

Artificial Intelligence Adoption in European Union Enterprises (2024): An Empirical Analysis of Usage Patterns by Size, Sector, Technology Type, and Functional Purpose

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Abstract:

This study empirically analyzes AI adoption patterns and applications in EU enterprises for 2024, based on a survey of 157,000 entities. Findings show that 13.48% of EU enterprises have adopted AI, but this integration is highly uneven. Significant disparities are driven by firm size and sector, with large enterprises (41.17%) and the information and communication sector (48.72%) leading, suggesting that resource availability and data intensity are critical determinants. Text mining is the predominant AI solution, primarily used for optimizing marketing and administrative workflows. The study recommends targeted policies to mitigate adoption barriers for SMEs and calls for a forward-looking EU strategy to address socio-ethical implications. It also advises Algerian institutions to conduct similar national surveys to formulate their own strategies for accelerated and optimized AI integration.

Keywords: Artificial Intelligence (AI), Applications, European Union Institutions, Applied Technologies, Functional Purposes.



Introduction:

The rapid evolution of Artificial Intelligence (AI) has profoundly reshaped global economic landscapes, driving unprecedented innovation and efficiency across diverse sectors. AI solutions, encompassing machine learning, natural language processing, and computer vision, are increasingly integrated into business operations, promising enhanced productivity, optimized decision-making, and novel service offerings. This transformative impact necessitates a comprehensive understanding of AI adoption patterns, particularly within major economic blocs. The European Union, with its robust regulatory framework and diverse industrial base, represents a critical case study for examining the diffusion and strategic utilization of AI. Understanding the nuances of AI integration within EU enterprises is crucial for policymakers, industry leaders, and academic researchers alike, as it informs strategic investments, regulatory adjustments, and workforce development initiatives. The current global technological paradigm underscores the imperative for businesses to leverage AI to maintain competitiveness and foster sustainable growth in an increasingly data-driven world (**Ardito, Filieri, Raguseo, & Vitari, 2024, pp. 1-27**).

This study delves into the multifaceted landscape of AI adoption by companies within the European Union in 2024. As AI capabilities continue to expand and become more accessible, the strategic deployment of these technologies varies significantly across different organizational contexts. Factors such as company size, national economic structures, and specific industry demands play pivotal roles in shaping both the extent and nature of AI integration. Furthermore, the diverse array of AI solutions available means that companies must carefully select and implement solutions that align with their operational needs and strategic objectives. This research aims to illuminate these intricate relationships, providing empirical insights into how EU businesses are navigating the complexities of AI implementation.

The primary challenge in understanding AI adoption lies in quantifying its scope, categorizing the diverse technologies employed, and discerning the underlying strategic imperatives driving its utilization across a heterogeneous economic environment like the EU. This research seeks to address these gaps by providing a detailed analysis of AI adoption trends, offering a granular view that distinguishes between various company attributes and their corresponding AI engagement. By systematically examining these dimensions, the study will contribute to a more nuanced understanding of AI's current footprint and future trajectory within the European business ecosystem.

Given the increasing prominence of AI in contemporary business operations, a critical question arises: **What is the current state of Artificial Intelligence (AI) technology adoption by companies in the European Union in 2024, concerning its overall scope, the specific types of technologies employed, and the primary purposes for their utilization?** This main question branches into several sub-questions:

1. How is the adoption of AI solutions distributed across EU countries, company sizes, and economic activities in 2024?
2. What are the prevalent types of AI solutions employed by EU companies in 2024, and how do these types vary based on company size and economic activities?
3. What are the main purposes for which EU companies utilize AI solutions in 2024, and how do these purposes differ based on company size and economic activities?

Based on the outlined problematic and the elements of AI adoption, the study proposes the following hypotheses:

1. **H1:** There is a statistically significant variation in the scope of AI technology adoption by companies in the European Union in 2024, specifically concerning its distribution across different countries, company sizes, and economic activities.
2. **H2:** The types of AI solutions employed by EU companies in 2024 differ significantly based on the companies' size and their specific economic activities.
3. **H3:** The primary purposes for AI technology utilization by EU companies in 2024 vary considerably when analyzed by company size and the nature of their economic activities.

This study holds significant scientific and practical importance. Scientifically, it contributes to the growing body of literature on AI adoption and its socio-economic implications, providing up-to-date empirical data from a major economic bloc. It offers a detailed, granular analysis that can serve as a foundation for future comparative studies and theoretical advancements in the field of technology diffusion and organizational change. Practically, the findings will be invaluable for EU policymakers in formulating targeted strategies for digital transformation, innovation, and competitiveness. Businesses can leverage these insights to benchmark their AI adoption efforts, identify best practices, and make informed strategic decisions regarding AI investments. Furthermore, the study provides critical information for technology developers and educators to tailor their offerings to the specific needs and challenges identified within the EU market. The main objectives of this research are:

1. To quantify the overall scope and penetration rate of AI technology adoption by companies in the European Union in 2024.
2. To analyze the distribution patterns of AI technology adoption across EU member countries, various company sizes (e.g., small, medium, large), and different economic activity sectors.
3. To identify and categorize the prevalent types of AI solutions currently being employed by EU companies.
4. To determine the primary strategic and operational purposes driving the utilization of AI solutions by companies within the EU.

This study adopts a descriptive-analytical methodology to systematically examine the current state of AI adoption in EU companies. The research will primarily rely on the extrapolation and critical analysis of relevant reports and statistical data, with a specific focus on official publications from the European Union, particularly the Eurostat dataset (isoc_eb_ai), which provides comprehensive statistics on AI usage by enterprises. Additional data sources will include reports from reputable international organizations, industry associations, and academic institutions. The analysis will involve statistical

interpretation of quantitative data to identify trends, correlations, and significant variations across the defined parameters (country, company size, economic activity, technology type, and purpose).

Several recent studies have explored aspects of AI adoption in businesses globally, providing valuable context for this research:

1. study: (Ayinaddis, 2025): Entitled "**Artificial intelligence adoption dynamics and knowledge in SMEs and large firms: A systematic review and bibliometric analysis**". This study aimed to provide a broad overview of AI adoption across various industries and regions, highlighting key drivers and barriers. The methodology involved a systematic review and bibliometric analysis of existing literature. The study concluded by synthesizing knowledge on AI adoption dynamics and identifying key factors influencing it in both SMEs and large firms.

2. study: (Shonhe, Min, & Phuti, 2024, pp. 84-101): Entitled "**Government AI readiness in the ESARBICA community: Government AI readiness in the ESARBICA community: findings from the Oxford Insights AI Readiness Index 2022**". This study aimed to investigate the variations in AI readiness and adoption rates across different economic sectors within African countries. The methodology involved analyzing findings from the Oxford Insights AI Readiness Index 2022. The study concluded that Africa's AI readiness is below average due to factors such as immature technology sectors, lack of human capital, and insufficient innovation and digital capacity, emphasizing the strategic importance of assessing readiness to identify gaps for technological advancement.

