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# *Readiness of Logistics Companies to Implement AI Tools in E-Business: An International Comparison*

**Keywords:** AI readiness; AI adoption; digital transformation; international logistics; e-business

**JEL:** O33; F23; L91

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**Abstract**

**Theoretical background:** The ongoing digital transformation is reshaping the global logistics, requiring businesses to adopt advanced technologies to stay competitive. Artificial intelligence (AI) stands out as a key driver of operational efficiency and innovation. However, AI readiness varies across logistics companies, influenced by regional digitalization levels. This paper explores the preparedness of international logistics businesses to integrate AI into their e-business operations, examining how digital development disparities impact the ability to leverage AI effectively. By comparing countries with different digitalization levels, the study provides an international understanding of the challenges and opportunities of AI adoption in logistics.

**Purpose of the article:** The purpose of this article is to analyse the readiness of logistics companies in Belarus, Germany, and Poland to implement AI tools in their e-business operations. The paper explores the key factors influencing AI adoption, along with the potential benefits, risks, and barriers to technological transformation, considering the varying levels of digitalization in these countries.
**Research methods:** The authors used a survey-based approach to collect data from logistics professionals ($N = 102$) from Belarus, Germany, and Poland. The survey was conducted via an online questionnaire using the computer-assisted web interview (CAWI) technique from December 8, 2024, to February 4, 2025.
**Main findings:** International logistics companies adopt AI tools primarily for route optimization, customer service chatbots, and inventory management. Resistance to change is the main barrier to AI adoption, with high costs and lack of expertise as significant concerns. AI adoption is mainly driven by the need for increased efficiency, cost savings, and faster decision-making. Germany exhibits the highest AI readiness, followed by Poland and Belarus, reflecting a correlation between digital maturity and AI implementation readiness. Practical recommendations were also developed to assist international logistics companies in adopting AI tools.

## Introduction

In the rapidly evolving digital business environment, shaped by technological changes, one of the key challenges for logistics companies is AI adoption readiness. Understanding how differences in digital development across countries impact businesses' ability to implement advanced technologies is crucial. The objective of this paper is to examine the readiness of international logistics companies to adopt AI tools in their e-business operations, considering digitalization disparities. As digital transformation shapes global competitiveness, this issue becomes more critical. International rankings and indexes measuring digital advancement and technology usage reveal significant differences in digital advancement, affecting logistics companies' AI integration ability. Assessing their readiness is vital for identifying barriers and enablers of AI adoption, impacting efficiency, business performance, and competitiveness.

The ICT Development Index (IDI) (ITU, 2024; Jagodič & Milfelner, 2022) emphasizes the importance of digital connectivity in driving economic and social development. It shows that countries with higher IDI benefit from better technological infrastructure, higher internet usage, and greater access to technologies. In logistics, AI readiness is closely linked to a country's IDI.

According to the Network Readiness Index (NRI) (Portulans Institute, 2024), a country's ability to adopt digital technologies, including AI, directly impacts its competitiveness and economic growth. It underlines that regions with high NRI are better positioned to integrate AI into businesses, driving efficiency and innovation.

The IMD World Digital Competitiveness Ranking (WDCR) (IMD, 2024) highlights that a company's ability to adopt technologies and AI is crucial for long-term success, noting the growing gap between digital leaders and laggards. Digitally advanced countries have better access to technology, skilled labour, and innovation, making them prepared for AI adoption. The logistics sector especially benefits from

AI tools through automation and optimization, making AI readiness assessment vital for identifying barriers and support needs.

According to the E-Government Development Index (EGDI) (UN, 2024), the level of public sector digitalization reflects the technological development of a country. This significantly influences the readiness of logistics sector to adopt advanced technologies like AI. Countries with a higher EGDI offer better conditions for AI adoption due to advanced digital infrastructure, easier access to data, efficient online public services, faster information exchange, and skilled workforce.

Furthermore, the Digital Economy and Society Index (DESI) (European Commission, 2024) indicates that AI adoption in companies, including logistics, depends on the level of digital business transformation. Countries with higher DESI offer better access to advanced systems, digital skills, and government support, while countries with lower DESI may face challenges.

This paper is structured as follows: introduction, literature review, research method, results, discussions, conclusions, and references. In the introduction, the authors present the subject of the paper, describe the structure, and define the research aim. The literature review provides an overview of knowledge related to AI readiness in logistics. In the methodology, the authors describe the research approach and the sample. The subsequent sections present the data collected, followed by a discussion and interpretation of the results. In the conclusions, the authors summarize the research, offer final insights, and provide practical recommendations for logistics companies.

## Literature review

Among technological innovations, AI stands out as a key driver of change with applications across various industries (Sainath & Lakshmi Devasena, 2023). The expansion of e-business has prompted logistics companies to implement AI to streamline processes and boost operational performance (Jagodič & Milfelner, 2020; Zhang, 2019). AI readiness denotes the degree to which companies are prepared to integrate AI technologies into their workflows. Most logistics businesses remain "AI novices," exploring AI without full adoption (Tanajura Ellefsen et al., 2019). Other researchers indicate that the digitalization levels in logistics vary widely across sectors and regions. Industry players generally show low to medium digital adoption (Kern, 2021). Despite the importance of digitalization in logistics, a gap persists between adopters and traditional businesses lagging in transformation (Albarracín Vanoy, 2023; Mukherjee et al., 2024; van Hoek, 2024; Yang & Lin, 2024).

Adopting digital technologies, including AI, boosts logistics performance in e-business by enhancing supply chain management and addressing industry-specific challenges. (Malhotra & Kharub, 2025). AI impacts multiple stages of supply chain, like demand forecasting, procurement, production, and distribution (Awasthi, 2024). Current research underlines the importance of techniques in this area, underscoring

AI's potential to improve processes. AI tools support data-driven decision-making, increase customer satisfaction, streamline logistics processes, reduce costs, improve services, and optimize sales planning and product cross-selling. Studies show AI enhances logistics efficiency, especially in supply chain and last-mile delivery. However, successful AI adoption in logistics requires collaboration among companies to maximize benefits in e-business (Al-Shboul, 2024; Hellingrath & Lechtenberg, 2019; Malhotra & Kharub, 2025; Richey et al., 2023; Sharma & Jain, 2022; Wong et al., 2013; Zaripova et al., 2024).

