Chasing AI – Required Competencies of Supply Chain Managers[*]

Katarzyna Grzybowska[1,*,†] and Blanka Tundys[2,*,†]

[1] *Poznan University of Technology, Rychlewskiego 2, 61695 Poznan, Poland*

[2] *University of Szczecin, Management Institute, Faculty of Economy, Finance and Management, Cukrowa 8, 71-004 Szczecin, Poland*

Abstract

The study presented in the article represents an innovative research approach. It results from the integration of supply chain management concepts with AI-based technologies, combined with a research methodology grounded in a systematic literature review and an expert method that utilizes the knowledge, experience, and insights of specialists in the field. The paper highlights the critical importance of AI-based technologies. It identifies a research gap in the form of a lack of competencies among supply chain managers in the context of artificial intelligence. The study's findings indicate that the majority of the examined technical competencies were rated as below expectations. This also applies to managerial competencies.

Keywords

digital transformation, future competences, orthogonal analysis, AI-Based Technology

1. Introduction

Under the influence of AI-related technologies, the economy and labor market are changing very dynamically. The ability to work with AI-based tools is becoming an essential requirement for many professionals and occupations, including supply chain managers. According to the "Future of Jobs 2025" report, 86% of employers consider artificial intelligence to be critical to the future of their business [1]. Artificial Intelligence (AI) and Big Data Technology (BDT) are among the fastest-growing technologies. On the other hand, as many as 63% of business leaders indicate that their employees lack the competencies necessary to implement and use new AI-based technologies [2].

A review of the literature, as well as observations from economic practice, reveals a significant research gap in this area. Given the novelty of the topic and its exceptionally dynamic development, there is a pressing need to undertake systematic research in this domain. Accordingly, the present study focuses on evaluating the current level of competencies both technical and managerial of supply chain managers in the context of artificial intelligence. The design of digitalized futures with AI methods raises several questions for future:

RQ1: What is the current level of competencies among supply chain managers in relation to artificial intelligence?

RQ2: Which competencies of supply chain managers, in light of AI development, should or should not be prioritized for further development over the next 2–3 years?

Skills and qualifications are thus at the heart of AI in education and educational research.

The structure of the paper is as follows: part 2 presents the theoretical foundations based on a literature review. Section 3 outlines the research methodology. Next part presents the results of the empirical investigation. Part 5 provides a discussion of the research findings. Finally, section 6 presents the conclusions and directions for future research.

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2. AI and Managerial Competencies

Artificial intelligence is playing an increasingly significant role in business operations. The ability to effectively leverage AI technologies is becoming a decisive factor in achieving competitive advantage for both enterprises and supply chains. Scientific research in this area remains relatively novel and addresses an important gap in the existing body of knowledge. Managing supply chains in the era of Industry 4.0 and 5.0 requires not only expertise in logistics but also a solid understanding of advanced technologies – including artificial intelligence [3,4]. Evidence from business practice indicates that the technical and digital competencies of managerial staff frequently fall short of expectations [5].

The adoption of AI-based technologies in business is accelerating rapidly – much like a snowball gaining momentum. According to the McKinsey Global Survey, in 2023, 75% of companies reported plans to increase their investments in artificial intelligence in the coming years, recognizing its potential to enhance operational efficiency [6]. By 2025, over 75% of respondents are expected to report that their organizations utilize AI in at least one business function [7].

There is no doubt that the dynamic transformations occurring across all sectors of the economy are also reflected in supply chains. In the context of the digital transformation of supply chain management, both technical and managerial competencies play a pivotal role in the effective deployment of artificial intelligence (AI)-based technologies [2]. Managers must possess not only the ability to work with various types of databases but also the capacity to critically interpret the results of AI analyses, recognizing their limitations and potential errors [5]. Practical collaboration with AI is also becoming increasingly important – for example, through effective prompt engineering or the application of machine learning algorithms for data analysis [8, 9]. At the same time, managerial competencies such as clear communication and the ability to facilitate dialogue between technical and non-technical teams are equally critical, as they enable the smooth implementation of technological solutions [3]. The ability to share knowledge and to adapt to new technologies and work methods significantly influences an organization's agility and resilience [10]. Equally critical are the abilities to identify problems and to engage in critical thinking, both of which support informed decision-making. Deficiencies in these areas may result in ineffective implementation of AI tools and constrain their transformative potential. In the coming years, a key challenge will be the integration of managerial competencies with the ability to utilize AI-related resources, tools, and techniques.