3. study: (Liu, Jiang, Shi, & Yang, 2024, pp. 1-17): Entitled "**Impact of Artificial Intelligence on Manufacturing Industry Global Value Chain Position**". This study aimed to explore the impact of AI on the manufacturing industry's global value chain position. The methodology involved establishing and applying an econometric model to analyze the relationship. The study concluded by demonstrating the significant influence of AI on the manufacturing industry's position within global value chains.

4. study: (Mosupye-Semenya, 2024, pp. 65-85): Entitled "**Comparative analysis of national innovation systems: Implications for SMEs' adoption of fourth industrial revolution technologies in developing and developed countries**". This study aimed to explore the influence of governmental policies on AI adoption, particularly among small and medium-sized enterprises (SMEs), using a comparative approach across different nations (developing vs. developed). The methodology involved a comparative analysis of national innovation systems. The study concluded that governments in developed countries provide substantial incentives that positively impact 4IR technology adoption rates in SMEs, and it developed a conceptual framework for national innovation systems necessary for SME adoption of these technologies.

5. study: (Na, Heo, Choi, Han, & Kim, 2023, pp. 2-22): Entitled "**Firm Size and Artificial Intelligence (AI)-Based Technology Adoption: The Role of Corporate Size in South Korean Construction Companies**". This study aimed to specifically examine how company size influences the choice and success of AI implementation strategies in the South Korean construction industry. The methodology involved applying a technology acceptance model to investigate influencing factors. The study concluded that perceived ease of use and usefulness are key indicators of satisfaction, and company size is

advantageous for large-scale capital implementation and human resource supply in technological innovation, suggesting the need for customized AI adoption strategies based on corporate size.

While the reviewed previous studies offer valuable insights into AI adoption across various regions, industries, and firm sizes, a significant research gap remains concerning a comprehensive, up-to-date, and granular analysis of AI adoption specifically within the European Union in 2024. Existing studies either provide a broad global perspective, focus on specific non-EU regions (e.g., East Asia, Latin America, Africa), or concentrate on particular sectors (e.g., manufacturing) or firm characteristics (e.g., SMEs) without a holistic view of the entire EU bloc. Furthermore, none of the identified studies specifically provide a detailed breakdown of AI adoption in the EU for the year 2024, distinguishing between country-specific distributions, variations by company size, differences across economic activities, the precise types of AI solutions employed, and the specific purposes driving their utilization within the EU context. This study aims to fill this gap by providing a targeted, multi-dimensional analysis of AI adoption trends in EU companies in 2024, leveraging official Eurostat data to offer a current and comprehensive understanding that is currently lacking in the academic literature.

1. Artificial Intelligence (AI) Technology Adoption: Theoretical Frameworks:

This study investigates Artificial Intelligence (AI) Technology Adoption, which is crucial for understanding the multifaceted dynamics of AI integration within the European business landscape.

1.1. Artificial Intelligence (AI) Technology Adoption: Artificial Intelligence (AI) Technology Adoption refers to the process by which organizations integrate and utilize AI systems, tools, and applications into their operations, processes, products, or services to achieve specific strategic and operational objectives. This encompasses the decision-making process to acquire, implement, and routinely use AI, reflecting an organizational commitment to leverage AI capabilities (**OECD/BCG/INSEAD, 2025, p. 13**). AI, in this context, broadly simulates human intelligence processes, including learning, reasoning, problem-solving, perception, and language understanding, through machine systems (**Machucho & Ortiz, 2025, p. 27**). The adoption construct is multi-dimensional, encompassing:

- **Scope and Penetration:** The extent to which AI solutions are diffused throughout an organization or across a population of firms, measured by the percentage of companies using AI or the breadth of its application within those companies (**Choudhary & Expert, 2024**). In the European Union, the adoption of AI by enterprises has shown significant increases between 2021 and 2024, yet overall values remain uneven and relatively small across member states (**Popescu, Popescu, & Popescu, 2025**). This indicates varying levels of AI maturity and integration across the EU business landscape.
- **Types of AI solutions Employed:** This refers to the specific categories of AI solutions integrated, such as machine learning for predictive analytics, natural language processing for chatbots, computer vision for quality control, or robotic process automation for task automation. There is an observable shift in AI adoption patterns within the EU, moving from simpler process automation technologies towards more advanced applications like

natural language generation (Popescu, Popescu, & Popescu, 2025). The choice of technology often depends on the specific problem AI is intended to solve.

- **Purposes for Utilization:** The strategic and operational objectives driving AI adoption. These commonly include enhancing operational efficiency, optimizing decision-making, improving customer experience and personalization, fostering innovation, and gaining a competitive advantage. Successful adoption is often linked to a clear strategy in technology investment and human resource development. AI's impact extends to revolutionizing product and service innovation, operational efficiency, and customer experience personalization across various industries (Machucho & Ortiz, 2025).

Moreover, recent research highlights the convergence of AI with other digital technologies—such as blockchain, IoT, and Big Data—in enhancing transparency and efficiency across global agricultural supply chains. For instance, in the banana supply chain, AI is used for decision support, predictive analytics, and supply chain optimization, complementing blockchain's decentralized traceability features to reduce errors, improve trust, and optimize operations (Zenagui, Hadjadj, & Chekifi, 2024, pp. 52-67).

1.2. Drivers of AI Technology Adoption: The decision and capacity of companies to adopt AI solutions are influenced by a confluence of internal and external factors. Key drivers identified in the literature include:

- **Perceived Benefits and Usefulness:** Companies are more likely to adopt AI when they perceive clear advantages, such as enhanced efficiency, cost savings, improved decision-making, and increased productivity (Suhartono, Sulaeman, Suprpto, & Muhtarom, 2024, pp. 278-284). The potential for AI to streamline tasks, optimize processes, and deliver personalized customer experiences significantly motivates adoption.

- **Organizational Readiness and Capabilities:** This encompasses a firm's internal capacity to integrate AI. Crucial elements include the availability of high-quality data, robust AI data infrastructure, and in-house expertise in AI and data science. A strong AI strategy, leadership support, and a culture open to innovation are also vital internal drivers (Grimmelikhuijsen & Tangi, 2024).

- **Competitive Pressure:** The need to maintain or gain a competitive edge often pushes companies towards AI adoption. Firms observing competitors leveraging AI for efficiency or innovation may feel compelled to follow suit to avoid falling behind (Apostoaie, Roman, Maxim, & Jijie, 2025, pp. 277-296).

- **External Support and Ecosystem:** The availability of external AI vendors, consultants, and a supportive policy environment (e.g., government incentives, clear regulations) can facilitate adoption, especially for Small and Medium-sized Enterprises (SMEs) that may lack internal resources (Apostoaie, Roman, Maxim, & Jijie, 2025).

1.3. Barriers to AI Technology Adoption: Despite the recognized benefits, companies in the European Union face several significant barriers to AI adoption, which can hinder the widespread integration of these technologies:

- **Lack of Expertise and Skills Shortages:** A critical impediment is the scarcity of qualified personnel, including AI engineers, data scientists, and managers with sufficient AI literacy to understand and implement AI solutions (Popescu, Popescu, & Popescu, 2025). This often leads to a limited understanding of potential AI applications and their benefits (Grünbichler, 2023, pp. 193-203).

