologies for organizations cannot be denied; however, certain factors must be considered. Among these factors are the challenges or barriers that may arise during a digital transformation process, allowing managers and decision-makers to prepare for adverse situations they may encounter. It is also necessary to consider that there are opportunities arising from digital transformation that companies can explore to improve organizational performance.

Following previous studies that identified in the literature strategic, economic-financial, and maturity criteria that should be considered when evaluating investment projects in Industry 4.0 enabling technologies (VEDOY et al., 2023) and criteria for digital transformation readiness (VEDOY; LIMA, 2023), there was a recognized need to research further possible issues that may be encountered when implementing Industry 4.0 technology in companies, as well as potential opportunities that may arise for organizations in this process.

To fill this gap, a Systematic Literature Review (SLR) was conducted to describe challenges and opportunities relevant to the digital transformation.

The article is organized into four parts, starting with the introduction. The second part describes the methodology used in constructing this article. The third part presents the results and discussions of the SLR. Finally, the conclusions are offered.

## 2 Methodology

The methodology adopted for this Systematic Literature Review (SLR) was the ProKnow-C (Knowledge Development Process – Constructivist), following the steps outlined by (ENSSLIN et al., 2014). However, this study focuses on selecting a portfolio of relevant articles on the subject and conducting a systematic analysis. The step-by-step process of the SLR is detailed in Figure 1.

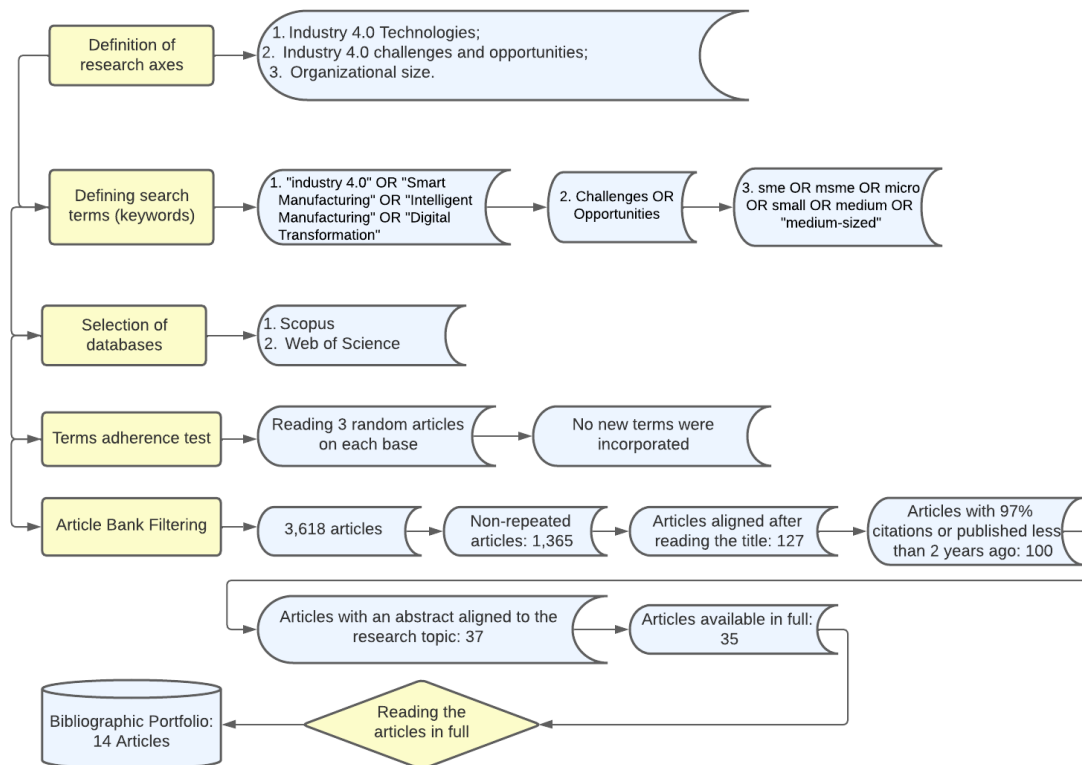


Fig. 1. ProKnow-C method (Knowledge Development Process – Constructivist).