AI improves logistics by automating processes, optimizing and streamlining sorting, distribution, and supply-demand calculations. This enhances performance beyond traditional methods and supports real-time decision-making through predictive analytics. AI aids in managing global supply chains, fostering sustainability, and improving transparency and coordination among stakeholders (Hokey, 2010; Jagodič & Milfelner, 2020; Krishnan et al., 2024; Madancian et al., 2024; Richey et al., 2023; Sharma & Jain, 2022). In e-business, AI tools personalize customer experiences and upgrade workflows enabling precise market segmentation and predictive advertising (Tudor, 2023).

AI adoption in logistics is driven by digital readiness, technology, security, and economic factors, varying by region and sector (Dora et al., 2022; Perotti et al., 2022). Managerial and government support, strong leadership, partnerships with vendors, cooperation with technology providers ensure AI tools compatibility with existing infrastructure (Antony et al., 2023; Usmani et al., 2023). Process integration and information exchange are vital factors in AI adoption (Nayal et al., 2022). Another important driver is an adaptive organizational culture, as embracing AI requires significant shifts within the company. Logistics businesses should foster an environment promoting learning and adaptability, while providing AI trainings for employees. Equally important is the human-machine collaboration factor, with AI managing routine tasks and employees focusing on complex decisions (Foster & Rhoden, 2020; Gupta et al., 2022; Ismaeil & Lalla, 2024; Lostal Martínez, 2024; Weinke, 2023).

A critical aspect of AI readiness in logistics is identifying the barriers hindering progress, like the need for multi-actor collaboration within supply chain management, fragmented data sources, and AI resistance from stakeholders (Shrivastav, 2022). Studies indicate low wages, lack of skilled labour, insufficient managerial support, limited technical capabilities, inadequate employee training, and financial constraints can obstruct AI adoption. Logistics companies face internal resistance to new technology and difficulty securing funding for AI tools and the potential return on investment, limiting innovation and efficiency (Barakat & Bouanba, 2024; Hangl et al., 2022; Khalifa & Elghany, 2021; Nićin et al., 2024; Shahzadi et al., 2024). Data security concerns and legal complexities are also vital obstacles to the AI integration (Ismaeil & Lalla, 2024).

The literature review revealed a research gap regarding the readiness of logistics companies to adopt AI in e-business. While global rankings and indexes assess

digitalization levels across regions, there is a shortage of comparative international studies analysing how these disparities influence AI integration. The following part of the article seeks to explore the relationship between a country's digital maturity and the AI readiness of logistics companies.

## Research method

### The research procedure and questions

The research method is a survey. The research framework aims to assess the readiness of international logistics companies from Belarus, Germany, and Poland from the perspectives of professionals with diverse ages, genders, education, job positions, and professional experience, to adopt AI tools in e-business. Selection of Belarus, Germany, and Poland was based on their varying levels of digital development (Figure 1). This comparison offers an opportunity to analyse the countries' stages of digital transformation and is particularly relevant for understanding how businesses in these regions are prepared to adopt AI tools in e-business.

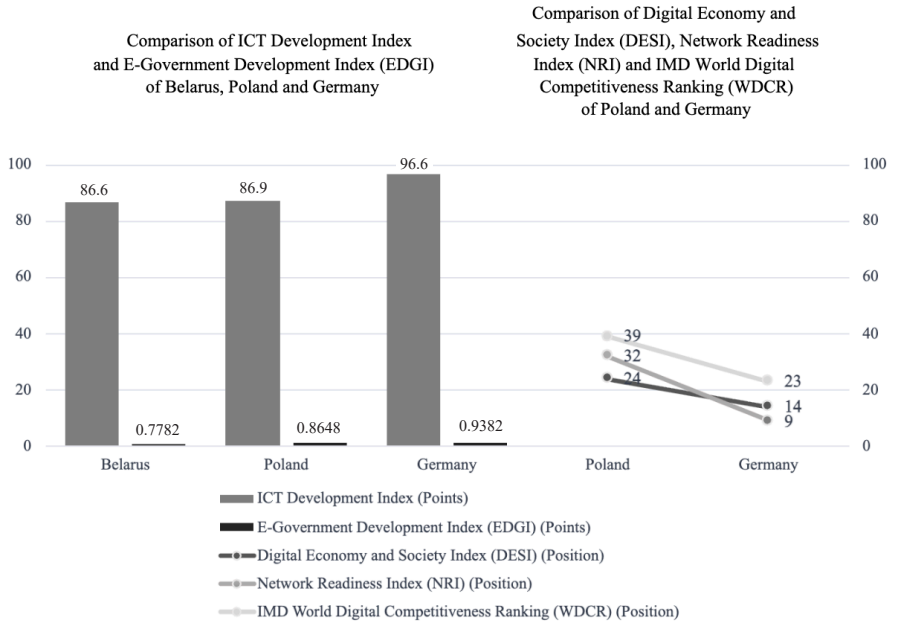


**Figure 1.** Comparison of digital development indexes of Belarus, Germany, and Poland, 2024

Source: Authors' own study based on the ICT Development Index, the DESI, the NRI, the WDCR, and the EGDI, 2024.

Germany leads in digital development, scoring highest in the IDI 2024, with Poland and Belarus lagging behind. In the DESI 2024, Germany ranks 14th and Poland 24th in the EU, while Belarus is not included. AI adoption among SMEs shows a significant gap: 10.8% in Germany vs. 2.9% in Poland. The NRI 2024 places Germany 9th globally and Poland 32nd out of 133 countries, with Belarus unranked. In the WDCR 2024, Germany ranks 23rd, ahead of 39th Poland. The EGDI 2024 classifies Germany and Poland "Very High," while Belarus downgraded, indicating challenges in digital governance. Summarizing, Germany is a global leader and a model to follow. Poland, while a strong player in Eastern Europe with active digital growth, lags behind the top-performing countries. Belarus faces a decline, requiring focused efforts to enhance digital infrastructure.

The research was divided into stages. First, a systematic literature review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, leading to the formulation of the following research questions:

Q1: What are the main areas of AI implementation in logistics companies?

Q2: What are the key barriers to AI adoption in logistics companies?

Q3: What factors drive the decision to implement AI in logistics companies?

Q4: What is the level of AI adoption readiness in logistics companies?

Next, the following hypothesis was formulated: logistics companies from countries with higher rankings in digital economy indexes are more ready to implement AI tools.