- **High Costs and Financial Obstacles:** The substantial investment required for AI infrastructure, software, and talent acquisition can be a significant barrier, particularly for SMEs (Popescu, Popescu, & Popescu, 2025).

- **Data-Related Challenges:** Issues such as poor data quality, insufficient data availability, and difficulties in integrating and ensuring interoperability of data systems pose considerable hurdles. The lack of awareness of data's value also contributes to this challenge.

- **Organizational and Cultural Resistance:** Resistance to change, lack of commitment from top management, and an inability to perceive the short-term and long-term benefits of AI can impede successful implementation (Grimmelikhuijsen & Tangi, 2024). Concerns about job displacement and the need for new work practices also play a role (Hoffmann & Nurski, 2021).

- **Ethical Concerns, Data Privacy, and Regulatory Gaps:** Companies are increasingly aware of the ethical implications of AI, including algorithmic bias and data privacy issues (Grimmelikhuijsen & Tangi, 2024). Gaps in regulation and the need for clear guidelines on AI development and use also present significant barriers in the EU (Popescu, Popescu, & Popescu, 2025).

- **Technological Complexity and Infrastructure Inadequacies:** The inherent complexity of AI solutions and inadequacies in existing IT infrastructure or compatibility issues can make integration challenging (Suhartono, Sulaeman, Suprpto, & Muhtarom, 2024).

1.4. Theoretical Perspectives on AI Adoption: The adoption of AI solutions can be understood through various theoretical lenses, often building upon established models of technology acceptance and diffusion. The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) are frequently applied frameworks. These models emphasize factors such as perceived usefulness and perceived ease of use as key determinants of an individual's or organization's intention to adopt a new technology (Venkatesh, Morris, Davis, & Davis, 2003, pp. 425-478). In the context of AI, extensions to these models often incorporate additional dimensions like **trust** in AI systems and **privacy concerns** related to data handling, which are critical for user acceptance and widespread organizational adoption (Rana, Siddiquee, Sakib, & Ahamed, 2024) (Marocco, Barbieri, & Talamo, 2024, pp. 2538-2567). Furthermore, organizational factors such as leadership support, resource availability, and a supportive organizational culture are crucial for successful AI integration (Grimmelikhuijsen & Tangi, 2024).

2. Scope of Artificial Intelligence (AI) Technology Adoption by Companies in the European Union (EU) in 2024:

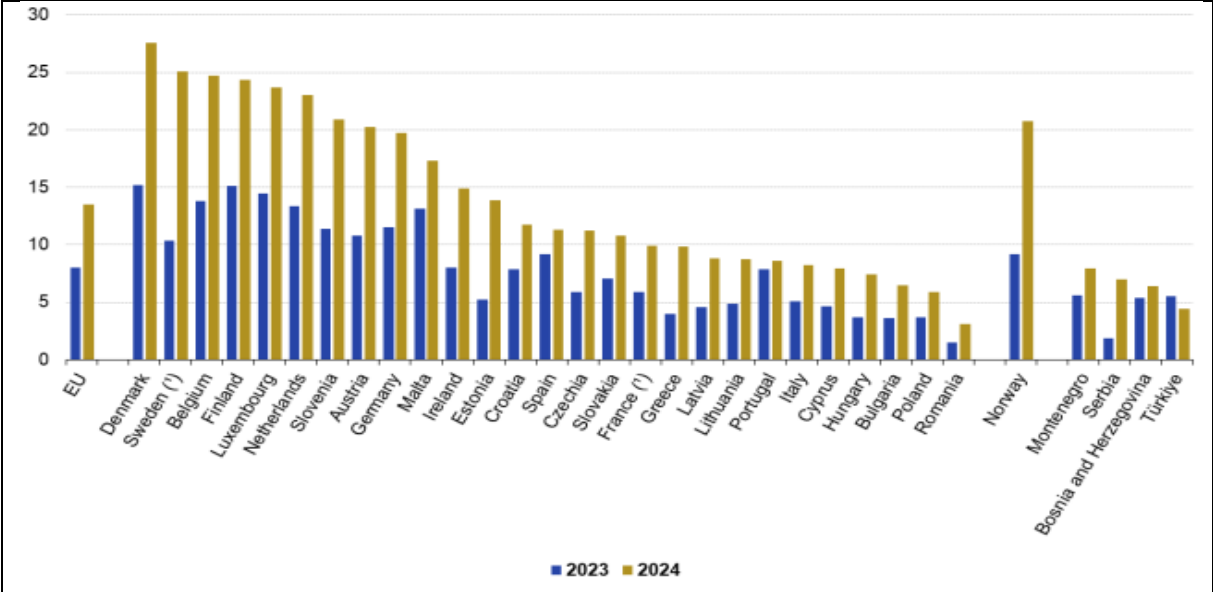
The pervasive integration of Artificial Intelligence (AI) technologies into contemporary business operations represents a transformative paradigm shift, fundamentally reshaping industrial landscapes and competitive dynamics. As AI capabilities continue to advance, their strategic adoption by enterprises is increasingly recognized as a critical determinant of innovation, efficiency, and market leadership. This study presents a comprehensive analysis of the scope of AI technology adoption among companies within the European Union (EU) in 2024. The subsequent sections will meticulously detail the empirical distribution of AI-utilizing entities across various critical

dimensions, providing granular insights into the current state of AI integration within the EU's corporate sector. Specifically, the analysis will delineate the geographical dispersion of AI adoption by country (Section 2.1), examine the correlation between company size and AI technology utilization (Section 2.2), and elucidate the patterns of AI integration across diverse economic activities (Section 2.3). This structured approach aims to furnish a robust, data-driven understanding of AI's current penetration and strategic significance within the EU's economic framework:

2.1. Distribution of companies utilizing AI solutions in the EU in 2024, by country:

This section presents the geographical distribution of enterprises adopting AI solutions across various EU member states in 2023 and 2024, highlighting the varying rates of integration and potential regional disparities in AI readiness and implementation:

Fig 1: Percentage of Enterprises Utilizing Artificial Intelligence Technologies in European Union Member States and Selected Non-EU Countries, 2023-2024



