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AI skills needs and **gaps** for **MSMEs** in the **retail sector** in **Cyprus, Germany, Italy, Poland,** and **Romania**

Increasing the uptake of AI in Retail
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AI skills needs and gaps for MSMEs in the retail sector in Cyprus, Germany, Italy, Poland, and Romania

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Introduction

Aim of the Report

The report represents the findings of research conducted under the auspices of the Work Package 3 titled "Analysis of AI Skills Needs and Gaps in Retail" of the "InAIR: Increasing the Uptake of AI in Retail" project, Coordination and Support Action funded by the European Union"s Horizon Europe Research and Innovation programme under Grant Agreement No. 101133847.

The aim of this report is to fulfill the first specific objective of the project, which is to identify the AI skill needs and gaps for MSMEs in the retail sector in Cyprus, Germany, Italy, Poland and Romania.

This research aims to guide retail sector companies and their employees through the digital revolution. Our motto is well reflected in the words of one of the retail sector stakeholders who shared their knowledge with us.

> *"It seems we are always afraid of the unknown, akin to hesitating at the edge of a dark forest. Yet, every breakthrough and revolution involves stepping into that darkness, getting to know it, and then moving beyond.*
>
> Int_Exp_Poland_9

Main results

AI adoption in retail is under-researched

Research on the impact of AI on the retail sector's operations is still in its early stages. The existing literature lacks comprehensive studies on the role of AI skills in small and medium-sized enterprises within the retail sector, especially concerning sustainable development and green skills (see Section 1 and Section 4).

Retail companies exhibit a low level of AI adoption

The retail sector faces distinct challenges in its digital transformation journey, notably with AI integration, due to sectoral fragmentation (97% of companies are micro, small, and medium-sized enterprises), low levels of digitalization (especially in Poland and Romania), a slow rate of AI adoption (particularly in Poland), and insufficient digital skills among employees (see Section 2 and Section 7).

Employers do not seek AI skills (yet)

The limited progress in AI integration within retail companies is evident from employers' minimal interest in hiring AI-skilled workers (see Section 5).

Retail companies adopt AI technologies in diverse ways

Companies demonstrate diverse approaches to using and integrating AI technologies (see Section 3 and Section 6). Consequently, the AI Core Curriculum and open educational resources should account for these varied models. Similarly, educational strategies should cater to specific subsets of transversal skills required by retail company managers, such as change management competencies, leadership skills, the ability to formulate growth strategies, and comprehensive knowledge of AI applications and AI project management (see Section 8).

Digital mindset is a new transversal skill

Digital transformation necessitates a new set of transversal skills and competencies, referred to as a "digital mindset" characterized by openness to innovation and organizational change, collaboration with new technologies and AI, and fundamental technical skills (see Section 8).

Overview of the Report

Section 1 of this report examines the potential of AI technology in the retail sector. We conducted a systematic and qualitative literature review, complemented by insights from experts and stakeholders gathered through co-creation workshops and questionnaires. The academic discourse, led by STEM researchers, primarily focuses on technical matters such as decision support systems, natural language processing, and the Internet of Things. However, there is a lack of in-depth studies on AI skills in MSMEs and sustainability. This examination of AI in retail considers both technical and socio-cultural perspectives, focusing on computational advancements and ethical considerations. AI has the potential to transform the retail sector by enhancing decision-making, automating processes, personalizing customer interactions, and optimizing workforce management. Despite these advantages, AI also raises ethical and social concerns. One concern is the potential for AI to be perceived as having mental capacities, which could complicate the roles of humans and machines. Additionally, AI-driven automation poses a risk of job displacement. Therefore, it is crucial to adopt a proactive approach to managing the socio-economic impacts of digitalization.

Section 2 analyzes the state of AI adoption in the retail sector, focusing on selected European Union countries: Cyprus, Germany, Italy, Poland and Romania. Over the past decade, the wholesale and retail trade sector has notably expanded, with Romania and Poland showing the highest turnover, while Germany and Italy have lagged behind the EU average, indicating disparities in growth rates across Europe. The sector is dominated by micro, small and medium-sized enterprises (MSMEs), especially in Romania, which hinders competitiveness and operational efficiency, thus slowing digitalization. The retail sector lags behind industries such as information and communication technology (ICT) and professional services in terms of digitalization. German and Cypriot enterprises perform above the EU average, while Polish firms exhibit low levels of digitalization. The variation in e-commerce adoption indicates a disparity in digital integration levels. AI adoption in the retail sector is the lowest among the analyzed sectors, with Germany exhibiting the lowest rate at 10%, and Poland having the highest percentage of firms not using AI. AI applications are commonly used in robotic process automation, speech recognition, and text mining. Cloud technology adoption is most prevalent in Cyprus and Italy, while Romania has the lowest rates. Similarly, the implementation of the Internet of Things (IoT) varies considerably across the region. The adoption of AI is hindered by a lack of specialized knowledge, high costs, and legal uncertainties. Low digital skills, particularly in Poland and Romania, further impede the adoption of technology in the retail sector and MSMEs.