For the development of this article, thematic axes and relevant search terms were first defined.

Subsequently, the research was conducted on the Scopus and Web of Science databases, considering a temporal cut-off of 5 years, from 2019 to 2023, covering the themes Technologies of Industry 4.0 and Challenges and Opportunities of Industry 4.0. The decision to focus on articles published within the past five years was made to ensure the incorporation of recent and pertinent research findings. This selection criterion acknowledges the rapid pace of technological advancements and shifts in industrial dynamics, which can quickly render information in older publications obsolete. By concentrating on more recent literature, we aim to capture the latest insights and developments pertaining to Industry 4.0 Technologies and the associated Challenges and Opportunities. The result of this search yielded a return of 3,618 articles.

Later on, a random reading of three articles from each database was carried out to assess the alignment of the search terms with the outlined thematic scope. No inclusion or removal of new terms was made at this stage. Following that, a selection of 1,365 non-duplicated articles was made, of which 127 had titles aligned with the previously established research axes. The subsequent stage involved choosing 100 articles, considering the top 97% in terms of citations or those published within a two-year period.

After reviewing the abstracts of the 100 selected articles, it was observed that only 37 were in line with the research theme, and only 35 were fully accessible for reading. Finally, the articles that fully met the criteria for systematic analysis were selected. Of the 35 reviewed articles, only 14 fulfilled all requirements and were therefore chosen for systematic analysis in the subsequent section of the article.

The present methodological approach was adopted to ensure robustness in the article selection, from the delimitation of search terms to the final analysis of chosen articles. The absence of temporal restrictions aimed to encompass the evolution of concepts over time, while randomness in the initial choice and subsequent careful selection aimed to ensure a representative and relevant sample for the study's purposes. The concluding phase of the systematic review focused on the 14 articles that best met the predefined criteria.

### 3 Results and Discussion

In this section, we will present the Systematic Literature Review (SLR) results. Initially, we will address the challenges faced in implementing Industry 4.0 technologies in companies. The reviewed studies highlighted obstacles such as resistance to change, the need for significant investments in technological infrastructure, and the demand for updating employees' skills. These challenges underscore the complexity of transitioning to Industry 4.0, requiring careful strategies to overcome them.

Following this analysis, we will explore some opportunities for companies embarking on a digital transformation process. The reviewed articles pointed out advantages such as improved operational efficiency, customization of products and services to meet market demands, and the strengthening of competitiveness on the global stage. Understanding these positive aspects is crucial for managers to make the most of the benefits that Industry 4.0 offers, contributing to a more comprehensive understanding of the impact of this transformation on organizations.

#### 3.1 Challenges of digital transformation

The implementation of Industry 4.0 technologies can be a slow and complex process. It is necessary for the managers involved in this process to be aware that various challenges may arise, which can alter or compromise the expected outcome of a digital transformation project. In Table 1, some challenges that may arise during the implementation of enabling technologies of Industry 4.0 in an organization can be observed.

Autores	Desafios
(FERNANDO et al., 2023)	1. Unclear Industry 4.0; 2. Higher-risk investment; 3. Insecurity of data sharing; 4. Lack of expertise; 5. Lack of clear incentive.
(ALIMOHAMMADLOU; ALINEJAD, 2023)	1. Technical and infrastructural obstacles; 2. Financial and budgetary obstacles; 3. Security and privacy obstacles; 4. Unawareness of blockchain technology; 5. A shortage of human resources and implementation expertise/knowledge; 6. Social-environmental barriers and energy consumption; 7. A lack of cooperation, communication and coordination; 8. A lack of management commitment and support; 9. Scalability.