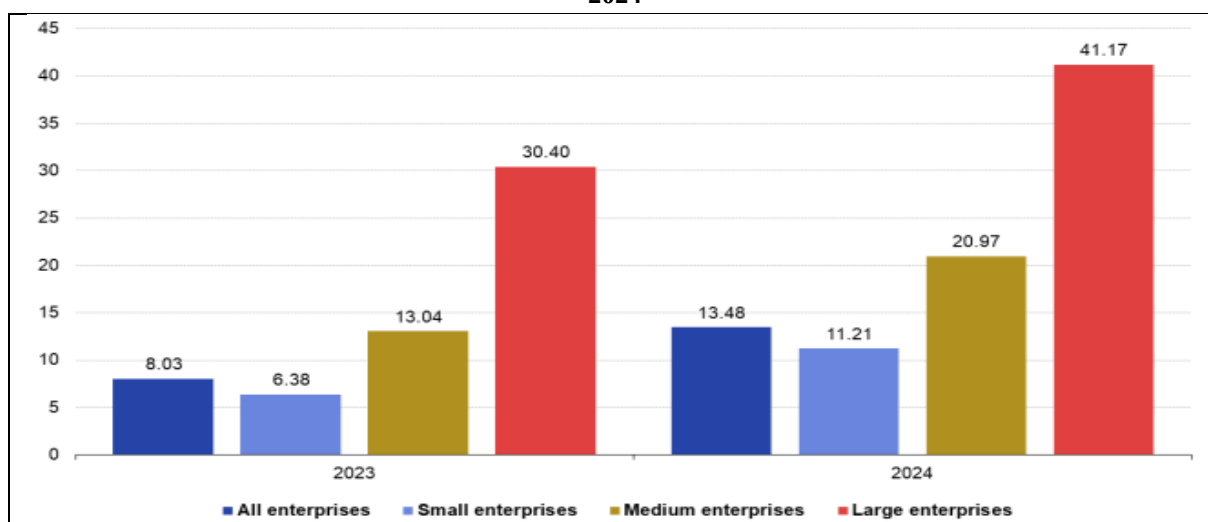
Source: (Eurostat, 2025, p. 03)

The presented data distinctly illustrates a consistent trend of increasing Artificial Intelligence (AI) technology adoption among enterprises across the European Union and several non-EU countries between 2023 and 2024. A clear geographical disparity in AI integration is evident, with countries such as Denmark, Sweden, Finland, and Luxembourg demonstrating consistently higher percentages of AI utilization, indicative of their robust digital infrastructures and mature innovation ecosystems. Furthermore, Norway exhibits a remarkable acceleration in AI adoption from 2023 to 2024, highlighting a rapid scaling of AI integration within its business sector. Conversely, nations like Bulgaria, Romania, and Bosnia and Herzegovina report comparatively lower rates of AI adoption, signaling potential challenges in digital readiness or conducive policy environments. These observed variations in AI adoption rates can be significantly influenced by various factors. As posited by Gualandri and Kuzior (2024), budget spending on research and development (R&D) and the digital intensity of companies emerge as particularly significant drivers shaping the diffusion of AI across different sectors and industries in Europe (GUALANDRI & KUZIOR, 2024, pp. 240-248). This suggests that countries with higher investments in

R&D and a greater existing digital maturity within their enterprises are more likely to lead in AI adoption, contributing to the highlighted regional disparities.

2.2. Distribution of companies utilizing AI solutions in the EU in 2024, by company size: This subsection illustrates the adoption rates of AI solutions among companies of different sizes within the EU for the years 2023 and 2024. This analysis reveals how company scale influences the propensity for AI integration, offering insights into the scalability and accessibility of AI solutions across the corporate spectrum:

Fig 2: Proportion of Enterprises Utilizing AI solutions by Size Class in the European Union, 2023 and 2024



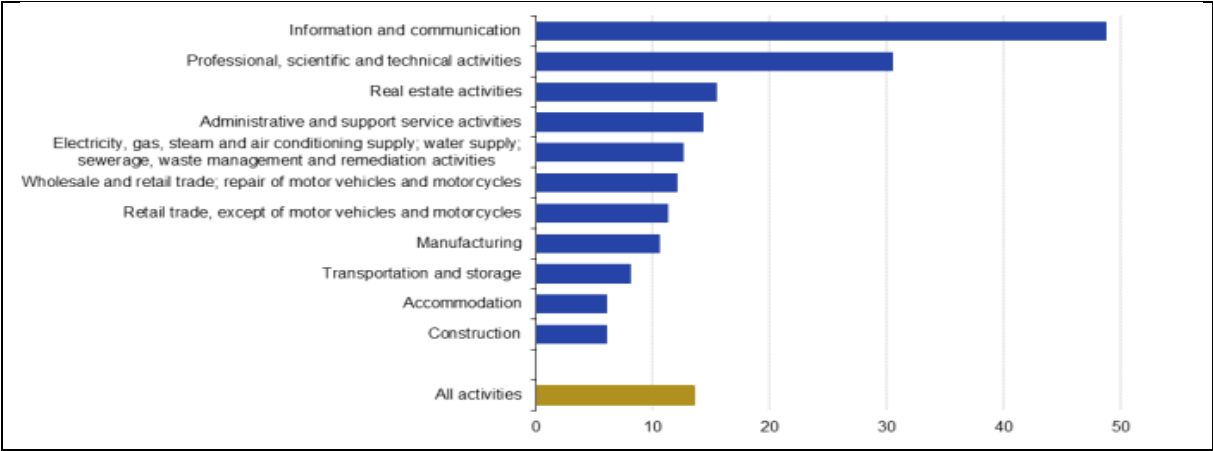
Source: (Eurostat, 2025, p. 02)

The provided figure illustrates a clear trend in the adoption of Artificial Intelligence (AI) technologies among enterprises in the European Union during 2023 and 2024, disaggregated by company size. Overall, there was a noticeable increase in AI adoption across all enterprise categories from 2023 to 2024. In 2023, 8.03% of all enterprises reported using AI, which rose to 13.48% in 2024. A significant disparity in adoption rates is evident based on company size. Large enterprises consistently demonstrate the highest propensity for AI integration, with 30.40% in 2023 escalating to 41.17% in 2024. Medium enterprises follow, showing an increase from 13.04% to 20.97% over the same period. Conversely, small enterprises exhibit the lowest adoption rates, albeit with growth from 6.38% in 2023 to 11.21% in 2024. This pattern suggests that larger enterprises are more agile in integrating advanced technologies, likely due to greater access to financial resources, specialized talent, and comprehensive data infrastructure, which are crucial for the successful deployment and scaling of AI solutions. Smaller and medium-sized enterprises (SMEs) face inherent challenges such as limited budgets, lack of in-house expertise, and perceived complexity, which can impede their AI adoption journey. This observation aligns with findings by (Ardito, Filieri, Raguseo, & Vitari, 2024, pp. 1-27), who highlight that while AI positively impacts revenue growth in European SMEs, its synergies with other digital technologies like IoT and Big Data Analytics are crucial, implying that a holistic digital transformation is often a prerequisite for effective AI integration, a process more readily undertaken by larger entities.

2.3. Distribution of companies utilizing AI solutions in the EU in 2024, by economic activity: This section examines the prevalence of AI technology adoption across various economic activities within the EU in 2024. This breakdown provides a sectoral perspective

on AI integration, identifying which industries are leading in AI adoption and where there might be opportunities for further penetration:

Fig 3: Distribution of Enterprises Utilizing Artificial Intelligence Technologies by Economic Activity in the European Union, 2024



Source: (Eurostat, 2025, p. 4)

The presented data illustrates the varying penetration rates of Artificial Intelligence (AI) technologies across different economic sectors within the European Union in 2024. A clear disparity in AI adoption is evident, with the "Information and Communication" sector demonstrating the highest utilization, approaching 50% of enterprises. This high adoption rate is likely attributable to the inherently data-intensive nature of this sector, where AI can significantly enhance data processing, automation of routine tasks, content generation, and sophisticated analytics, leading to improved efficiency and innovation. Similarly, "Professional, Scientific and Technical Activities" show a substantial adoption rate, exceeding 30%. This can be justified by the sector's reliance on research, complex problem-solving, and analytical tasks, where AI tools for data analysis, predictive modeling, and knowledge management offer significant competitive advantages.