In Section 3, we present a series of case studies and best practices illustrating the real-world applications of AI in the retail sector. Outsourced AI tools, frequently marketed as requiring no technical expertise or maintenance, in fact necessitate a fundamental comprehension of a company's operational data and the AI tool's functionality and advantages. The implementation of these tools necessitates the exercise of critical thinking skills to evaluate their performance.

In most cases, AI is employed to enhance customer support, underscoring the necessity for organizations to possess a foundational understanding of AI and its applications.

Section 4 examines the definitions and classifications of AI skills. Currently, there is a lack of comprehensive studies on AI skills in MSMEs, particularly in the retail sector, and on sustainability and green skills. Most AI research in the retail sector is conducted by STEM professionals, focusing on technical aspects such as decision support systems, natural language processing, and the Internet of Things. Recent initiatives emphasize literacy, social, and technical competencies. AI applications in the retail sector include business decision support, automation of inventory and supply chain processes, enhancement of customer relationships, monitoring consumer behavior, and automating recruitment procedures. Potential challenges associated with AI in retail include job losses, a lack of suitable skills, trust issues, technical difficulties, and the need for sustainable practices. The absence of a systematic definition of the relationship between AI skills and digital transformation in the retail sector highlights the need for empirical research. The OECD Employment Outlook report proposes a framework for AI skills required for the development, maintenance, and interaction of AI systems. Addressing these gaps could enhance our understanding of the interconnections between AI skills, digital transformation, and sustainability in the retail sector. A research agenda integrating qualitative and quantitative methods and multiple stakeholder perspectives is essential.

Section 5 presents an analysis of the future AI skills that employers will require. The key findings include a comparative analysis of job advertisements across selected countries, which revealed several commonalities. These include a pronounced emphasis on proficiency in office software such as Microsoft Office and enterprise resource planning (ERP) systems such as SAP, along with a robust demand for customer relationship management (CRM) skills and expertise in digital marketing (e.g., Google Ads) and e-commerce platforms. Furthermore, the report indicates that basic computer skills and overall digital literacy are considered essential. Nevertheless, it is evident that there are notable differences between countries. Cyprus places a premium on agile methodologies and design tools such as Figma and Adobe Design. Germany, on the other hand, places a strong emphasis on cloud technologies (AWS, Docker), advanced IT infrastructure, and creative skills (Adobe Photoshop, Illustrator). Italy, meanwhile, values data business intelligence, social media management, and hardware installation and support. Poland, finally, places a significant focus on advanced Excel skills and specific SAP modules. Romania, on the other hand, places a strong emphasis on emerging technologies such as VR glasses and electronic processing software. Moreover, Italy and Romania place a strong emphasis on customer interaction and retail front-end competencies, while Cyprus and Germany tend to prioritize technical and backend skills.

Section 6 examines the AI skills requirements and deficiencies from the perspective of stakeholders in the retail sector. This section examines the challenges currently facing the industry and considers how artificial intelligence can offer potential solutions. In a series of co-creation workshops held across selected EU countries, participants identified a set of essential skills and competencies that micro, small and medium-sized enterprises

(MSMEs) should possess to leverage AI effectively. Furthermore, they identified skills that are essential for managers and employees. This section presents an overview of the skill sets that were collectively identified during the workshops. The subsequent section delineates the requisite skills and characteristics that MSMEs must possess to successfully implement artificial intelligence (AI). This is followed by a discussion on the critical AI skills that are necessary for both business leaders and employees.

Section 7 examines the obstacles impeding the implementation of AI in the retail sector, with a particular focus on the challenges faced by MSMEs. Previous studies have identified numerous barriers to the adoption of AI in the retail sector. These include concerns over job displacement, a scarcity of AI expertise, and issues surrounding trust both internally and with customers. Furthermore, technical obstacles, concerns regarding sustainability, and the absence of industry standards present significant challenges. The co-creation workshop identified several key obstacles faced by MSMEs in the retail sector. These include maintaining efficient supply chains and managing inventory, navigating digital transformation, adapting to AI-driven technological shifts, and effectively addressing communication challenges in customer relationships spanning marketing and service. Participants emphasized the competitive pressures exerted by digital giants from the United States and China, which have a profound impact on the sector's landscape. Furthermore, the workshop highlighted the difficulty that MSMEs encounter in retaining and nurturing a skilled workforce capable of handling AI-driven advancements.