(GOEL et al., 2022)	1. Little awareness; 2. Little managerial support; 3. Little technical knowledge; 4. Insufficient funds; 5. No clear government policies; 6. Lesser resources for research and development; 7. No solid, long-term vision; 8. Little enthusiasm from stakeholders; 9. Lack of IT-based infrastructure (software and hardware); 10. Untrained and unskilled personnel; 11. Little coordination and association between SCM members; 12. Leading to unemployment in society; 13. Doubt about the sustainability of I 4.0; 14. Lack of alternate solutions to the technological breakdown; 15. Uncertain predicted demand for a product.
(PACKMOHR; BRINK; PAUL, 2023)	1. Missing skills (IT knowledge, information about and decisions on technologies, process knowledge); 2. Technical (dependency on other technologies, security (data exchange), current infrastructure); 3. Individual (fear of data control loss, fear of transparency /acceptance, fear of job loss); 4. Organizational & cultural (keeping traditional roles/principles, no clear vision/ strategy, resistance to cultural change/mistake culture, risk aversion, lack of financial resources, lack of time); 5. Environmental (lack of standards, lack of laws).
(KUMAR; SINGH; DWIVEDI, 2020)	1. Lack of awareness about I4.0 contributions to ethical and sustainable production; 2. Lack of management support for I4.0 technologies; 3. The high initial cost of I4.0 technologies for ethical and sustainable operations; 4. Lack of funds for investment in I4.0 technologies; 5. Lack of awareness about government policies for I4.0 and sustainability; 6. Lack of dedicated resources for research & development on I4.0 technologies; 7. Lack of long term planning on the adoption of I4.0 technologies for ethical and sustainable operations; 8. Lack of motivations from customers/OEMs on adopting I4.0 technologies for ethical and sustainable operations; 9. Lack of IT-based infrastructure (Software & Hardware); 10. Lack of trained workforce for sustainable operations & I4.0 technologies; 11. Lack of coordination and collaboration among supply chain partners; 12. Fear of unemployment/reduction in workforce; 13. Fear of failure of I4.0 technologies ;14. Lack of alternative solutions to the technological breakdown; 15. Fear of demand uncertainty due to market disruptions.
(MACHADO et al., 2021)	1. Lack of technical expertise; 2. Cybersecurity issues; 3. Resistance to change/change management practices and adopting innovation for society; 4. Lack of investment in R&D; 5. Cost of improvement & OSCM economic condition; 6. Lack of support from regulatory authority/poor legislation ; 7. Lack of commitment from top management; 8. Alternative resources and energy needs.
(KUMAR et al., 2023)	1. Lack of Infrastructure; 2. Lack of Awareness; 3. Lack of Cultural Feasibility; 4. Lack of Resources; 5. Lack of Employee's Competence/expertise; 6. Lack of Government and Organizational Support; 7. Low Cost of Virgin Product; 8. Lack of implementation Plan and Policy for Sustainability; 9. Lack of Trust; 10. Lack of Business Model; 11. Lack of Intention to Sustainability; 12. High Investment Cost.
(JAMWAL; AGRAWAL; SHARMA, 2023)	1. Lack of digital skills; 2. Lack of Infrastructure; 3. Lack of dedicated resources for R&D ; 4. Existing job disruption; 5. Lack of awareness in management; 6. Lack of support from supplier; 7. Resistance to change; 8. Low maturity level for desired technology; 9. Lack of Standards and reference architecture; 10. Reliability and stability of Cyber physical systems; 11. Lack of adoption of base technologies; 12. Lack of technology integration; 13. Higher investment cost; 14. Product Characteristics; 15. Lack of clearly defined economic benefits; 16. Lack of support from government policies; 17. Restricted laws and regulations; 18. Data security and privacy issues.
(PRAUSE, 2019)	1. Relative Advantage; 2. Complexity; 3. Compatibility; 4. Cost; 5. Top Management Support and Championship; 6. Satisfaction with Existing Systems; 7. Organizational Structure; 8. Market Uncertainty; 9. Industry Cluster; 10. Market Transparency; 11. Security Concerns.