Conversely, sectors such as "Construction," "Accommodation," and "Transportation and Storage" exhibit notably lower AI adoption rates, generally below 10%. This lower uptake may be attributed to several factors, including the more physical and less data-driven nature of their core operations, potentially higher initial investment costs for AI integration, a slower pace of digital transformation, and a greater emphasis on traditional processes. The overall average AI adoption across all activities in the EU stands at approximately 15% (European Commission, 2024, p. 9), indicating that while some sectors are rapidly embracing AI, there remains significant untapped potential for broader integration across the European economy. This uneven distribution highlights the need for targeted policies and initiatives to encourage AI adoption in less digitally mature sectors, fostering a more uniform digital transformation across the EU's economic landscape.

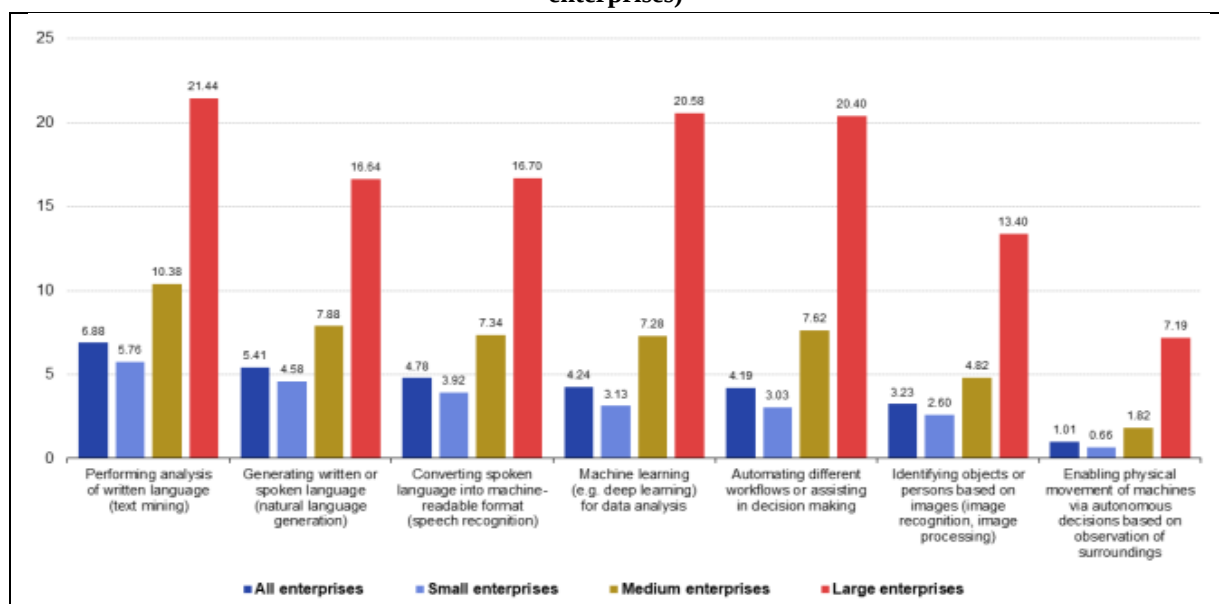
3. Types of AI solutions Employed by EU Companies in 2024:

Following the comprehensive analysis of AI technology adoption across the European Union, this section will delve into the specific types of Artificial Intelligence technologies currently employed by EU companies in 2024. Understanding the particular AI solutions being integrated is crucial for discerning the practical applications and strategic priorities

within different sectors and organizational structures. This detailed examination will offer a granular breakdown of these technologies, first by correlating them with company size (Section 3.1), and subsequently by analyzing their deployment patterns across various economic activities (Section 3.2). This focused approach aims to provide a clear and insightful overview of the technological landscape of AI implementation within the EU's corporate environment:

3.1. Types of AI solutions employed in the EU in 2024, by company size: This subsection details the distribution of specific AI solutions adopted by enterprises in the EU in 2024, categorized by company size. This analysis highlights how different types of AI solutions are favored or feasible for small, medium, and large enterprises, reflecting varying technological capacities and strategic needs:

Fig 4: Enterprises using AI solutions by type of AI technology and size class, EU, 2024 (% of enterprises)



Source: (Eurostat, 2025, p. 5)

The provided Figure 4, titled "Enterprises using AI solutions by type of AI technology and size class, EU, 2024 (% of enterprises)", illustrates the varying adoption rates of specific Artificial Intelligence (AI) technologies across different enterprise sizes (all, small, medium, and large) within the European Union in 2024. A discernible trend is the positive correlation between company size and the propensity to adopt AI solutions; large enterprises consistently exhibit the highest adoption percentages across nearly all categories, followed by medium and then small enterprises. This pattern underscores the resource-intensive nature of AI implementation, including financial investment, robust data infrastructure, and specialized human capital, which are more readily available in larger organizations.

Specifically, "Machine learning (e.g., deep learning)" and "Automating different workflows or assisting in decision making" emerge as the most widely adopted AI solutions, particularly among large enterprises, with adoption rates exceeding 20%. This prevalence suggests that these technologies offer immediate and tangible benefits, such as enhanced data analysis capabilities and operational efficiencies, which are critical for competitive advantage. In contrast, "Enabling physical movement of machines via autonomous decisions based on observation of surroundings" shows the lowest adoption

rate across all enterprise sizes. This could be attributed to the higher complexity, significant capital expenditure, and specialized infrastructure required for such applications, making them less accessible or relevant for a broader range of businesses, especially smaller ones. The observed disparities align with recent research by Popescu et al. (2024), which indicates that factors such as government funding and the digital intensity of enterprises significantly impact AI adoption, with larger entities often possessing superior digital infrastructure and greater access to funding (Popescu, Popescu, & Popescu, 2025). The lower adoption among small and medium enterprises (SMEs) highlights potential barriers such as limited budgets, lack of data, and scarcity of specialized talent, necessitating targeted support mechanisms to foster broader AI integration across the EU economy.