The objective of Section 8 is to present recommendations and guidelines for the development of an AI core curriculum that is specifically tailored for MSMEs operating within the retail sector. The discussions held during the co-creation workshops, which were conducted in various EU countries, focused on the planned training initiatives that were designed to enhance the AI skills within the retail sector. This section is based on the insights shared by participants and proposes a structured approach that prioritizes practical advice. The report outlines the specific needs identified during the workshops in order to ensure that the curriculum effectively addresses the challenges and requirements that are unique to MSMEs in the retail sector.

Research methodology

The comprehensive description and analysis of the subject matter was achieved through application of several complementary research methods. Desk research was conducted using systematic (quantitative) literature review, critical qualitative literature review and statistical data analysis. To be noted, the systematic literature review was carried out in an innovative way using text mining techniques. Next, we collected and described 13 real-life examples of AI use in MSMEs and 3 best practices. Original data were collected through web scraping and text mining of job advertisements in the five countries; and, parallelly, through co-creation workshops, interviews and questionnaires addressed to the retail sector experts, employers, employees and other stakeholders. It should be noted that we decided to extend the research plan presented in the project application by applying two different yet complementary methods of literature review and complementing co-creation workshops with interviews and questionnaires.

The research team consisted of quantitative and qualitative sociologists, economists and data scientists, sensitized to collecting empirical insights crossing the disciplinary boundaries. We used diverse analytical methods, such as text mining, thematic analysis and statistical analysis. The collected data allowed for preparation of rich description of the subject matter, empirically grounded analysis and, as a result, evidence-based recommendations for design of the AI Core Curriculum and open educational resources (WP 4 and 5 of the inAiR project). The more detailed description of the research methodology is presented in Table 1.

Table 1 Research methodology

Method	Task	Description	Main conclusions
Systematic Literature Review	Task 3.1. (a) analyzing the transversal, information, digital, technical and green skills needs for MSMEs working in Retail and (b) the related skills gaps in the consortium's countries. Target: 10 statistical datasets on areas related to AI adoption in MSMEs (e.g., technology adoption, investments in AI and advanced ICT skill development by MSMEs).	To analyze data from scientific articles retrieved from the Scopus database, covering the period from 2018 to 2024, we employed bibliometric and text-mining techniques. The search yielded a total of 1,699 publications. For the analysis, we used the full texts of 645 articles for which we had obtained permissions to retrieve the PDFs, along with the metadata and abstracts of the entire sample. We applied Latent Dirichlet Allocation (LDA) using BERTopic to identify topics within the abstracts of articles focused on AI in retail.	• Most of the research on AI in retail is conducted by scholars specializing in STEM disciplines, with a primary focus on technical issues. • The principal areas of investigation encompass decision support systems, natural language processing, and the Internet of Things. • There is a lack of research on the application of AI skills in micro, small and medium-sized enterprises (MSMEs) and on the sustainability and green skills required in the workplace.
Qualitative Literature Review	Task 3.1. (a) analyzing the transversal, information, digital, technical and green skills needs for MSMEs working in Retail and (b) the related skills gaps in the consortium's countries.	To conduct a qualitative analysis within the context of the literature review, 107 scientific articles, peer-reviewed publications, and policy documents were selected. This qualitative literature review mapped the applications of AI, as well as the definitions and classifications of AI skills and challenges relevant to the research objectives.	• The analysis of AI skills has not yet been conducted in a comprehensive manner. • AI functions in retail include decision-making support, inventory management automation, customer relationship improvement, offline behavior tracking, and job recruitment automation. • The challenges associated with the adoption of AI in the retail sector include the potential for job displacement, the existence of skill gaps, a lack of trust, technical issues, and the need to adhere to sustainability standards.
Statistical Data Analysis	Task 3.1. (a) analyzing the transversal, information, digital, technical and green skills needs for MSMEs working in Retail and (b) the related skills gaps in the consortium's countries. Target: 10 statistical datasets on areas related to AI adoption in MSMEs (e.g., technology adoption, investments in AI and advanced ICT skill development by MSMEs).	To analyze retail-related and MSMEs data, including trade, digitalization, and employee skills, data were gathered from Eurostat. The statistical and graphic analysis focused on the following themes: characteristics of the retail sector in selected countries, digitalization within the retail sector, adoption of advanced digital technologies, and digital skills of employees.	• Many MSMEs may struggle with digitalization due to limited resources, hindering advanced technology adoption • Retail sectors demonstrate moderate digitalization levels compared to other industries • AI adoption in retail varies widely across Europe, with lower rates in Poland and Romania and higher rates in Germany • Digital skills among employees are essential for successful technology adoption, enabling efficient use of modern tools
Text mining of Jobs Ads	Task 3.1. analyzing relevant statistical datasets and open data, as well as original, web-scraping analysis of AI-related online job adverts at micro, small and medium-sized retailers in all consortium countries. Target: 75 AI-related online job adverts at micro, small and medium-sized retailers analyzed via web-scraping analysis.	The objective of this study was to analyze the technology requirements and digital skills necessary for the adoption of AI in retail MSMEs. The methodology employed in this study was as follows: (1) the major job advertisement platforms in the focus countries were identified, (2) custom web scraping tools were employed to retrieve job offers, and (3) a topic modeling analysis was conducted on the text of these job offers.	• Proficiency in office software (e.g., Microsoft Office) and ERP systems (e.g., SAP) is universally valued in retail and e-commerce sectors. • Strong demand for technical skills in managing CRM systems. • Emphasis on digital marketing skills (e.g., Google Ads) and e-commerce platform expertise. • Basic computer skills and general digital literacy are essential, indicating the need for foundational digital competencies.