(HORVÁTH; SZABÓ, 2019)	1. Lack of appropriate competences and skilled workforce Longer learning time (training of staff); 2. Lack of financial resources Return and profitability Shortcomings in tendering systems Long evaluation period for tenders; 3. Lack of a leader with appropriate skills, competencies and experience; 4. Lack of conscious planning: defining goals, steps and needed resources; 5. Inadequate organizational structure and process organization; 6. Contradictory interests in different organizational units Resistance by employees and middle management; 7. Lack of a unified communication protocol; 8. Lack of back-end systems for integration; 9. Lack of willingness to cooperate (at the supply chain level); 10. Lack of standards incl. technology and processes; 11. Lack of proper, common thinking; 12. Unsafe data storage systems; 13. The need for large amounts of storage capacity.
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The table 1 highlights various of challenges identified by different authors when implementing Industry 4.0 technologies in companies. Authors such as Fernando et al. (2023), Alimohammadlou and Alinejad (2023), and Goel et al. (2022) point out challenges such as a lack of clarity about Industry 4.0, high-risk investment, insecurity in data sharing, lack of expertise, and unclear incentives. Other authors, such as Packmohr, Brink, and Paul (2023), Kumar, Singh, and Dwivedi (2020), and Machado et al. (2021), emphasize issues such as a lack of technical skills, financial obstacles, resistance to change, and a lack of regulatory support.

Additionally, Kumar et al. (2023), Jamwal, Agrawal, and Sharma (2023), and Prause (2019) highlight challenges related to a lack of infrastructure, awareness, cultural resistance, lack of competence, and the need for government support. These comprehensive challenges address technical, financial, cultural, and strategic aspects, emphasizing the complexity of transitioning to Industry 4.0. For successful implementation, managers need to address these issues holistically, considering the interconnectedness and scope of the challenges presented.

Understanding these challenges provides an essential foundation for adequate preparation and overcoming obstacles during the digital transformation journey, enabling managers and companies to be better prepared to face the inherent challenges of adopting Industry 4.0.

### 3.2 Opportunities for digital transformation

As was observed in Table 1, several barriers must be taken into account before starting an investment project in enabling technologies of Industry 4.0. Understanding these potential problems is a way to prepare better to overcome them. However, one should not only consider the possible challenges that may arise along the way, but it is also necessary to know why one is investing in these technologies and what results can be expected when implementing them. Therefore, in Table 2, some opportunities for implementing a digital transformation process can be observed.

**Table 1.** Opportunities for digital transformation.

<b>Autores</b>	<b>Opportunities</b>
(HWANG; KIM, 2022)	1. Increased technical efficiency.
(CSIZMADIA et al., 2023)	1. Restructuring of human work by reducing periods of non-value creation; 2. Improved group work; 3. Improved access to data; 4. Reduced cost and time; 5. Greater efficiency; 6. low investment; 6. Low training cost; 7. Low administrative expenses; 8. Low occasional costs.
(MÜLLER; BULIGA; VOIGT, 2018)	1. Improvement in production equipment; 2. Better use of the workforce; Improvement in relationships with Partners, suppliers and Customer groups; 3. Improvement of services; 4. Improvement in payment methods.

(HORVÁTH; SZABÓ, 2019)	1. Higher added value; 2. Reducing costs; 3. Continuous monitoring of company performance; 4. Reduction in error rate; 5. Improvement in delivery times; 6. Improved efficiency.
(AUBRY et al., 2022)	1. Improving the capability to plan, schedule and control production; 2. Improving control and quality of production processes; 3. Decreasing costs and lead times; 4. Increasing production automation; 5. Increasing flexibility of production processes; 6. Improving the workers' conditions in relation to safety, ergonomics and physical effort; 7. Developing an integrated platform of a product/service to perform servitisation strategies; 8. Entering new markets through new products and services enabled by digital technologies; 9. Adding functionalities to products enabled by digital technologies; 10. Reducing the time and cost of design; 11. Improving collaboration with customers and/or suppliers in new product development.

In Table 2, it is possible to observe several opportunities associated with the implementation of Industry 4.0, as highlighted by different authors. Hwang and Kim (2022) emphasize the increase in technical efficiency as a significant advantage. Csizmadia et al. (2023) identify various opportunities, including restructuring human work processes, improved group collaboration, enhanced data access, cost and time reduction, overall increased efficiency, and low training costs and investments. Müller, Buliga, and Voigt (2018) focus on improvements in production equipment, workforce utilization, relationships with partners, suppliers, and customer groups, and enhancements in services and payment methods.