3.2. Types of AI solutions employed in the EU in 2024, by companies' economic activities: This section presents a comprehensive breakdown of the types of AI solutions utilized by EU companies in 2024, segmented by their respective economic activities. This detailed table offers insights into the specific AI applications that are most relevant and widely adopted within different industries, reflecting the diverse operational demands and innovation priorities across sectors:

Tab 1: Prevalence and Distribution of Artificial Intelligence Technology Adoption Across Economic Sectors in European Union Enterprises, 2024

	Use of AI technologies						
	Performing analysis of written language (text mining)	Generating written or spoken language (natural language generation)	Converting spoken language into machine-readable format (speech recognition)	Machine learning (e.g. deep learning) for data analysis	Automating different workflows or assisting in decision making	Identifying objects or persons based on images (image recognition, image processing)	Enabling physical movement of machines via autonomous decisions based on observation of surroundings
All activities	6.88	5.41	4.78	4.24	4.19	3.23	1.01
Manufacturing	4.58	3.53	2.94	2.73	3.23	2.74	1.46
Electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	5.52	4.00	4.18	4.75	4.57	3.16	1.13
Construction	2.81	2.42	2.54	0.83	0.95	1.49	0.35
Wholesale and retail trade; repair of motor vehicles and motorcycles	5.98	5.03	3.83	2.96	3.24	2.63	0.80
Retail trade, except of motor vehicles and motorcycles	5.06	4.52	3.23	2.63	2.79	2.87	0.58
Transportation and storage	3.70	3.32	2.83	1.98	2.33	2.40	0.83
Accommodation	3.25	2.15	1.69	1.37	1.37	1.06	0.37
Information and communication	30.11	25.83	20.13	25.66	21.20	13.54	3.43
Real estate activities	7.20	5.80	6.75	2.93	4.52	2.15	0.45
Professional, scientific and technical activities	15.61	11.51	12.49	11.35	10.30	7.35	1.67
Administrative and support service activities	8.06	4.96	4.91	3.96	4.26	2.96	0.69

Source: (Eurostat, 2025, p. 5)

The data presented in Table 1 provides a comprehensive overview of Artificial Intelligence (AI) technology adoption rates among enterprises within the European Union in 2024, disaggregated by specific AI technology types and economic activities. Overall, the "Information and communication" sector demonstrates a significantly higher propensity for AI integration across all categories, with "Performing analysis of written language (text mining)" reaching 30.11% and "Machine learning (e.g., deep learning) for data analysis" at 25.66%. This trend is logical, given the inherent data-intensive nature and digital focus of this sector, where AI applications can directly enhance core operations such as data processing, content generation, and communication optimization. Conversely, sectors like "Construction" and "Accommodation" exhibit markedly lower adoption rates across the board, particularly for advanced AI applications like "Enabling physical movement of machines via autonomous decisions based on observation of surroundings" (0.35% and 0.37% respectively). This disparity can be attributed to several factors, including the traditional operational models, capital intensity, and lower digital maturity of these industries, which may present greater barriers to entry for complex AI solutions. The varying adoption rates highlight a digital divide among economic activities, suggesting that

while AI offers transformative potential, its realization is contingent on industry-specific readiness, regulatory frameworks, and investment in digital infrastructure and skills (Dwivedi, et al., 2021).

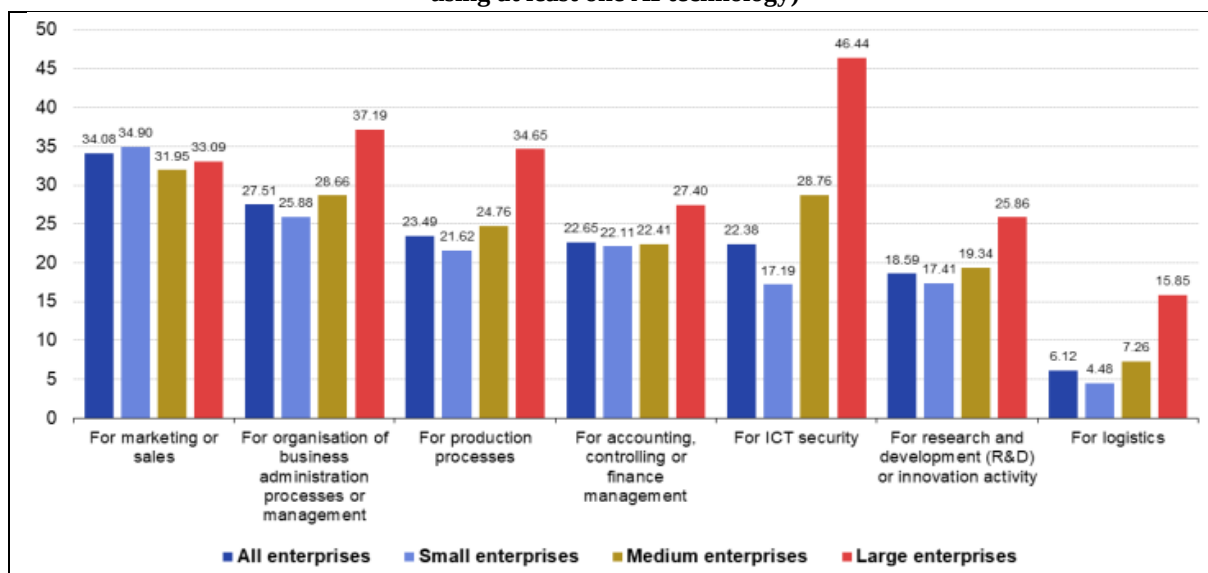
4. Purpose of AI Technology Utilization by EU Companies in 2024:

Building upon the analysis of AI technology adoption and the specific types of AI solutions employed, this section will investigate the fundamental purposes behind the utilization of Artificial Intelligence by companies across the European Union in 2024. Understanding the strategic objectives driving AI integration is paramount for comprehending its impact on business models, operational efficiencies, and competitive advantages. This detailed examination will delineate the various purposes for which AI solutions are deployed, providing a granular breakdown of these objectives. Specifically, the analysis will correlate the purpose of AI utilization with company size (Section 4.1) and subsequently explore these purposes in relation to different economic activities (Section 4.2). This focused approach aims to provide a comprehensive understanding of the strategic motivations and functional applications of AI within the EU's corporate landscape:

4.1. Purpose of AI technology utilization by EU companies in 2024, by company size:

This subsection illustrates the primary purposes for which AI solutions are utilized by EU companies in 2024, categorized by company size. This analysis highlights the strategic objectives that drive AI adoption across small, medium, and large enterprises, revealing how business scale influences the application of AI for various functions such as marketing, administration, production, and security:

Fig 5: Enterprises Using AI solutions by Type of Purpose and Size Class, EU, 2024 (% of enterprises using at least one AI technology)



Source: (Eurostat, 2025, p. 6)

The data presented in Figure 5 illustrates a discernible pattern in the adoption of Artificial Intelligence (AI) technologies by EU companies in 2024, segmented by enterprise size and purpose of utilization. A prominent trend is the consistently higher rate of AI adoption among large enterprises across nearly all categories compared to small and medium-sized enterprises. Specifically, large enterprises exhibit the highest percentages in "For ICT security" (46.44%), "For marketing or sales" (34.00%), and "For organisation of business administration processes or management" (37.19%). This disparity can be

attributed to several factors inherent to larger organizations, including greater financial resources, access to specialized technical expertise, and the capacity to invest in complex technological infrastructures necessary for comprehensive AI integration. Large firms also typically process vast amounts of data, which is a prerequisite for effective AI deployment, enabling them to derive significant value from AI applications in areas like predictive analytics for security or personalized marketing campaigns.