Managerial competencies are of critical importance in managing supply chains within dynamic and technology-driven environments. The ability to communicate clearly with a diverse range of stakeholders – both internal and external to the organization – is regarded as a cornerstone of effective collaboration [11]. The ability to translate complex technical concepts into language that is understandable to non-technical teams directly impacts the effectiveness of innovation implementation [12]. By sharing knowledge and supporting organizational learning, managers contribute to the development of an adaptive and agile organizational culture [13]. Competencies such as problem identification and critical thinking enhance organizational resilience and enable faster responses to disruptions within the supply chain [14].

3. Research Methodology

The conducted study integrates two key aspects: the competencies of supply chain managers and artificial intelligence. It specifically focuses on assessing the level of competencies among supply chain managers in the context of AI. The research employs a methodology based on a literature review, utilizes the expert method, and incorporates orthogonal analysis.

3.1. Research plan

The overall research design was divided into three stages. The literature review enabled the formulation of research directions and the development of research questions. The review was

conducted in three steps: (1) defining the scope of analysis; (2) identifying keywords, types and categories of documents, and language criteria; (3) selecting, evaluating, and synthesizing the existing body of peer-reviewed academic work. Data extracted from the selected academic publications were organized for further synthesis and analysis. The curated set of scientific sources served as the foundation for the subsequent research phase. The results of the literature analysis formed the basis for determining the scope of questions used in a structured interview, which was then administered to selected experts.

The expert method applied in the second stage of the study was employed as an expert assessment [15] with the aim of: (1) evaluating the current level of competencies among supply chain managers in the context of artificial intelligence, and (2) identifying the future direction of supply chain managerial competency development over the next 2–3 years, given the dynamic advancement of AI-based technologies.

The study involved a selected group of twelve academic experts who specialize in supply chain management and possess expertise in artificial intelligence. These experts bring extensive domain knowledge and diverse academic backgrounds, enabling the confrontation of independent and varied perspectives. Their contributions ensured a multidimensional and objective evaluation of the research problem.

The opinion survey conducted in the second stage enabled the implementation of orthogonal analysis in the third phase of the study. Orthogonal analysis was applied to identify potential relationships among the various examined aspects. As a result, specific recommendations were developed, and directions for future research were outlined.

3.2. Expert profile

The panel of selected experts who agreed to participate in the study consisted of representatives from leading academic institutions in Poland. The experts included professors holding the following academic positions: (1) Research-oriented positions (2 experts), whose responsibilities include conducting scientific research and/or supervising doctoral students; (2) Research and teaching positions (10 experts), whose duties encompass scientific research, teaching students, and/or participating in doctoral education.

The selected experts represent two distinct scientific domain: (1) The social sciences, within the discipline of management studies, which focuses on: (a) identifying relationships between workplace situations and human behavior, and (b) employing an interdisciplinary research approach; (2) the engineering and technical sciences, specifically in the field of computer science and telecommunications, which: (a) concentrates on the application and advancement of state-of-the-art information and communication technologies, and (b) facilitates the development of innovative technical solutions, such as artificial intelligence and virtual reality technologies.

The structure of the expert group reflects a diverse range of professional experience. The largest proportion of participants consisted of experts with 21–25 years of academic experience (41%), followed by those with over 26 years of experience (25%). The study also included younger experts, with 11–15 years (17%) and 16–20 years (17%) of professional academic experience. In addition to their extensive academic backgrounds, all experts possess business experience within the industrial sector. Each expert reported having more than five years of industry experience, with 17% of them having worked in the business sector for over 26 years.

Relying on the intellectual potential of experts in the study is of critical importance and has significant implications for the research process. The expert method is only as accurate and reliable as the experts selected to participate. Therefore, the primary challenge of expert-based methods lies in the careful selection of participants and minimizing the risk of superficial or overstated expertise.

Experts were selected based on their documented academic achievements in supply chain research and their specialized knowledge in the field of artificial intelligence. Half of the experts (50%) rated their AI expertise at an advanced level, while 17% classified their knowledge as expert-

level. In the domain of supply chains, 58% of respondents reported an expert-level understanding, and 25% indicated advanced-level competence.