Horváth and Szabó (2019) present opportunities such as increased added value, cost reduction, continuous monitoring of company performance, reduced error rates, improved delivery times, and enhanced efficiency. Aubry et al. (2022) elaborate on a comprehensive set of opportunities, including improvements in production planning, scheduling, and control; enhanced quality control in production processes; cost and time reduction; increased production automation; improved working conditions in terms of safety and ergonomics; and the development of integrated platforms for servitization strategies. Additionally, opportunities include entry into new markets, adding features to products enabled by digital technologies, reducing design time and cost, and improving collaboration in developing new products with customers and/or suppliers.

In summary, opportunities associated with Industry 4.0 range from increased technical efficiency, restructuring of human work, better collaboration, cost reduction to improvements in production equipment and workforce utilization, enhanced relationships, improved services, and increased overall efficiency, highlighting the multifaceted benefits of adopting Industry 4.0 technologies.

## 4 Final Considerations and Conclusions

This article emphasizes the significance and crucial role played by Micro, Small, and Medium Enterprises (MSMEs) in the Brazilian economy, coupled with the challenges posed by the onset of Industry 4.0. Acknowledging the importance of these businesses, the study delves into potential benefits and hurdles linked to adopting Industry 4.0 technologies, conducting a systematic literature review. The methodology encompasses a thorough search and selection process, leading to the analysis of 35 articles focused on challenges and opportunities related to digital transformation.

Identified challenges encompass issues such as a lack of clarity about Industry 4.0, high-risk investments, data-sharing insecurities, a shortage of expertise, financial obstacles, resistance to change, and the necessity for regulatory support. These challenges underscore the multifaceted nature of transitioning to Industry 4.0, necessitating a holistic approach by managers. Conversely, the study sheds light on numerous opportunities for embracing Industry 4.0. These prospects include heightened technical efficiency, restructuring work processes, enhanced collaboration, cost and time reduction, improved

relationships, upgraded services, and an overall boost in efficiency.

As a suggestion for future research, the strategies that micro, small, and medium-sized enterprises (MSMEs) can adopt to overcome challenges and seize identified opportunities could be analyzed. By addressing these issues in detail, it will be possible to offer valuable guidance to assist MSMEs in the digital transformation process.

In summary, the article furnishes valuable insights for managers and decision-makers engaged in the digital transformation of MSMEs. Grasping the outlined challenges and opportunities is pivotal for adequate preparation and the successful implementation of Industry 4.0 technologies. By comprehensively addressing these issues, companies can elevate their competitiveness, contribute to economic growth, and navigate the intricacies of the fourth industrial revolution within the Brazilian context. For prospective studies, it is recommended that the challenges and opportunities presented be considered in crafting models and tools aiding managers in the decision-making process for investments in Industry 4.0 enabling technologies.

## References

ALIMOHAMMADLOU, M.; ALINEJAD, S. Challenges of blockchain implementation in SMEs' supply chains: an integrated IT2F-BWM and IT2F-DEMATEL method. **Electronic Commerce Research**, 2023.

ALMEIDA, R. P. et al. How to assess investments in industry 4.0 technologies? A multiple-criteria framework for economic, financial, and sociotechnical factors. **Production Planning and Control**, 2022.

AUBRY, M. et al. Exploring digitalisation in the agri-food sector and its paradoxes: Evidence from a comparative study with small French companies. **Studies in Agricultural Economics**, v. 124, n. 2, p. 44–58, 2022.

CSIZMADIA, T. et al. Examining Industry 4.0 through the lens of human resource and knowledge management: Implications for SMEs. **Management & Marketing**, v. 18, n. 1, p. 1–19, 2023.

ENSSLIN, S. R. et al. Disclosure of the State of the Art of Performance Evaluation Applied to Project Management. **American Journal of Industrial and Business Management**, v. 04, n. 11, p. 677–687, 2014.

FÉLIX, J. R. B. et al. A indústria 4.0 em pmes: um estudo de caso em uma empresa da região metropolitana de natal-RN. **Encontro Nacional de Engenharia de Produção - ENEGEP. Anais...**2021.

FERNANDO, Y. et al. A mixed-method study on the barriers of industry 4.0 adoption in the Indonesian SMEs manufacturing supply chains. **Journal of Science and Technology Policy Management**, v. 14, n. 4, p. 678–695, 1 jun. 2023.