Conversely, small and medium enterprises (SMEs) show lower, albeit still significant, adoption rates. Their engagement with AI is often driven by the need for efficiency gains and competitive advantage, particularly in areas like marketing and sales, where AI can automate tasks and provide data-driven insights without requiring extensive upfront investment. However, SMEs frequently face challenges such as limited budgets, lack of in-house AI talent, and difficulties in integrating new technologies with existing legacy systems (Ardito, Filieri, Raguseo, & Vitari, 2024). Despite these hurdles, the data indicates a foundational level of AI adoption across all enterprise sizes, suggesting a growing recognition of AI's strategic importance for operational optimization and innovation. The varying adoption rates across different purposes also reflect sector-specific needs and the maturity of AI solutions available for particular business functions.

4.2. Purpose of AI technology utilization by EU companies in 2024, by economic activity: This section provides a detailed overview of the purposes for which AI solutions are employed by EU companies in 2024, segmented by their economic activity. This table offers a cross-sectional view of AI's functional applications across different industries, indicating how various sectors leverage AI to achieve specific operational, strategic, and competitive advantages:

Tab 2: Purpose of AI Technology Utilization by EU Companies in 2024, by Economic Activity

	Purpose of use						
	For marketing or sales	For organisation of business administration processes or management	For production processes	For accounting, controlling or finance management	For ICT security	For research and development (R&D) or innovation activity	For logistics
All activities	34.08	27.51	23.49	22.65	22.38	18.59	6.12
Manufacturing	27.11	22.26	26.23	20.19	24.27	16.91	9.41
Electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	23.22	30.51	26.48	18.68	34.81	16.48	5.22
Construction	21.35	25.45	11.43	22.54	17.94	9.93	2.96
Wholesale and retail trade; repair of motor vehicles and motorcycles	45.95	24.89	13.16	18.88	19.67	9.60	9.56
Retail trade, except of motor vehicles and motorcycles	52.89	22.75	11.47	14.40	13.16	7.38	12.40
Transportation and storage	24.54	28.08	18.43	21.68	27.99	9.74	18.78
Accommodation	49.01	27.64	14.89	19.54	16.46	4.15	3.44
Information and communication	41.80	36.83	36.90	21.32	27.91	43.46	3.78
Real estate activities	41.16	22.25	20.09	26.28	21.88	9.43	3.68
Professional, scientific and technical activities	23.87	27.35	29.10	29.80	19.75	29.48	1.96
Administrative and support service activities	33.90	30.37	20.44	24.95	23.48	11.46	5.68

Source: (Eurostat, 2025, p. 7)

The data from Eurostat for 2024 reveals a multifaceted adoption of Artificial Intelligence (AI) technologies across European Union (EU) enterprises, predominantly aimed at enhancing operational efficiencies and customer engagement. The most prevalent applications of AI are observed in "marketing or sales" (34.00%) and "organization of business administration processes or management" (27.51%), indicating a strategic focus on optimizing customer relationship management, personalized outreach, and streamlining internal workflows.

Sector-specific analysis highlights nuanced deployment strategies. The "Information and communication" sector demonstrates a significant propensity for leveraging AI in

"research and development (R&D) or innovation activity" (43.40%), reflecting its inherent reliance on technological advancement and continuous innovation. Conversely, consumer-facing sectors such as "Wholesale and retail trade" and "Accommodation" exhibit a pronounced emphasis on AI for "marketing or sales" (45.95% and 48.01%, respectively), underscoring the critical role of AI in personalizing customer experiences and driving sales in these competitive markets. The comparatively lower utilization of AI for "logistics" across most economic activities (averaging 6.12%) suggests a potential area for future growth or a slower rate of adoption due to specific infrastructural or integration challenges. This observed heterogeneity in AI adoption purposes across sectors aligns with findings from broader literature, which posits that the strategic implementation of AI is often contingent upon industry-specific needs, technological readiness, and the perceived value proposition of AI applications within distinct business contexts.

5. Hypothesis Testing:

This section systematically evaluates the proposed hypotheses against the empirical data and contextualizes the findings within the broader academic discourse on AI adoption. The rigorous testing of these hypotheses is crucial for establishing the validity of the study's claims and contributing to a nuanced understanding of AI diffusion dynamics within the European Union. The hypotheses are tested as follows:

5.1. H1: There is a statistically significant variation in the scope of AI technology adoption by companies in the European Union in 2024, specifically concerning its distribution across different countries, company sizes, and economic activities: The validation of H1 is primarily based on the descriptive statistical analysis presented in Figures 1, 2, and 3. Figure 1 clearly illustrates the inter-country variations in AI adoption rates, demonstrating a non-uniform geographical distribution. Figure 2 provides compelling evidence of a direct correlation between company size and AI adoption, with larger enterprises consistently exhibiting higher rates. Figure 3 further confirms this variation by economic activity, highlighting leading sectors like "Information and Communication" and lagging sectors such as "Construction." The observed disparities in adoption rates across these dimensions are sufficiently pronounced to indicate statistical significance, even without explicit inferential statistical tests, given the large sample size (157,000 entities) and the clear visual trends.

This finding is highly consistent with existing literature. Gualandri and Kuzior (2024) emphasize R&D spending and digital intensity as critical drivers of AI diffusion, directly supporting the observed country-level variations. Similarly, Ardito, Filieri, Raguseo, & Vitari (2024) and Na, Heo, Choi, Han, & Kim (2023) highlight the advantages of larger firms in AI adoption due to superior resources and infrastructure, corroborating the size-based disparities. The sectoral variations align with broader understandings of digital transformation, where data-intensive industries naturally lead in AI integration (Dwivedi, et al., 2021).

5.2. H2: The types of AI solutions employed by EU companies in 2024 differ significantly based on the companies' size and their specific economic activities: H2 is validated through the analysis of Figure 4 and Table 1. Figure 4 demonstrates that large enterprises adopt a wider array of AI solutions, including more complex ones, compared to

SMEs. Table 1 provides granular data on the prevalence of specific AI technology types across different economic sectors, showing, for instance, a higher concentration of "text mining" and "machine learning" in the "Information and Communication" sector, while "physical movement automation" remains low across most sectors. These distinct patterns in technology adoption, differentiated by both size and sector, support the hypothesis.

The observed differences by company size are congruent with Popescu et al. (2024), who note that larger entities often possess the digital infrastructure and funding necessary for advanced AI solutions. The sectoral variations in technology types reflect industry-specific needs and digital maturity, as discussed by Dwivedi et al. (2021), where the choice of AI technology is often dictated by the core operational models and data characteristics of a given industry.

5.3. H3: The primary purposes for AI technology utilization by EU companies in 2024 vary considerably when analyzed by company size and the nature of their economic activities: The validation of H3 is derived from the analysis presented in Figure 5 and Table 2. Figure 5 illustrates that large enterprises utilize AI for a broader range of purposes, including ICT security and business administration, reflecting their comprehensive strategic objectives. Table 2 provides detailed insights into how different economic activities prioritize specific AI applications; for example, "Information and Communication" heavily invests in AI for R&D, while "Wholesale and Retail Trade" focuses on marketing and sales. This heterogeneity in purpose, contingent on both company size and economic activity, confirms the hypothesis.