Table 1 Research methodology - continued

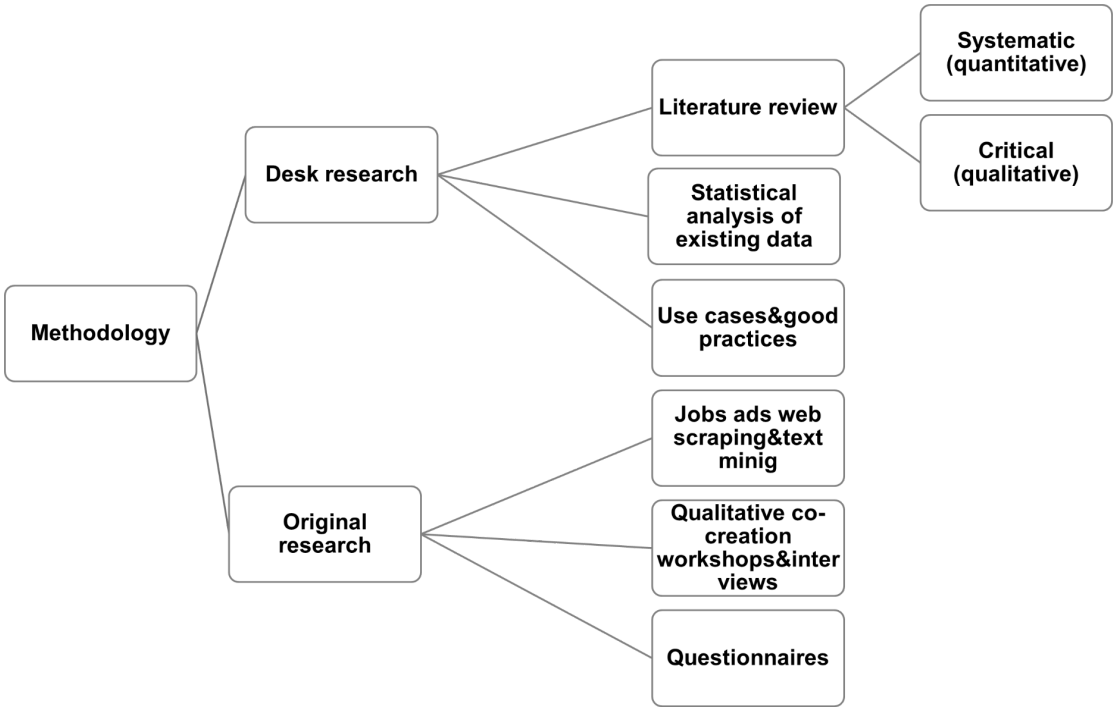
Method	Task	Description	Main conclusions
Use Case Analysis	Task 3.1. (c) identifying use cases and best practices of AI adoption for greener retailers with particular focus on the consortium's countries, and analyzing the success and failure factors. Target: 15 use cases and best practices of AI adoption for greener retailers reviewed.	Use cases (13) and best practices (3) were compiled from academic and gray literature, consultations with industry experts, and industry conferences. Information was sourced from company websites and interviews with representatives. We focused on cases with specific implementation results, such as KPIs (e.g., conversion rate, customer satisfaction score) or operational impacts explained by company representatives.	The analyzed use cases were employed in the co-creation workshops with the primary objective of fostering discussion and reflexivity among participants and sharing success stories pertaining to the implementation of AI in micro, small and medium-sized enterprises (MSMEs) engaged in retail operations.
Co-Creation Workshops	Task 3.2. Gathering qualitative insights for validation of results of T3.1 and mapping out various stakeholders' needs, with special emphasis to be put on addressing the needs of workers at risk of becoming redundant due to the uptake of new AI related technologies. Target: 50 relevant industry experts engaged in co-creation of relevant knowledge (e.g., specialized retail consultants and technology experts, retail business owners and academics, trade unions, chambers of commerce, representatives of other relevant national and EU-funded projects and initiatives.	A total of 9 online co-creation workshops were conducted: 3 in Italy, and 2 each in Germany, Poland, and Romania, held between April 4th and May 25th. The 58 participants included MSME owners and managers, digital specialists, and representatives from universities, research agencies, and organizations promoting digital transformation in European retail MSMEs. The transcribed empirical data were analyzed using Atlas.Ti software, following the guidelines of Reflexive Thematic Analysis. The objective was to generate themes as patterns of meaning within the empirical material. The penultimate version of the report was shared with all the contributors who were able to introduce their comments and modifications, as an additional co-creative input to the research results.	The main challenges for MSMEs in the retail sector are: • maintaining supply chains and inventory; • digitally transforming businesses, adapting to artificial intelligence (AI)-related technological changes; • effectively managing communication in customer relationships; • the competitive pressures exerted by digital giants in the United States and China, which are reshaping the retail landscape; • retaining and developing MSMEs' workforce. Fundamental skills that MSMEs in the retail sector should possess to implement solutions based on AI include: • understanding of the business context; • understanding of the processes involved in data production and AI technologies; • a core set of skills that constitute a culture of openness to acquiring new knowledge and learning about new technological solutions. To integrate AI successfully managers in the retail companies should possess skills allowing for: • Formulation of strategic plans for the integration of AI technologies within the organization; • Evaluation of the potential benefits and risks associated with the deployment of AI applications; • Oversight of data generation processes and infrastructure to ensure compliance with regulatory and ethical standards. To use AI effectively employees in the retail companies should: • Have comprehension AI technology and its tangible applications; • Appreciate of the potential implications of AI in retail contexts; • Posses fundamental computer skills; • Be open to ongoing learning and the acquisition of new competencies