4. Research Findings

For the purposes of this study, an orthogonal analysis was conducted. This analysis was carried out through the creation of crosstabulation tables and the grouping of data extracted from the expert survey. This approach enabled comparison and evaluation of the results. The findings are presented in this section using bubble charts. The competency level of supply chain managers was divided into two main categories: technical competencies and managerial competencies. The assessment of these competencies was conducted by experts using a standard 5-point Likert scale. A rating of 1 indicated that the evaluated competency was significantly below the required level, while a rating of 5 represented a level well above expectations – interpreted as a mastery level.

4.1. What Is the Current Level of Competencies Among Supply Chain Managers in the Context of Artificial Intelligence?

Businesses and economic organizations are fully engaged and consider AI technology a strategic priority in their operations. On the other hand, they emphasize a lack of qualified personnel capable of implementing their vision and strategy.

This is underscored by various studies indicating that companies face a short age of qualified employees who can integrate their domain-specific expertise with AI technologies [16, 17]. They also indicate that this is one of the primary barriers to the development of AI-related initiatives. Additional obstacles include a lack of financial resources, limited access to appropriate technologies, and insufficient availability of relevant data [18, 19]. An analysis of the academic literature indicates that, despite the growing interest in AI technologies among enterprises, existing barriers – such as the lack of qualified personnel, limited financial resources, insufficient access to appropriate technologies, and difficulties in obtaining relevant data – significantly hinder the implementation of AI-driven strategies. These findings are also confirmed by the results of our research.

In the area of technical competencies (Fig. 1), a majority of experts (58%) rate supply chain managers' current ability to work with various types of databases as insufficient to meet the required standard. This indicates that the competency does not meet the expected level considered sufficient for the role and its associated responsibilities. It also suggests a clear need for targeted training, skill development, and/or the accumulation of further experience in order to reach the desired level of proficiency. A similar assessment applies to the Practical knowledge of AI technologies. More than half of the experts (58%) believe that supply chain managers possess only basic and limited knowledge and skills in the practical use of AI tools. This level of expertise and experience does not sufficiently meet the expectations and/or requirements associated with this professional role. A similarly low assessment was given for the current level of Mathematical skills (algebra, statistics), with 50% of experts rating it as below expectations. This result is somewhat surprising, as mathematical competencies form the foundation of both technical and managerial knowledge. Mathematics is essential for understanding relationships within analyzed data, particularly for supply chain managers, and ultimately serves as a cornerstone of many modern technologies. Half of the experts (50%) also agree on the current assessment of the competency Ability to apply AI and/or ML algorithms for data analysis, indicating that this skill is significantly below expectations. In practice, this suggests a clear need for improvement, further specialized training, and/or alignment with established professional standards.
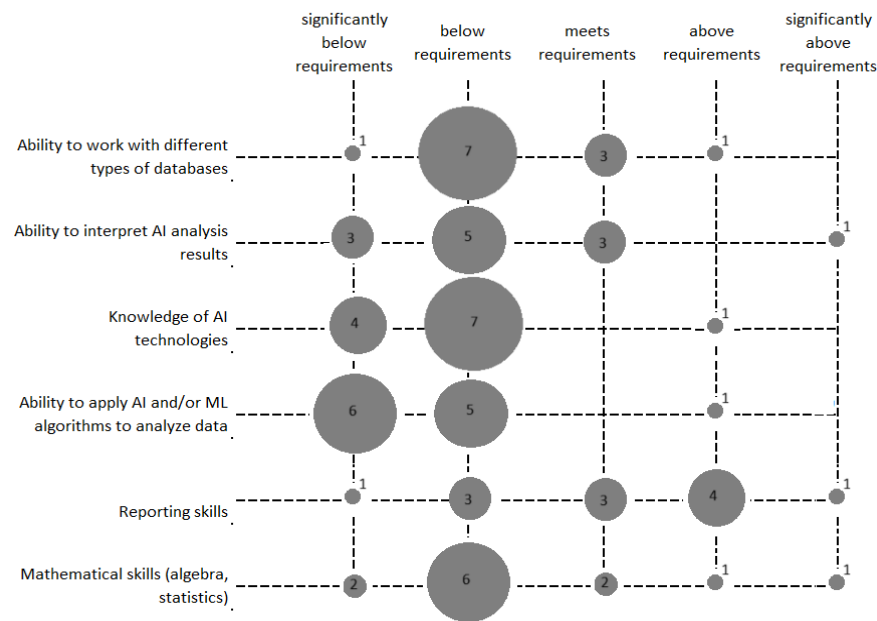
Figure 1: Current Level of Technical Competencies Among Supply Chain Managers According to Experts. (own work).