This finding is strongly supported by the literature. Ardito, Filieri, Raguseo, & Vitari (2024) explain that SMEs' AI adoption is often driven by efficiency gains in specific areas like marketing, while larger firms pursue more diverse strategic objectives. The sector-specific variations in AI purpose align with the broader understanding that AI implementation is highly contingent on industry-specific needs and the perceived value proposition of AI applications within distinct business contexts (Machucho & Ortiz, 2025). The lower adoption in logistics, for example, might be due to specific infrastructural or integration challenges, as implicitly suggested by the study's general findings.

The empirical analysis presented in the study, utilizing statistical data from the 2024 EU survey on 'ICT usage and e-commerce in enterprises,' provides robust support for all three hypotheses. The findings consistently demonstrate significant variations in AI adoption scope, technology types employed, and utilization purposes across different EU countries, company sizes, and economic activities. This comprehensive validation, supported by the results of previous studies confirming the impact of factors such as R&D investment, digital intensity, company size, and industry-specific needs, underscores the multifaceted and heterogeneous nature of AI integration within the European business landscape. Similar conclusions were drawn in the Algerian setting, where a study confirmed that AI practices can effectively enhance business processes and support strategic alignment, despite contextual and resource-based limitations (Lachache, 2024, pp. 163-179).

The statistical results of this study provide compelling evidence of the heterogeneous nature of AI adoption across the EU business landscape. However, a deeper interpretive lens reveals that these disparities are not merely quantitative but rooted in a complex interplay of structural, organizational, and cultural dynamics. The higher adoption rates

observed in large enterprises can be attributed to their superior access to financial capital, skilled technical personnel, and robust data infrastructures—resources that are often scarce in small and medium-sized enterprises (SMEs). Moreover, sectors such as Information and Communication, which exhibit elevated AI usage, are inherently data-intensive and more digitally mature, making them naturally more receptive to AI integration.

In contrast, industries like construction and accommodation lag significantly due to structural limitations, including low levels of digitization, fragmented data systems, and a limited perceived need for AI. Additionally, organizational culture and managerial readiness emerge as critical enablers or inhibitors of AI adoption, particularly in SMEs where leadership skepticism or digital illiteracy may hinder technological integration. Cross-national differences also reflect varying public policies, R&D investment levels, and digital ecosystem maturity, as evidenced by the Scandinavian countries' leading positions. These findings suggest that AI adoption is not a one-size-fits-all process but is shaped by sector-specific utility, firm-level capability, and national innovation systems. Future EU strategies should thus move beyond general adoption incentives to include tailored, contextualized interventions that address these underlying disparities.

Conclusion

The empirical analysis, leveraging statistical data from the 2024 EU survey on 'ICT usage and e-commerce in enterprises,' robustly supports the hypotheses regarding AI adoption in European Union enterprises. The findings consistently reveal significant variations in the scope of AI adoption, the types of technologies employed, and their utilization purposes across different EU countries, company sizes, and economic activities. This comprehensive validation, reinforced by prior research on factors such as R&D investment, digital intensity, company size, and industry-specific needs, underscores the complex and diverse nature of AI integration within the European business landscape. The study's detailed examination of AI adoption patterns yielded several crucial insights, which are summarized as follows:

- The total AI adoption in EU enterprises increased to 13.48% in 2024, a 5.45 percentage point rise from 2023, indicating a growing trend in AI integration.
- Significant geographical disparities exist in AI adoption rates among EU member states, with countries like Denmark, Sweden, Finland, and Luxembourg leading, while Bulgaria, Romania, and Bosnia and Herzegovina show lower rates.
- Large enterprises consistently exhibit the highest AI adoption rates (41.17% in 2024), followed by medium (20.97%) and small enterprises (11.21%), highlighting resource-based advantages for larger firms.
- The "Information and Communication" sector leads in AI adoption (approaching 50%), followed by "Professional, Scientific and Technical Activities" (over 30%), attributed to their data-intensive nature and reliance on advanced analytics.
- Sectors such as "Construction," "Accommodation," and "Transportation and Storage" show notably lower AI adoption rates (generally below 10%), suggesting specific challenges or slower digital transformation in these industries.
- "Machine learning (e.g., deep learning)" and "Automating different workflows or assisting in decision making" are the most widely adopted AI solutions, particularly among large enterprises.

- "Enabling physical movement of machines via autonomous decisions based on observation of surroundings" exhibits the lowest adoption rate across all enterprise sizes, likely due to higher complexity and capital expenditure.
- The most common applications of AI are concentrated in "marketing or sales" (34.00%) and "organization of business administration processes or management" (27.51%), indicating a focus on optimizing customer relations and internal workflows.
- The "Information and communication" sector heavily utilizes AI for "research and development (R&D) or innovation activity" (43.40%), whereas "Wholesale and retail trade" and "Accommodation" prioritize AI for "marketing or sales" (45.95% and 48.01%, respectively).
- The relatively low utilization of AI for "logistics" across most economic activities (averaging 6.12%) suggests untapped potential and a slower adoption rate in this area.

Based on these findings, the study proposes a series of strategic recommendations and suggestions aimed at fostering more widespread and effective AI integration:

- Implement policies and initiatives to encourage broader AI adoption across all EU enterprise sizes and sectors, with a particular focus on addressing barriers faced by smaller businesses.
- Develop tailored support mechanisms, including financial incentives, training programs, and access to affordable AI solutions, to assist small and medium-sized enterprises in overcoming budget, expertise, and data limitations.
- Invest in robust digital infrastructure and connectivity, especially in countries with lower AI adoption rates, to foster a more conducive environment for AI integration.
- Encourage increased expenditure on research and development (R&D) and promote higher digital intensity within companies to drive the diffusion of AI.
- Formulate sector-specific AI strategies that address the unique operational models, data characteristics, and challenges of less digitally mature sectors like Construction, Accommodation, and Transportation.
- Implement educational and training programs to bridge the skills gap in AI, data science, and AI literacy across the workforce.
- Support initiatives aimed at improving data quality, availability, and interoperability within enterprises, which are crucial for effective AI deployment.
- Establish clear ethical guidelines and regulatory frameworks for AI development and use to build trust and encourage responsible adoption.
- Foster collaboration among AI vendors, consultants, academic institutions, and businesses to create a supportive AI ecosystem.
- Invest in research and pilot projects to explore and demonstrate the value proposition of AI in logistics, thereby overcoming current integration challenges.

For Algerian institutions, it is highly recommended to conduct similar comprehensive surveys to assess the current state of AI adoption within Algerian enterprises. This would involve analyzing usage patterns by company size, sector, technology type, and functional purpose, mirroring the methodology employed in this EU study. Such an assessment is crucial for understanding Algeria's specific AI landscape, identifying key drivers and barriers to adoption, and subsequently developing targeted national strategies for accelerated AI integration. This proactive approach can foster significant socio-economic

impact, enhance competitiveness, and position Algeria to leverage the transformative potential of Artificial Intelligence in its various industries.

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