Subsequently, a survey questionnaire was developed, integrating the principles of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). These frameworks were employed to design questions on key factors influencing AI readiness, like ease of use, usefulness, and social influence. Finally, the authors collected and analysed the data using descriptive statistics, drew conclusions, and outlined directions for future research.

The research was conducted using the computer-assisted web interview (CAWI) method. An online questionnaire with 43 core and 9 metadata questions was designed to address the research questions, covering:

- analysis of the influence of various drivers on AI adoption readiness;
- analysis of employees' familiarity with AI tools and their willingness to adopt them;
- identification of current AI tools usage in logistics operations;
- analysis of the challenges and opportunities associated with AI usage.

The survey was created using Google Forms and conducted from December 8, 2024, to February 4, 2025. It was distributed online to two Belarusian companies, one German company, one Polish company, and part-time students working in logistics companies.

**The characteristics of the respondents**

The survey was completed by 102 employees from logistics companies in Belarus, Germany, and Poland, including part-time students working in logistics companies. Respondents were selected for their professional involvement in logistics and exposure to AI-driven solutions in e-business, providing diverse perspectives across markets with varying digitalization levels. Respondent characteristics are shown in Table 1.

**Table 1.** The characteristics of the respondents

| Characteristics ($N$ = 102) | | Frequency | Percentage |
|---|---|---|---|
| Gender | female | 49 | 48 |
| | male | 52 | 51 |
| | other | 1 | 1 |
| Age | < 20 years | 1 | 1 |
| | 21–30 years | 37 | 36.3 |
| | 31–40 years | 40 | 39.2 |
| | 41–50 years | 21 | 20.6 |
| | 51–60 years | 3 | 2.9 |
| | > 60 years | 0 | 0 |
| Education | high school | 10 | 9.8 |
| | Bachelor's degree | 60 | 58.8 |
| | Master's degree | 32 | 31.4 |
| | doctoral degree (PhD) | 0 | 0 |
| Job position | managerial | 27 | 26.5 |
| | non-managerial | 75 | 73.5 |
| Professional experience | no experience | 1 | 1 |
| | < 1 year | 10 | 9.8 |
| | 1–5 years | 36 | 35.3 |
| | 6–10 years | 31 | 30.4 |
| | 11–15 years | 13 | 12.7 |
| | > 15 years | 11 | 10.8 |
| Operation area | freight forwarding | 47 | 46.1 |
| | supply chain management | 8 | 7.8 |
| | warehousing and distribution | 33 | 32.4 |
| | route optimization | 10 | 9.8 |
| | last-mile delivery | 4 | 3.9 |
| Company size | micro (1–9 employees) | 3 | 2.9 |
| | small (10–49 employees) | 63 | 61.8 |
| | medium (50–249 employees) | 32 | 31.4 |
| | large (250+ employees) | 4 | 3.9 |
| Company's AI transformation level | early stage | 38 | 37.3 |
| | developing | 57 | 55.9 |
| | advanced | 7 | 6.8 |
| | fully AI transformed | 0 | 0 |
| Country | Belarus | 31 | 30.4 |
| | Germany | 30 | 29.4 |
| | Poland | 41 | 40.2 |

Source: Authors' own study.

Among 102 respondents, 51% were male, and 39.2% were aged 31–40. 58.8% had a bachelor's degree and 73.5% worked in non-managerial positions. 46.1% operated in freight forwarding and 61.8% in small companies. 35.3% had 1–5 years of professional experience, while 37.3% indicated their companies in the early stage of AI transformation. The distribution of respondents across the countries: 30.4% from Belarus, 29.4% from Germany, and 40.2% from Poland.

## Results

The questionnaire responses were grouped by thematic categories and emerging trends. Graphs were generated to illustrate key patterns and differences across countries, which are analysed in relation to the authors' hypotheses and key index data discussed earlier. Question coding is presented in Table 2.

**Table 2.** Coding of questions from the questionnaire

| No. | Category | Code | Question |
|---|---|---|---|
| 1 | Leadership | L1 | Our company's leaders understand the opportunities and risks of adopting AI tools |
| 2 | | L2 | Our company's leaders provide clear guidance on how AI tools are integrated into the company's overall strategy |
| 3 | | L3 | Our company's leaders encourage open discussions about the potential of AI tools throughout the company |
| 4 | | L4 | Our company's leaders have a clear plan for adopting AI tools into business operations over the next 12–18 months |
| 5 | | L5 | Our company's leaders prioritize using AI tools to drive innovation and value creation rather than maintaining traditional processes |
| 6 | | L6 | Our company's leaders communicate the usefulness of AI tools clearly to employees |
| 7 | | L7 | Our company's leaders are visible advocates for AI tools adoption within the company |
| 8 | Management style | MS1 | Our company has a standard process for adopting and implementing AI tools |
| 9 | | MS2 | We have clear metrics to evaluate the impact of AI tools adoption in our company |
| 10 | | MS3 | Our company has clearly defined roles and responsibilities for the adoption and use of AI tools |
| 11 | | MS4 | The right people are involved in AI tools adoption, and they receive appropriate incentives to ensure successful implementation |
| 12 | | MS5 | Employees responsible for AI tools adoption are seen as key business partners |
| 13 | | MS6 | The process of using AI tools is simple and easy to understand for employees |
| 14 | | MS7 | Our management ensures there are resources and support to facilitate AI tools adoption |
| 15 | Competence | C1 | Our company is able to operate effectively in a rapidly changing environment, driven by AI technologies |
| 16 | | C2 | AI tools are implemented quickly and efficiently in our company |
| 17 | | C3 | Business managers understand AI tools, and technology managers understand how to align them with business goals |

| No. | Category | Code | Question |
|---|---|---|---|
| 18 | Competence | C4 | Our company is skilled at managing relationships with partners to support AI tools adoption |
| 19 | | C5 | We can establish and manage collaborations with partners more quickly when adopting AI tools |
| 20 | | C6 | Employees believe that AI tools will significantly improve their job performance |
| 21 | | C7 | Employees feel confident using AI tools to improve their work processes |
| 22 | Technology | T1 | We have the necessary technology (e.g., networks services, equipment, security systems) to support AI tools adoption |
| 23 | | T2 | AI tools used in our company are flexible to adapt to changes in the business environment |
| 24 | | T3 | AI tools used in our company are flexible enough to meet changing customer needs |
| 25 | Technology | T4 | AI tools are a key focus of our company's strategy |
| 26 | | T5 | AI tools used in our company are user-friendly and require minimal training |
| 27 | | T6 | Employees receive sufficient support in using AI tools |
| 28 | Attitudes | A1 | AI tools can significantly change the way I work |
| 29 | | A2 | AI tools can significantly improve my job performance |
| 30 | | A3 | I'm willing to adopt AI tools in my daily work tasks |
| 31 | | A4 | Our company is successively adapting AI tools |
| 32 | | A5 | I'm satisfied with the performance of AI tools currently used in our company |

Source: Authors' own study.