The current Reporting skills of supply chain managers were assessed as above expectations by 4 experts (33%). Reporting skills involve leveraging one's experience in data analysis, developing visualizations and reports, and creating presentations to support organizations in making informed business decisions. In the area of managerial competencies, the majority of experts (67%) rate the current level of Knowledge sharing among supply chain managers as below expectations. The ability to share knowledge is a key component of social competencies (Fig. 2) and is regarded as highly valuable due to its significant impact on organizational and supply chain development. However, a substantial deficit in this area is observed, as confirmed by the expert assessments.

Five out of twelve experts (42%) indicate that the Ability to communicate clearly and the Ability to communicate with technical and non-technical teams among supply chain managers meet the requirements for the position. Without clear and precise communication, it is difficult to imagine effective collaboration in the supply chain, making accurate decisions, or building lasting relationships within the supply chain. The experts' opinions on two competencies – Problem identification and Critical thinking – are surprising. Both of these skills are often cited as essential for functioning in the 4th Industrial Revolution. However, in both cases, 42% of the experts believe that these competencies among supply chain managers are below the required standard.
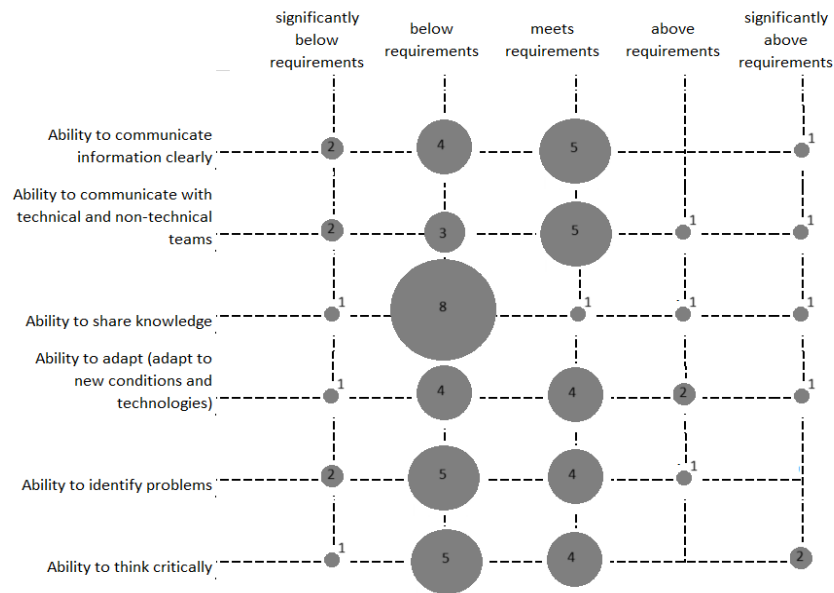
Figure 2: Current Level of Managerial Competencies Among Supply Chain Managers According to Experts. (own work).

The ability to identify and subsequently solve problems is fundamental in businesses and supply chains. However, many organizations still rely on ad hoc methods to address issues. In other words, the most obvious explanation for a problem is sought, and a solution is implemented, assuming that the root cause has been identified. To effectively identify and solve problems, however, additional competencies are also required. Among these is the Ability for critical thinking, which involves the capacity to independently, logically, and objectively assess situations, information, or arguments.

4.2. Which Competencies of Supply Chain Managers, Considering the Development of AI, Should/Should Not Be Further Developed in the Next 2-3 Years?

As previously indicated, the main barrier to the use of AI-based technologies in business is the lack of a qualified workforce. Managers often learn intuitively, based on their experiences. However, in order to gain insights into the latest discoveries and track new algorithmic features (amid the constant lack of financial resources for training and skill development), they sign up for online courses or participate in industry events and AI networking. Nevertheless, given the rapid pace of development of AI technologies, courses and acquired knowledge can quickly become outdated.