Table 1 Research methodology – continued

Method	Task	Description	Main conclusions
Qualitative In-Depth Expert Interviews	Task 3.2. Gathering qualitative insights for validation of results of T3.1 and mapping out various stakeholders' needs, with special emphasis to be put on addressing the needs of workers at risk of becoming redundant due to the uptake of new AI related technologies.	13 in-depth individual qualitative interviews were conducted with experts in retailing and the implementation of new technologies in the market, including AI, from Germany, Poland, Romania, and the Czech Republic. The transcribed empirical data underwent analysis in Atlas.Ti software in accordance with the guidelines of Reflexive Thematic Analysis. The objective of this approach was to generate themes as patterns of meaning within the empirical material.	The interviews added to the insight formulated on the basis of the co-creation workshops' data.
Survey Research	Task 3.2. Gathering qualitative insights for validation of results of T3.1 and mapping out various stakeholders' needs, with special emphasis to be put on addressing the needs of workers at risk of becoming redundant due to the uptake of new AI related technologies.	We have designed and distributed a questionnaire among industry experts and retail stakeholders in Cyprus. This type of research was applied as a way of risk mitigation tool; preliminary consultation with experts in Cyprus suggested that the retail stakeholders may more willingly share their experience and knowledge in written form due to language barrier. All in all, we collected 16 questionnaires.	The questionnaires provided insights about the main challenges of the retail sector AI adoption in Cyprus.

Source: Own elaboration

Figure 1 Research methodology scheme



Source: own elaboration

In this report, when we refer to the 'retail sector,' we are using a general term to encompass various aspects of retail activities. It's important to note that in economic literature and statistical analyses, there are more specific classifications such as the 'service sector' and the 'retail trade industry.' These distinctions help categorize different types of economic activities within the broader retail landscape. However, for the purposes of this report, we are employing a broader definition that encompasses all activities typically associated with retail.

We prefer to use the general term 'AI' or 'artificial intelligence technologies' (in plural) whenever possible, to highlight the differences among various types of AI, particularly between rule-based algorithms and machine learning. Our respondents generally used the notion of AI, differentiating only in the case of the newest application of machine learning, namely generative AI/large language models.

Capitalizing on our previous research and publications, particularly Śledziewska, Włoch (2021), in this report we treat AI as a specific kind of digital technology that enhances the datafication of business operations. We consider AI adoption and integration within retail companies as a case of digital transformation.

1.The Potential of AI technologies use in retail

In this section, we provide a comprehensive overview of the current state of AI integration in retail, identify critical gaps in the literature concerning use of AI technologies in retail, and address both the technological and socio-cultural dimensions of AI integration. To this end, we conducted both systematic (quantitative) and qualitative literature reviews, complemented by insights from experts and stakeholders in the retail sector gathered through co-creation workshops and questionnaires.