## Analyses of AI adoption trends in logistics across Belarus, Germany, and Poland

The survey results reveal differences in AI familiarity in logistics e-business operations across the countries studied (Figure 2). In Belarus, most employees (58.1%) have basic awareness, 25.8% some experience, 16.1% none, and 0% extensive experience, indicating an early AI adoption stage. In Germany, AI exposure is higher, with 53.3% having some experience, 30% basic awareness, 16.7% extensive experience, and 0% no experience. Polish respondents show a similar trend to Belarus, with 53.7% having basic awareness, 29.3% some experience, 9.8% no experience, and 7.3% extensive experience. While AI awareness is widespread, practical experience remains limited across all three countries, especially in Belarus, aligning with the key indexes presented earlier.

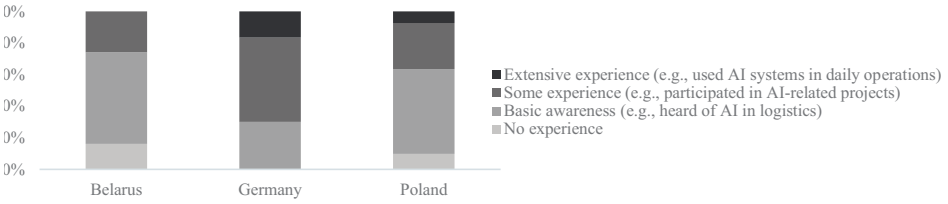


**Figure 2.** Familiarity with AI in logistics across the studied countries

Source: Authors' own study.

Respondents were asked about their companies' AI adoption readiness in e-business (Figure 3). In Belarus, most employees (74.2%) perceive their companies as slightly ready, 22.6% as moderately ready, and 3.2% as highly ready, reflecting an early stage of AI adoption. In Germany, readiness levels are higher with 40% rating their companies as very ready, 36.7% as moderately ready, and 23.3% as slightly ready, indicating strong digital capabilities. Poland presents a mixed picture: 41.5% see their companies as moderately ready, 39% as slightly ready, 9.8% as unprepared, and 9.8% as very ready, underlining moderate AI integration. These findings align with the key indexes presented earlier.

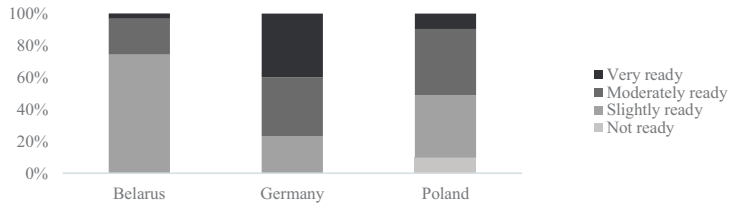


**Figure 3.** Logistics companies' readiness for AI implementation across the studied countries

Source: Authors' own study.

Respondents shared their perspectives on their companies' AI transformation progress (Figure 4). In Belarus, 64.5% see their companies in the early stage, while 35.5% are in developing stage, indicating slower AI adoption. In Germany, 63.3% identify their companies in the developing stage, and 23.3% in advanced stage, reflecting strong position in digital transformation. In Poland, 65.9% report developing phase, and 34.1% early phase, indicating progress but lagging behind Germany. These findings align with the discussed key indexes.

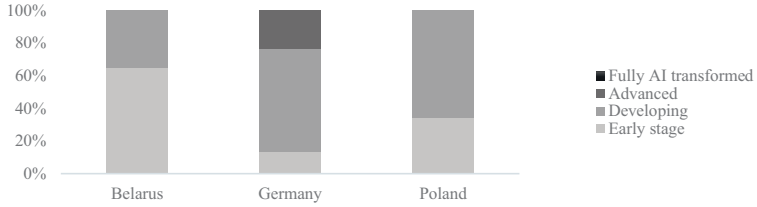


**Figure 4.** Logistics companies' AI transformation levels across the studied countries

Source: Authors' own study.

In Belarus, most employees perceive AI adoption as moderate (41.9%) or low (38.7%), with few indicating high (3.2%) or very low (16.1%). In Germany, 70% see AI adoption as moderate, and 23.3% consider it high. In Poland, perceptions are mixed: 51.2% report moderate AI adoption, 17.1% high, 2.4% very high, while 26.8% low (Figure 5). These findings align with the previously presented key indexes.

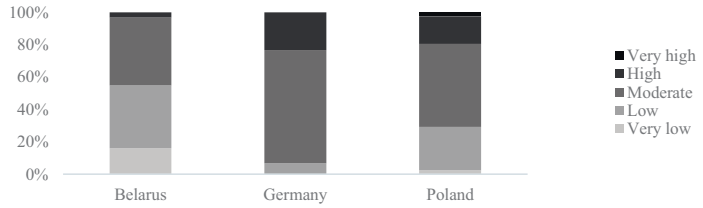


**Figure 5.** Perception of AI adoption by competitors in logistics across the studied countries

Source: Authors' own study.

The survey assessed AI's role in logistics companies' competitiveness (Figure 6). In Belarus, 54.8% of respondents perceive AI as not critical, 41.9% as moderately critical, 3.2% as critical, and none as very critical, indicating AI is not yet seen a key driver of competitiveness. In Germany, 56.7% of employees consider AI moderately critical, 20% critical, 16.7% very critical, with 6.7% not critical. In Poland, 56.1% view AI as moderately critical, 17.1% as critical, and 26.8% as not critical, with no respondents seeing it as very critical, similar to Belarus. These findings align with the discussed key indexes.