In the future, a supply chain manager should understand and integrate AI-based technology with both technical and soft skills. In the study, experts were asked to provide their opinions on the development or discontinuation of the competencies analyzed in the earlier sections of the paper. The experts were notably more consistent on this issue, particularly regarding the strong emphasis on the development and enhancement of the competency Ability to interpret AI analysis results (Fig. 3). This skill was highlighted by 10 experts (83%). Every supply chain manager intending to utilize AI-based technologies should possess excellent data analysis and interpretation skills. Candidates who are proficient in using data manipulation tools will be highly sought after in business.

4.3. Various marks in the front matter

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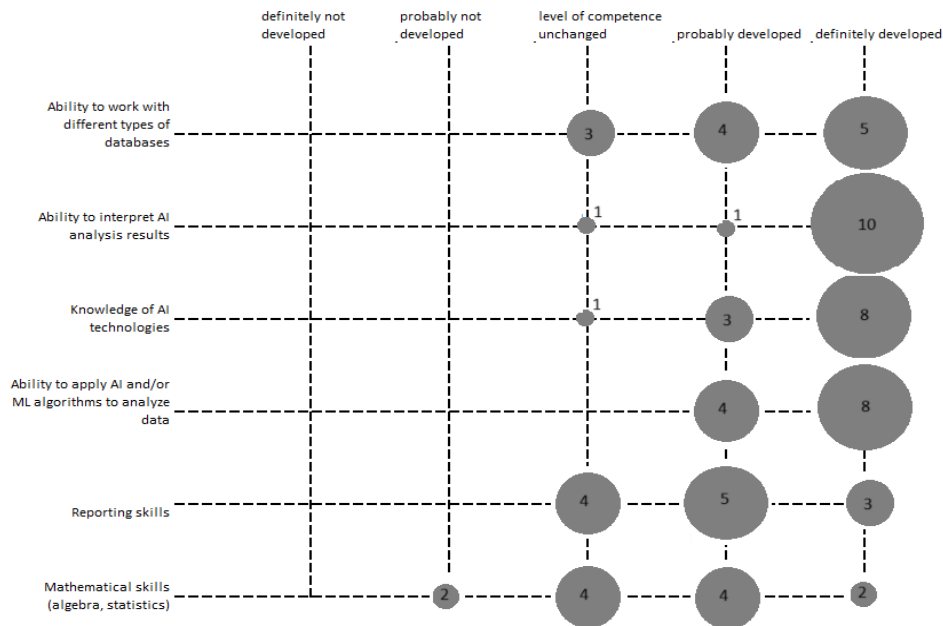

Figure 3: Technical Competencies of Supply Chain Managers in the Next 2-3 Years According to Experts. (own work).

Experts also emphasize the urgent need to develop skills related to practical Knowledge of AI technologies (67%) and the Ability to apply AI and/or ML algorithms for data analysis (67%). The interpretation of the experts' feedback aligns with the demands of the contemporary labor market. Specialists are increasingly expected to work effectively with AI-based technologies, prepare and process datasets, select appropriate analytical models, as well as train and optimize these models.
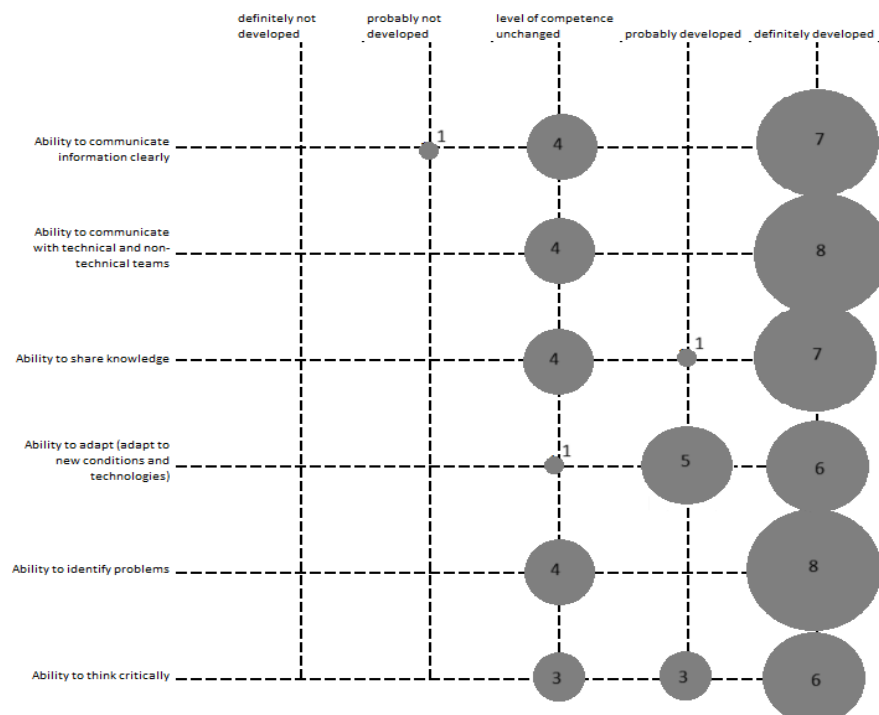
Figure 4: Managerial Competencies of Supply Chain Managers in the Next 2-3 Years According to Experts. (own work).