Key takeaways

- The academic discourse on artificial intelligence in retail has been largely dominated by researchers from the STEM fields.
- The most significant topics of discussion in scholarly journals concerning AI integration are of technical character and focus on decision support systems, natural language processing, and the Internet of Things.
- **The academic literature does not, as yet, include in-depth examination of the role of AI skills in micro, small and medium-sized enterprises (MSMEs) within the retail sector.**
- **Notably absent from the literature are studies and empirical articles examining sustainability and green skills issues in using AI technologies by MSMEs, also in the retail sector.**
- The extant literature emphasizes the transforming potential of AI technologies application in the retail sector supporting decision-making through predictive analytics, automating inventory and supply chains, enhancing customer relationships through personalized interactions, and optimizing workforce management via automated recruitment processes.
- Qualitative literature review suggests that AI uses could be perceived through two lenses: a technical view focusing on computational advancements, and a socio-cultural perspective integrating AI into societal contexts, emphasizing ethics and human adaptation.
- Retail stakeholders claim that AI is reshaping strategies and operations, driving significant digital investments. However, this **transformation also brings challenges like job displacement and the need for proactive management of digitalization's socio-economic impacts**.

1.1. AI uses in retail based on Systematic Literature Review

This section provides a comprehensive overview of the current research on artificial intelligence (AI) in the retail sector, derived from a systematic literature review and text mining analysis. Our approach involved a quantitative review of a broad range of scientific literature. We employed bibliometric and text-mining techniques to analyze data from articles retrieved from the Scopus database, covering the period from 2018 to 2024. This analysis helped to identify the main topics addressed within the field, characterize the leading academic journals, and outline the primary research areas discussing AI applications in retail.

1.1.1. Data Collection

In the data collection phase, we used Scopus – a leading citation database renowned for its comprehensive repository of high-quality, peer-reviewed papers (Zhu and Liu, 2020). In the retrieval process, we used the Scopus API to systematically extract the relevant publications and their metadata.

The keywords combinations we used were:

TITLE-ABS-KEY (X AND Y) AND PUBYEAR > 2017 AND PUBYEAR < 2025

Where: X=['sales', 'retail', 'e-commerce'], Y=['AI', 'artificial intelligence']. These keywords were scrutinized within titles, abstracts, author keywords, and 'topics' as delineated by the platform. To ensure the reliability of our analysis, we refined our focus exclusively to peer-reviewed articles, specifically limiting our scope to the categories of articles and reviews.

For reproducibility purposes we present the exact search query:

(TITLE-ABS-KEY ("AI") OR TITLE-ABS-KEY ("artificial intelligence")) AND (TITLE-ABS-KEY ("sales") OR TITLE-ABS-KEY ("retail") OR TITLE-ABS-KEY ("e-commerce")) AND (DOCTYPE (ar) OR DOCTYPE (re)) AND PUBYEAR > 2017 AND PUBYEAR < 2025

This search yielded a total of 1699 publications (after duplicates removal). In the analysis we used full texts of 645 articles for which we had permissions to retrieve pdfs and metadata and abstracts of the full sample.

1.1.2. Results

The final dataset includes a total of **1,604 research articles and 95 reviews** (scholarly papers summarizing the current state of research). These articles cover research from 105 different countries, as indicated by authors affiliations, demonstrating a wide geographical distribution. The total number of authors is 5532 and they represent 273 distinct institutions, and their work

is published in a total of 809 different journals. Average collaboration index (number of authors per article) is 3.42 (single author papers constitute only 13% of total) meaning that research in this area is often done in collaborations. Average citation per document is 19 which is a good score considering that we analyze recent research.

In Table 2 we present the most common keywords provided by authors to classify their research. We used top 50 keywords from which we removed the trivial ones (e.g. AI, e-commerce).

Table 2 Top author keywords

deep learning	covid-19
big data	internet of things
natural language processing	industry 4.0
chatbot	social media
data mining	innovation
blockchain	digital marketing
decision support systems	supply chain management
sentiment analysis	recommender systems
decision support system	purchase intention
digitalization	forecasting
customer experience	automation
trust	prediction
iot	personalization
explainable ai	chatgpt
marketing	service robots
customer service	internet of things (iot)
classification	data analytics
neural networks	customer satisfaction
sustainability	customer relationship management
supply chain	computer vision
digital transformation	

Source: own elaboration

In Table 3 we present the subject areas (broad disciplines) to categorize the research on AI and retail. Table 4 shows main journals in which authors publish this research.