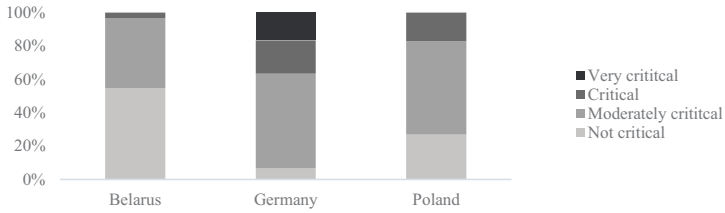


**Figure 6.** Perception of AI's role in maintaining competitiveness in logistics across the studied countries

Source: Authors' own study.

**Comparative analysis of AI adoption in logistics across Belarus, Germany, and Poland**

The questions in this subsection used a Likert scale (1 – *strongly disagree*, 2 – *disagree*, 3 – *neutral*, 4 – *agree*, 5 – *strongly agree*). The authors analysed the data by calculating average responses, comparing countries, relating results to the key indexes, and explaining variations.

Leaders in logistics companies show varying levels of understanding of AI's opportunities and risks (Figure 7, L1, Table 2). German leaders score the highest, Belarusian and Polish leaders also show good awareness, but indicate some gaps. Differences exist in the clarity of AI integration into companies' strategies, with Germany scoring higher, indicating better planning (Figure 7, L2). German leaders encourage open discussions about AI, indicating openness to new technologies, while Belarus and Poland score lower (Figure 7, L3). All three countries show uncertainty in creating AI adoption plans within 12–18 months (Figure 7, L4), and none prior-

itize AI over traditional processes for innovationand value creation (Figure 7, L5). German companies score higher, while Belarus and Poland show stronger attachment to traditional processes. Germany scores highest in communicating AI's usefulness to employees (Figure 7, L6), with Poland and Belarus showing less effective communication. A similar trend appears in leaders' willingness to adopt AI in e-business (Figure 7, L7).

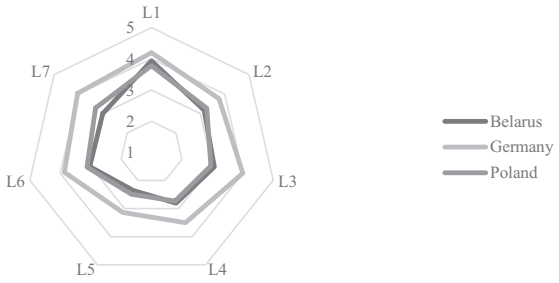


**Figure 7.** Comparison of leadership perceptions on AI adoption in logistics across the studied countries

Source: Authors' own study.

In areas such as understanding the opportunities and risks, encouraging open discussions, and creating AI adoption plans regarding, Belarus scores slightly higher than Poland (Figure 7, L1, L3, L4), which contradicts their positions in global digitalization rankings. This could be explained by government initiatives in Belarus promoting digitalization and AI, raising leadership awareness. Market competition also plays a role: Poland's advanced digital economy may lead to a more cautious approach, while Belarus, facing economic challenges, may see AI as crucial for growth. Overall, German logistics companies are more ready for AI adoption, followed by Poland and Belarus, generally aligning with the previously presented key indexes. Germany leads over the other two countries in fostering AI discussions and leadership adoption, likely due to its advanced infrastructure, stronger leadership support, and better AI integration in business strategy (Figure 7, L3, L7).

Germany leads in AI implementation in e-business operations, with established processes, unlike Belarus and Poland (Figure 8, MS1, Table 2). German companies emphasize having clear metrics to evaluate AI adoption, while Polish and Belarusian responses are more neutral or negative (Figure 8, MS2). This trend continues in the clear definition of roles for AI integration, where Germany scores higher than Poland and Belarus (Figure 8, MS3). German companies also demonstrate that the right people are involved in AI adoption, with incentives aligned for successful implementation, whereas Poland and Belarus score lower (Figure 8, MS4). The perception of employees responsible for AI adoption as key business partners varies significantly, with Germany more neutral, while Belarus and Poland show a negative stance (Figure 8, MS5). German employees report an easier process with AI tools usage, while

Poland and Belarus face more challenges (Figure 8, MS6). All three countries report having resources for AI adoption, with Germany leading (Figure 8, MS7).

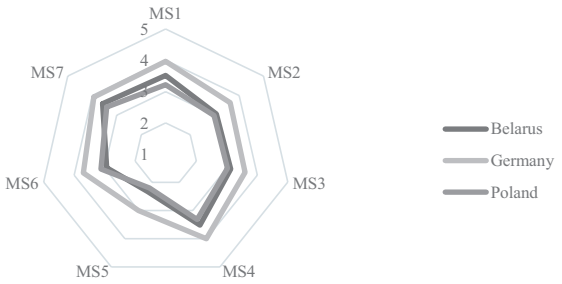


**Figure 8.** Comparison of management style perceptions on AI adoption in logistics across the studied countries

Source: Authors' own study.

In all areas, except the perception of ease of adopting AI tools, Belarus ranks slightly higher than Poland, which contradicts global digitalization rankings (Figure 8, MS1–MS5, MS7). This discrepancy may be due to Belarusian logistics firms being more agile and adopting AI faster, while Poland's larger, hierarchical companies face slower integration. Additionally, Belarus's newer tech infrastructure may facilitate AI adoption. Overall, German logistics companies are more ready for AI adoption in e-business operations, followed by Belarus, and Poland, though this does not fully align with the discussed key indexes. Despite this, Germany stands out with a significant gap in how employees responsible for AI integration are viewed as key business partners, reflecting a more strategic approach to AI (Figure 8, MS5).

AI readiness in logistics was evaluated based on employee competencies. German companies show the highest adaptability to AI-driven changes, indicating a more future-ready business environment, while Belarusian and Polish firms score slightly lower (Figure 9, C1, Table 2). Germany also leads in the speed and efficiency of AI adoption in e-business operations, with Poland following, and Belarus lagging behind (Figure 9, C2). Business and technology managers in all three countries vary in aligning AI tools with business goals, with Germany scoring highest (Figure 9, C3). German and Belarusian companies perform better in AI adoption partnerships, while Polish firms score significantly lower (Figure 9, C4). All three countries face challenges in AI collaborations, with Germany showing the strongest capabilities (Figure 9, C5). German employees are the most optimistic about AI's impact on job performance, supporting smoother adoption, while Belarusian and Polish employees are less confident (Figure 9, C6). German respondents are the most assured in using AI tools, while Belarusian employees are moderately confident, and Polish employees are the least confident, with some expressing scepticism (Figure 9, C7).