In relation to managerial competencies (Fig. 4), experts particularly emphasized the urgent need to develop two competencies: Ability to communicate with technical and non-technical teams and Ability to identify problems (both 67%). The first competency requires not only an understanding of technical issues but also the ability to explain them in a simple, understandable way, tailored to the audience, such as an employee from another department or one with a different set of specialized competencies. Supply chain managers typically have a higher level of competencies related to problem identification by nature. However, in the highly dynamic and fragile business environment, this level should be even higher. Thus, the ability to identify potential challenges, irregularities, or threats, and to leverage AI technology to recognize and solve them, becomes one of the key competencies of the modern manager.

5. Discussion of Research Findings

When comparing the competencies under examination, it may be surprising that experts placed greater emphasis on the development of managerial rather than technical skills. At first glance, this may appear counterintuitive, especially given the rapid advancement of new technologies, including those based on artificial intelligence. However, this phenomenon is relatively easy to explain.

First, the implementation of cutting-edge technologies, including AI-based solutions, does not in itself guarantee business success. Technology is merely a tool, and its effectiveness depends on a range of contextual factors-chief among them, human capital. Second, technical knowledge and skills tend to become obsolete relatively quickly as technologies evolve, whereas managerial competencies are more enduring and transferable across contexts. Third, the concept of Industry 5.0, which succeeds Industry 4.0, places the human element at the center of technological processes. In a business environment increasingly characterized by complexity and unpredictability-often described using the BANI framework (Brittle, Anxious, Nonlinear, Incomprehensible)-managers play a critical role in creating the conditions under which technologies can be implemented effectively and sustainably.

6. Conclusions

Artificial intelligence is at the top of the list of the fastest growing skills. Skill gaps related to AI-based technologies are considered the biggest barrier to business transformation from 2025 to 2030 [1].

The conducted study provided answers to the research questions posed in the paper. The current level of competencies among supply chain managers in the context of artificial intelligence was identified. The majority of the technical competencies were rated as below the required standard: (1) Ability to work with various types of database; (2) Practical knowledge of AI technologies; (3) Mathematical skills (algebra, statistics); (4) Application of AI/ML algorithms for data analysis. The exception was Reporting skills, which was the only competency rated above expectations. Similarly, the following managerial competencies were also rated below the required standard: (1) Knowledge sharing ability; (2) Ability to communicate with technical and non-technical teams; (3) Ability to communicate clearly; (4) Ability to identify problems and Critical thinking ability.

The study also identified which competencies of supply chain managers, considering the development of AI, should or should not be further developed in the next 2–3 years. Experts specifically recommend focusing on the development of technical competencies: (1) Ability to interpret AI analysis results; (2) Practical knowledge of AI technologies; (3) Ability to apply AI and/or ML algorithms for data analysis, as well as managerial competencies: (1) Ability to

communicate clearly; (2) Ability to communicate with technical and non-technical teams; (3) Ability to share knowledge; (4) Ability to identify problems.