GHOBAKHLOO, M. Industry 4.0, Digitization, and Opportunities for Sustainability. **Journal of Cleaner Production**, v. 252, p. 119869, 1 dez. 2019.

GOEL, P. et al. Deployment of Interpretive Structural Modeling in Barriers to Industry 4.0: A Case of Small and Medium Enterprises. **Journal of Risk and Financial Management**, v. 15, n. 4, 1 abr. 2022.

HORVÁTH, D.; SZABÓ, R. Z. Driving forces and barriers of Industry 4.0: Do multinational and small and medium-sized companies have equal opportunities? **Technological Forecasting and Social Change**, v. 146, p. 119–132, 1 set. 2019.

HRBIĆ, R.; GREBENAR, T. Assessment of Readiness of Croatian Companies to Introduce I4.0

Technologies. **Journal of Risk and Financial Management**, v. 15, n. 12, 1 dez. 2022.

HWANG, W. S.; KIM, H. S. Does the adoption of emerging technologies improve technical efficiency? Evidence from Korean manufacturing SMEs. **Small Business Economics**, v. 59, n. 2, p. 627–643, 1 ago. 2022.

JAMWAL, A.; AGRAWAL, R.; SHARMA, M. Challenges and opportunities for manufacturing SMEs in adopting industry 4.0 technologies for achieving sustainability: Empirical evidence from an emerging economy. **Operations Management Research**, 2023.

KUMAR, R.; SINGH, R. K.; DWIVEDI, Y. K. Application of industry 4.0 technologies in SMEs for ethical and sustainable operations: Analysis of challenges. **Journal of Cleaner Production**, v. 275, 1 dez. 2020.

KUMAR, S. et al. Barriers to adoption of industry 4.0 and sustainability: a case study with SMEs. **International Journal of Computer Integrated Manufacturing**, v. 36, n. 5, p. 657–677, 2023.

MACHADO, E. et al. Barriers and enablers for the integration of industry 4.0 and sustainability in supply chains of msmes. **Sustainability (Switzerland)**, v. 13, n. 21, 1 nov. 2021.

MÜLLER, J. M.; BULIGA, O.; VOIGT, K. I. Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. **Technological Forecasting and Social Change**, v. 132, p. 2–17, 1 jul. 2018.

PACKMOHR, S.; BRINK, H.; PAUL, F.-H. Unraveling perceptions of barriers to digital transformation-contrasting small and medium-sized with large enterprises. **IADIS International Journal on Computer Science and Information Systems**, v. 18, n. 1, p. 102–119, 2023.

PRAUSE, M. Challenges of Industry 4.0 technology adoption for SMEs: The case of Japan. **Sustainability (Switzerland)**, v. 11, n. 20, 1 out. 2019.

SAFAR, L. et al. Concept of SME Business Model for Industry 4.0 Environment. **TEM Journal**, v. 7, p. 626–637, 1 ago. 2018.

SCHUH, G. et al. **Industrie 4.0 Maturity Index. Managing the Digital Transformation of Companies**. [s.l.: s.n.].

SEBRAE. **Atualização de estudo sobre participação de micro e pequenas empresas na economia nacional**. Disponível em: <[www.sebrae.com.br](http://www.sebrae.com.br)>. Acesso em: 22 fev. 2024.

SEBRAE. **Data Sebrae Painéis**. Disponível em: <<https://datasebraeindicadores.sebrae.com.br/resources/sites/data-Sebrae/data-Sebrae.html#/Empregados>>. Acesso em: 22 fev. 2024.

VEDOY, A. DE P.; LIMA, J. D. DE. **Avaliando a Prontidão para transformação Digital em Micro, Pequenas e Médias Empresas: Uma Revisão Sistemática da Literatura**. XXX SIMPEP. **Anais...**2023.

VEDOY, A. DE PAULA. et al. **Modelos de suporte à tomada de Decisão em Projetos de Investimento em Tecnologias da Indústria 4.0**. Encontro Nacional de Engenharia de Produção - ENEGEP. **Anais...**2023.