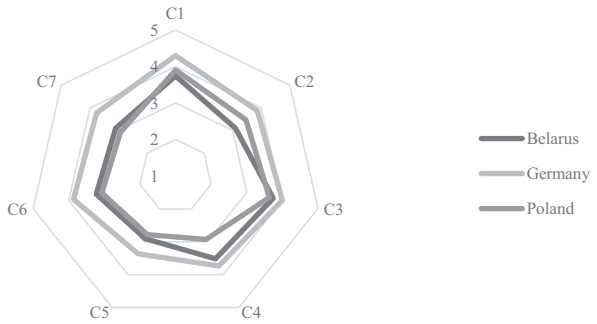


**Figure 9.** Comparison of competence perceptions on AI adoption in logistics across the studied countries

Source: Authors' own study.

Respondents from Belarus score higher than those from Poland in areas like aligning AI with business goals, managing AI adoption partnerships, and employees' confidence in AI's impact on their jobs (Figure 9, C3–C7). This contradicts their positions in global digitalization rankings. These differences, as the authors hypothesize, may stem from Belarusian government initiatives promoting AI and economic challenges making AI adoption more urgent. Belarus may also emphasize AI training to bridge competence gaps, while Poland's stable tech environment reduces the need for change. Overall, German logistics companies exhibit the strongest AI-related competencies, Polish – show moderate adaptability, and Belarusian – perform similarly to Poland but with slightly stronger results. These findings partially diverge from global digitalization rankings.

Logistics companies show varying levels of confidence in their technology infrastructure for AI integration. German employees are the most confident, while those from Belarus and Poland show slightly less confidence, suggesting challenges in full preparedness (Figure 10, T1, Table 2). Germany also shows the highest agreement on AI tools' flexibility to adapt to changes in the e-business environment, while Belarus and Poland show moderate flexibility with room for improvement (Figure 10, T2). The same pattern appears regarding AI tools' flexibility to meet changing customer needs (Figure 10, T3). All three countries strongly disagree that AI tools are central to their strategy, though Germany considers them somewhat important (Figure 10, T4). German companies report minimal training required for AI tools, while Belarusian and Polish companies are neutral (Figure 10, T5). Employees in Germany report the most support for using AI, with Belarusian and Polish employees feeling adequately supported, but to a lesser extent (Figure 10, T6).

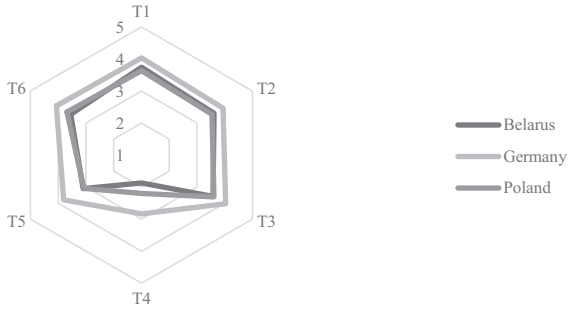


**Figure 10.** Comparison of technology perceptions on AI adoption in logistics across the studied countries

Source: Authors' own study.

Despite Poland ranking higher in digitalization indexes, Belarus outperforms Poland in terms of the necessary technology for AI adoption and the flexibility of AI tools to adapt to changes in the e-business environment (Figure 10, T1–T2). This may be due to Belarusian companies prioritizing tech upgrades for AI adoption because of economic challenges and a smaller market, which makes their AI tools more flexible. Poland's more advanced digital infrastructure may add complexity, potentially hindering seamless integration and reducing flexibility. Overall, Germany leads in AI technology integration, while Belarus and Poland show a more neutral outlook with a slight trend toward agreement, but not as strongly as Germany. These findings align with digitalization trends discussed earlier.

Respondents were asked about their attitudes toward AI adoption in e-business operations and AI tools currently used in their companies. German employees strongly believe in AI's potential to improve work performance, with Belarus and Poland showing positive, but slightly lower views (Figure 11, A1–A2, Table 2). Germany exhibits the highest willingness to adopt AI tools in daily tasks, followed by Belarus, while Poland remains more cautious due to concerns about AI integration complexity (Figure 11, A3). German companies report sufficient success in adapting AI tools for e-business, while Belarus and Poland facing more challenges (Figure 11, A4). Satisfaction with AI tools currently used in the companies is higher in Germany, while Belarus and Poland report moderate satisfaction (Figure 11, A5).

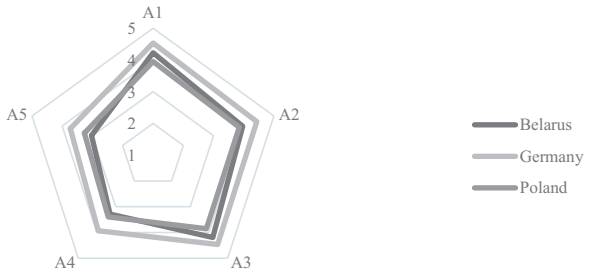


**Figure 11.** Comparison of attitudes toward AI adoption in logistics across the studied countries

Source: Authors' own study.

In areas like AI's impact on work and job performance, and employees' willingness to adopt it, Belarus scores higher than Poland, contradicting the global digitalization rankings (Figure 11, A1–A3). This discrepancy may be due to Belarusian companies prioritizing AI integration despite digital infrastructure challenges, while Poland's more advanced infrastructure may lead to a more cautious approach. Overall, Germany leads in AI adoption and belief in its impact, with Belarus slightly outperforming Poland, but both lag behind Germany. These findings do not fully align with the earlier presented digitalization indexes.

**Analysis of AI adoption goals, benefits, and risks in logistics across Belarus, Germany, and Poland**

AI usage areas vary in logistics, reflecting different strategic priorities and AI maturity levels in e-business operations (Figure 12). In Belarus, chatbots for customer service and inventory management dominate, with limited adoption of predictive analytics, route optimization, and fraud detection. Germany shows the most diverse AI adoption, with strong usage in predictive analytics, route optimization, and chatbots, but lower implementation in inventory management and fraud detection, suggesting these areas are either not widely adopted or addressed by other technologies. In Poland, AI adoption is more balanced, with route optimization leading, followed by chatbots and inventory management. Predictive analytics and fraud detection remain underused. The number of respondents reporting that their companies do not use AI is minimal, showing its integration across all three countries, though with different focuses. The top three AI adoption areas across Belarus, Germany, and Poland are route optimization, chatbots for customer service, and inventory management.