Table 3 Top subject areas

Subject area	Number of publications
Computer Science	960
Engineering	569
Business, Management and Accounting	504
Social Sciences	312
Decision Sciences	192
Mathematics	185
Economics, Econometrics and Finance	139
Materials Science	111
Psychology	89
Arts and Humanities	83
Environmental Science	81

Source: own elaboration

Table 4 Top journals

Journal Name	Number of Publications
Sustainability	34
IEEE Access	31
Technological Forecasting and Social Change	22
Computers and Industrial Engineering	18
Expert Systems with Applications	17
Applied Sciences	17
International Journal of Information Management	16
Mobile Information Systems	15
Electronics (Switzerland)	15
Decision Support Systems	14

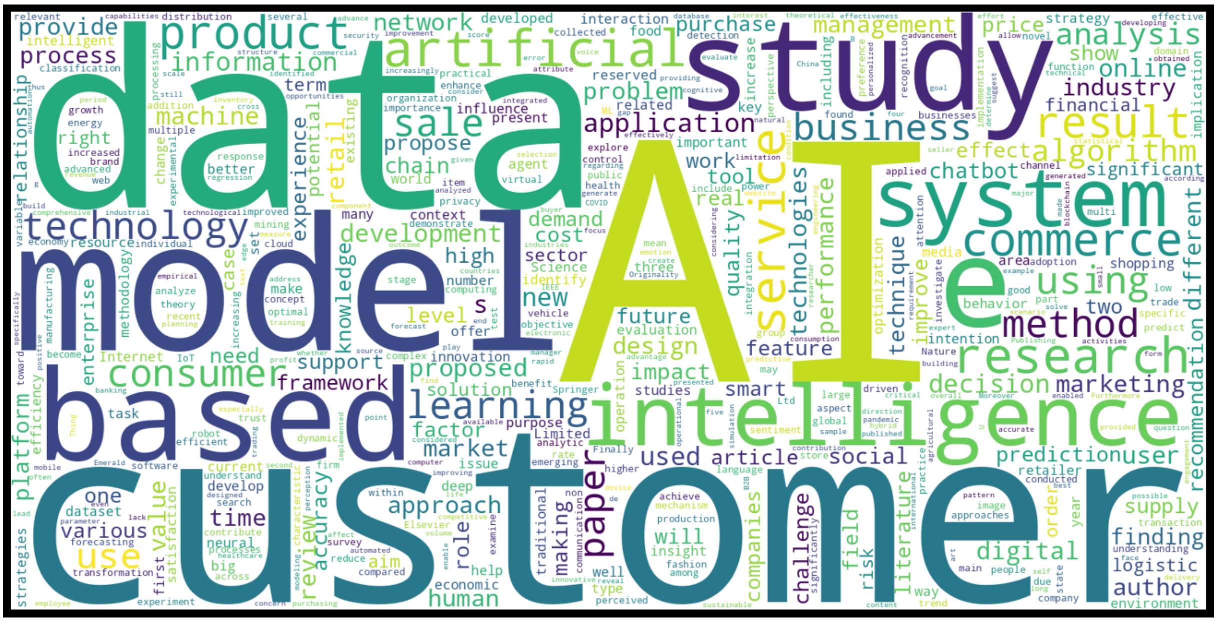
Source: own elaboration

The selected scientific articles are dominated by those from the fields listed in Table 3, i.e. computer science and engineering, followed by those from management and social sciences. Within the total pool of articles, those with characteristics similar to those of the STEM fields dominate, with fewer articles from the social sciences and humanities. It is noteworthy that the articles listed include those written in the field of environmental sciences. In terms of journals, the most important journals listed in Table 4 are Sustainability, IEEE Access and Technological Forecasting and Social Change. As in the fields, the journals are dominated by journals with a

technical focus, while journals in the social sciences and humanities play a minor role or, as in the case of Sustainability, are of low quality.

We also detailed the most common words and phrases in the article abstracts as part of our systematic analysis of the existing literature on AI in retail, resulting in Figure 2 and Table 5.

Figure 2 Wordcloud of most common terms appearing in articles' abstracts



Source: own elaboration

Table 5 Top 3-grams appearing in articles' abstracts

3-gram	Number of occurrences
decision support systems	114
natural language processing	58
internet of things	56
ant colony optimization	53
supply chain management	45
artificial intelligence decision	45
artificial intelligence technologies	44
language processing systems	36
classification of information	35
decision making decision	31
learning algorithms learning	31
algorithms learning systems	30

intelligence decision making	28
sales artificial intelligence	27
making decision support	26
support vector machines	26
algorithms machine learning	25
article artificial intelligence	25
artificial intelligence data	23
deep neural networks	23
learning algorithms machine	23
quality of service	22
language processing natural	22
optimization artificial intelligence	21
artificial intelligence commerce	21
artificial intelligence behavioral	20
customer relationship management	19
colony optimization artificial	19
machine learning algorithms	19
intelligence behavioral research	19
particle swarm optimization	19
artificial intelligence consumption	18
intelligence consumption behavior	18
artificial intelligence big	18
intelligence big data	18
human computer interaction	17
sales sentiment analysis	17
long short term	17
short term memory	17
convolutional neural network	17
public relations sales	16
5g mobile communication	16
artificial intelligence customer	16
deep learning learning	16
swarm optimization pso	16
information and communication	16
artificial intelligence electronic	16
design methodology approach	15
algorithm artificial intelligence	15
convolutional neural networks	15

Source: own elaboration

Among the top 3 grams listed in Table 5, the top 10 issues worth noting are decision support systems, natural language processing, the Internet of Things, ant colony optimization, supply chain management, artificial intelligence decision, artificial intelligence technologies, language processing systems, classification of information, and decision-making decision. The analysis shows that **the literature to date on the application of AI in retail has mainly focused on the technical aspects of applying this technology, its material considerations related to infrastructure and cloud computing, as well as the management aspects of using this type of technology.** Figure 2 presents the most common single words and Table 5 combinations of three words (so called 3-grams) used in articles' abstracts. The main interest has been limited to picking up the thread of models applied to customer areas, as the cloud with the most frequently used words might suggest.