The need for further research has been identified in two areas. The first should focus on identifying effective training models in AI-based technologies. This research should particularly address the question: how can the effectiveness of employee learning be increased with a limited budget? The second research direction should explore the impact of competency gaps on the effectiveness of AI technology implementation. In this case, the key question should be: to what extent do specific competency gaps realistically slow down or even prevent AI technology deployments?

Acknowledgements

Declaration on Generative AI

The author(s) have not employed any Generative AI tools.

References

[1] World Economic Forum, The Future of Jobs Report 2025 (2025).

[2] I. Popa, M. M. Cioc, A. Breazu, C. F. Popa, Identifying sufficient and necessary competencies in the effective use of artificial intelligence technologies. Amfiteatru Economic, 26(65), (2024) 33-52.

[3] J. Rana, Y. Daultani, Mapping the role and impact of artificial intelligence and machine learning applications in supply chain digital transformation: a bibliometric analysis. Operations Management Research, 16(4), (2023) 1641-1666.

[4] R. Deepa, S. Sekar, A. Malik, J. Kumar, R. Attri, Impact of AI-focussed technologies on social and technical competencies for HR managers – A systematic review and research agenda. Technological Forecasting and Social Change, 202, (2024) 123301.

[5] T. J. F., França, H., São Mamede, J. M. P., Barroso, V. M. P. D. Dos Santos, Artificial intelligence applied to potential assessment and talent identification in an organisational context. Heliyon, 9(4) (2023).

[6] McKinsey, The state of AI in 2023: Generative AI's breakout year (2023).

[7] McKinsey, The state of AI: How organizations are rewiring to capture value (2025).

[8] M. Y. Hryhorak, O. M. Harmash, T. Popkowski, Artificial intelligence in supply chain management: opportunities and threats for professional competence. Electronic scientific and practical publication in economic sciences, 24 (2023).

[9] A. M. Khedr, Enhancing supply chain management with deep learning and machine learning techniques: A review. Journal of Open Innovation: Technology, Market, and Complexity, (2024) 100379.

[10] H. Manurung, G. Yudoko, L. Okdinawati, A conceptual framework of supply chain resilience towards sustainability through a service-dominant logic perspective. Heliyon, (2023) 9(3).

[11] Y. Liu, W. Fang, T. Feng, M. Xi, Blockchain technology adoption and supply chain resilience: exploring the role of transformational supply chain leadership. Supply Chain Management: An International Journal, 29(2), (2024) 371-38.

[12] I. Oubrahim, N. Sefiani, A. Happonen, The influence of digital transformation and supply chain integration on overall sustainable supply chain performance: An empirical analysis from manufacturing companies in Morocco. Energies, 16(2), (2023) 1004.

[13] L. C. R. Júnior, G. F. Frederico, M. L. N. Costa, Maturity and resilience in supply chains: a systematic review of the literature. International Journal of Industrial Engineering and Operations Management, 5(1), (2023) 1-25.

[14] P. Derwik, D. Hellström, Competence in supply chain management: a systematic review. Supply Chain Management: An International Journal, 22(2), (2017) 200-218.

[15] F. Smarandache, J. E. Ricardo, E. G. Caballero, M. Y. L. Vázquez, N. B. Hernández, Delphi method for evaluating scientific research proposals in a neutrosophic environment. Neutrosophic Sets Syst. 34, (2020) 204-213.

[16] R. Machucho, D. Ortiz, The Impacts of Artificial Intelligence on Business Innovation: A Comprehensive Review of Applications, Organizational Challenges, and Ethical Considerations. Systems, 13(4), (2025) 264.

[17] M. Mohib, F. K. Khan, E. R. El Burari, S. Ali, The Challenges and Limitations of Artificial Intelligence Adoption in Small and Medium-Sized Enterprises. Review Journal of Social Psychology & Social Works, 3(1), (2025) 292-303.

[18] V. Uren, J. S. Edwards, Technology readiness and the organizational journey towards AI adoption: An empirical study. International Journal of Information Management, 68, (2023) 102588.

[19] O. Ali, P. Murray, A. Al-Ahmad, L. Tahat, An Integrated Framework for Addressing the Challenges and Strategies of Technology Adoption: A Systematic Review. Emerging Science Journal, 8(3), (2024) 1215-1242.