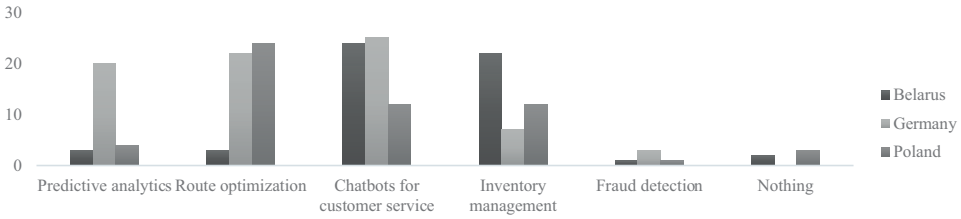


**Figure 12.** AI tools usage areas in logistics across the studied countries

Source: Authors' own study.

The main objectives of using AI across the studied countries reveal both similarities and differences (Figure 13). In Belarus, the main goals are efficiency improvement and customer satisfaction, with less focus on cost reduction. AI is also used for task automation, decision-making support, and risk management, but supply chain visibility and real-time analytics are not priorities. In Germany, efficiency improvement leads, followed by task automation, cost reduction, and enhanced decision-making. Risk management and customer satisfaction are secondary, while supply chain visibility and real-time analytics are less prioritized. In Poland, efficiency improvement is also the top goal, followed by task automation, decision-making, and cost reduction. Customer satisfaction and risk management are secondary, with supply chain visibility and real-time analytics ranking low. The top three objectives for using AI tools across Belarus, Germany, and Poland are efficiency improvement, automation of repetitive tasks, and cost reduction.

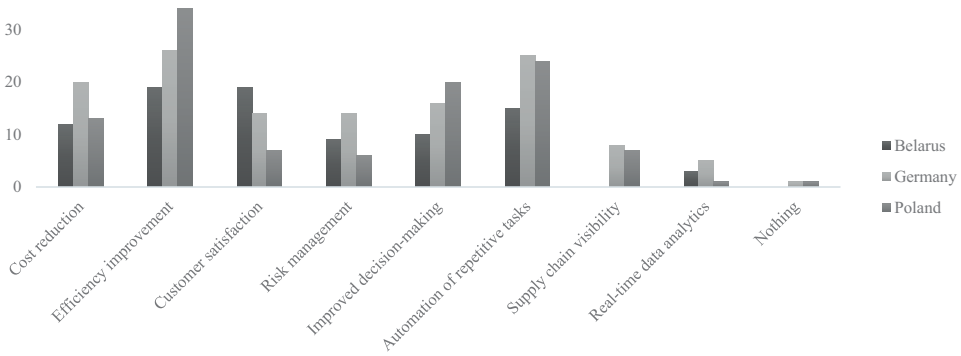


**Figure 13.** Objectives of AI tools usage in logistics across the studied countries

Source: Authors' own study.

Respondents were asked about the anticipated benefits of AI tools adoption in e-business operations (Figure 14). In Belarus, the primary expected benefits are increased efficiency, improved customer experience, cost savings, faster decision-making, and increased logistics repetitiveness, while more time for creative thinking

ranks lowest. In Germany, the benefits are similar, with efficiency and cost savings being the top priorities. Improved customer experience, faster decision-making, automation of logistics tasks are also important, while more time for creative thinking is less prioritized. In Poland, increased efficiency and faster decision-making are the key anticipated benefits, mirroring trends in Belarus and Germany. Cost savings and the potential for more repetitive logistics processes are also highlighted, while improved customer experience and more time for creative thinking are not as highly prioritized. The top three benefits of AI adoption in e-business operations across studied countries are increased efficiency, cost savings, and faster decision-making.

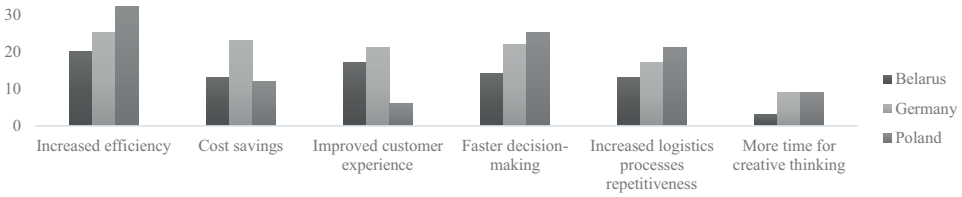


**Figure 14.** Anticipated benefits of AI tools adoption in logistics across the studied countries

Source: Authors' own study.

The process of AI adoption is accompanied by barriers that impede successful implementation. In Belarus, the primary challenges are high costs and resistance to change, followed by insufficient infrastructure and a lack of expertise (Figure 15). In Germany, high costs and resistance to change are significant barriers as well. However, fewer respondents in Germany highlight the lack of expertise, suggesting a more skilled workforce or greater access to AI-related knowledge. Insufficient infrastructure is not a major concern in Germany. In Poland, the lack of expertise is the biggest barrier, indicating greater difficulties acquiring the necessary AI skills compared to Belarus and Germany. Resistance to change is another major challenge in Poland, with infrastructure remaining an issue but less critical. Resistance to change emerges as the top barrier to AI implementation across the studied countries.

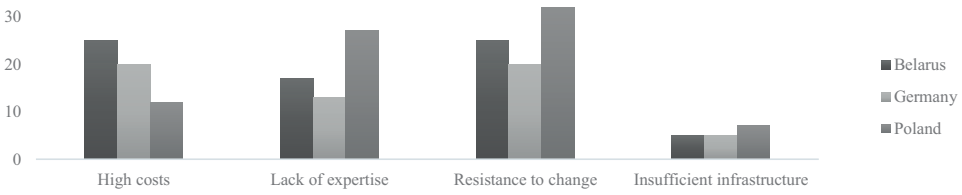


**Figure 15.** Barriers of AI tools adoption in logistics across the studied countries

Source: Authors' own study.

The authors also explored the risks and challenges associated with AI implementation in logistics (Figure 16). In Belarus, the most frequently cited risk is high implementation costs, followed by job displacement, data security issues, and dependence on external vendors. In Germany, high implementation costs are similarly a major challenge, followed by job displacement and dependence on external vendors, though data security issues are less of a concern. In Poland, high implementation costs lead the list of risks, followed by concerns over data security, reliance on external vendors, and job displacement. The top challenge associated with AI adoption across the countries studied is high implementation costs.

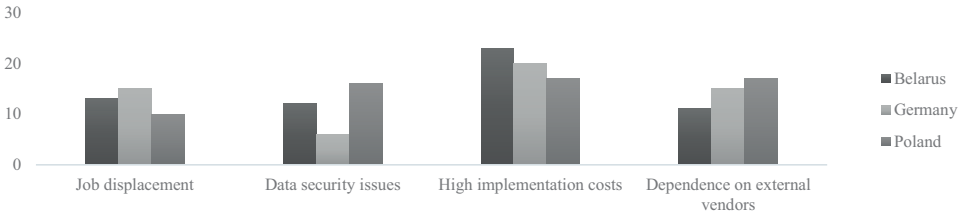


**Figure 16.** Risks and challenges of AI tools adoption in logistics across the studied countries

Source: Authors' own study.

## Discussion

This study reveals differences in AI readiness levels among logistics companies in the countries studied, aligning with previous research on the uneven pace of digitalization in logistics (Albarracín Vanoy, 2023; Dora et al., 2022; Mukherjee et al., 2024; Perotti et al., 2022; van Hoek, 2024; Yang & Lin, 2024). However, it highlights the role of digital maturity in shaping AI adoption, an underexplored aspect in earlier studies. According to the literature, while most logistics companies are still "AI novices," this research highlights country-specific variations, with Belarus and Poland facing more challenges, such as weaker infrastructure and lower digital awareness, compared to Germany (Tanajura Ellefsen et al., 2019). The study confirms known AI adoption barriers like those found in the literature: costs, skills gap, and resistance to change (Barakat & Bouanba, 2024; Khalifa & Elghany, 2021; Nićin et al., 2024; Shahzadi et al., 2024). However, the authors suggest these barriers differ across regions, making a one-size-fits-all approach to AI integration potentially ineffective. This research emphasizes the importance of human-machine collaboration: Germany is more receptive, Poland and Belarus face scepticism over job displacement, mirroring findings by other researchers (Foster & Rhoden, 2020; Gupta et al., 2022; Ismaeil & Lalla, 2024; Lostal Martínez, 2024; Weinke, 2023). While previous studies mainly focus on the benefits and challenges of AI, this research underlines the crucial link between countries' digitalization levels and their ability to successfully adopt

AI tools in e-business operations. Overall, it contributes to the expanding literature on AI readiness in logistics by offering a comparative international perspective that emphasizes national inequalities.

## Conclusions

The aim of this paper was to assess the readiness of international logistics companies to implement AI tools in their e-business operations, considering variations in digital maturity and identifying key barriers and enablers of AI adoption. This goal was fully achieved through a survey of international professionals with diverse backgrounds, assessing their perceptions of organizational readiness for AI-driven transformation. The paper also addressed the research gap by examining the relationship between a country's digital maturity and logistics companies' AI readiness, based on a comparative analysis of Belarus, Germany, and Poland.

The research allowed to answer the formulated research questions by analysing and interpreting the collected data. The main areas of AI adoption in logistics across Belarus, Germany, and Poland include route optimization, customer service chatbots, and inventory management. Predictive analytics and fraud detection remain underutilized (Q1).

The main barrier to AI adoption across all three countries is resistance to change. In Belarus and Germany, high costs are also a significant concern, while in Poland, the lack of expertise is the most critical obstacle (Q2).

The decision to implement AI in international logistics is primarily driven by increased efficiency, cost savings, and faster decision-making. These objectives are shared across Belarus, Germany, and Poland. Logistics companies seek to optimize decision-making, reduce human errors, and improve operational productivity. Customer satisfaction and risk management are also secondary drivers but are given less priority (Q3).

Germany demonstrates the highest level of AI adoption readiness, with the most diverse and widespread implementation of AI. In Belarus and Poland, AI readiness is relatively similar, with both countries showing moderate to high readiness levels. However, Poland tends to score slightly higher in most areas, reflecting its more advanced digital infrastructure. Despite this, Belarus outperforms Poland in certain aspects, providing a nuanced comparison of their AI adoption perspectives (Q4).

The hypothesis formulated earlier has been confirmed by the research findings. The results indicate varying levels of AI maturity, with Germany exhibiting the highest AI adoption, followed by Poland and Belarus. These findings align with global digitalization rankings, supporting the conclusion that countries with stronger digital infrastructure and higher rankings in digital economy indexes demonstrate a greater readiness for AI implementation in logistics.

Based on the research results, practical recommendations were developed to assist international logistics companies in AI adoption, while effectively addressing barriers and maximizing the benefits of digital transformation. It is recommended that companies prioritize investment in employee training and AI competencies to ensure that staff have the necessary skills to successfully embrace AI tools. AI integration strategies should be tailored to the local context, considering the varying levels of digitalization across different regions. To overcome resistance to change, it is crucial to foster a culture of innovation and flexibility, encouraging employees to embrace new technologies. Furthermore, implementing cost-effective and scalable AI tools will ensure ease of implementation. Finally, implementing robust data security measures and following data privacy regulations is essential to maintaining trust and reducing risks associated with AI solutions.

**Limitations**

The research was based on a sample of logistics employees from Belarus, Germany, and Poland, as well as part-time students working in logistics companies. The respondents represented a range of ages, genders, educational backgrounds, job positions, and levels of professional experience. The majority held a bachelor's degree, worked in non-managerial positions, had 1–5 years of experience, specialized in freight forwarding, and were employed in small companies. The distribution of respondents was uneven, with a larger proportion from Poland. The inclusion of part-time students may have influenced the results due to their potentially limited work experience. These factors may limit the generalizability of the findings to the broader logistics sector. The authors' conclusions reflect the specific perspectives of the surveyed group and the current state of AI adoption readiness in the companies studied, which may differ from other regions or industry segments.

**Future research**

The research was limited to three European countries – Belarus, Germany, and Poland – with varying levels of digital development. Future studies should take a global approach to compare AI readiness across different continents. Longitudinal research could also track the evolution of AI adoption and its long-term impact. Additionally, future research should employ inferential statistics to quantify the significance of the cross-country differences identified in this study.

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