Moreover, we employed Latent Dirichlet Allocation (LDA) using BERTopic to identify topics within the abstracts of articles focused on AI in retail. LDA is a generative statistical model that allows sets of observations to be explained by unobserved groups, effectively uncovering the hidden thematic structure in a collection of documents (Jelodar et al., 2019). BERTopic, on the other hand, leverages BERT embeddings for document representation and clustering, enhancing the interpretability and coherence of the topics discovered (Grootendorst, 2022).

By applying LDA with BERTopic, we were able to systematically organize the research articles into distinct topics, facilitating easier navigation and analysis of the literature. The resulting model has been saved in our project repository on Zenodo. This file allows researchers with basic Python skills for an organized review of research and enables browsing articles by specific topics. In Table 6 we present the topics along with the most characteristic keywords and number of articles for which the given topic is a main one. Names of topics were created using ChatGPT4o based on full lists of characteristic keywords.

Table 6 Topic modeling results

Topic Name	Keywords	Article Count
AI Chatbots and Consumer Interaction	[ai, chatbots, chatbot, consumers]	215
Product Reviews and Sentiment Analysis	[reviews, sentiment, product, analysis]	62
IoT and Cloud Computing	[iot, cloud, data, smart]	60
Recommendation Systems	[recommendation, recommender, recommendations]	55
Digital Trade and Economic Transformation	[digital, trade, countries, transformation]	49
Customer Data Mining and Behavior	[data, customer, mining, behavior]	43
Fashion Design and Image Processing	[fashion, design, image, clothing]	43
Supply Chain Decision Making	[decision, supply, chain, inventory]	39
Demand Forecasting and Sales Models	[forecasting, demand, models, sales]	37
Agricultural Practices and Poultry Farming	[poultry, farmers, agricultural, rural]	35
Service Robots and Customer Acceptance	[robots, service, robot, acceptance]	26
Customer Loyalty and Metaverse	[customer, metaverse, loyalty, tools]	25
Omnichannel Retail and AI	[retail, ai, retailers, omnichannel]	23
Industrial Supply Chain Management	[chain, supply, manufacturing, industrial]	22
Customer Churn Prediction	[churn, customer, models, prediction]	21
Smart Retail Sector	[retail, retailing, smart, sector]	19
Logistics and E-commerce Distribution	[logistics, distribution, commerce, cross]	19
Business Marketing and E-commerce Research	[commerce, marketing, business, research]	18
Financial Credit Risk and Scoring	[credit, risk, financial, scoring]	18
AI in Sales and Selling Techniques	[sales, salespeople, ai, selling]	16
Fraud Detection in Transactions	[fraud, detection, transactions, fraudulent]	15
User Models in Mobile Commerce	[user, model, trained, mobile]	10

Source: own elaboration

Among the themes detailed in the systematic literature review in Table 6, **the issue of consumer interaction with chatbots based on artificial intelligence technology emerges as a key area of focus**. This includes how consumers engage with AI-powered chatbots and the implications for customer service and satisfaction. In addition, consumer relationships extend to several other critical aspects.

Firstly, **product reviews and marketing sentiment analysis are highlighted as key issues.** This involves the use of AI to analyze consumer feedback and sentiment expressed in product reviews, helping retailers to understand consumer opinions and improve their products and services.

Secondly, **recommendation systems** are identified as another important area. AI-powered recommendation systems enhance the consumer shopping experience by suggesting products based on past purchase behavior and preferences. Consumer data mining and the analysis of consumer shopping behavior also appear as central themes in the literature. These themes explore how AI technologies can process vast amounts of consumer data to identify patterns and trends, which can then be used to tailor marketing strategies and optimize inventory management.

Structural issues related to **data infrastructure and cloud computing** also receive significant attention. These themes delve into the technological backbone required to support AI applications in retail, highlighting the importance of a robust data infrastructure and the role of cloud computing.

Finally, **supply chain management** is another key theme in the literature. The role of AI in optimizing supply chain operations, from inventory management to logistics and distribution, is explored, showing how AI can improve efficiency and reduce costs in the retail sector.

1.2. AI uses in retail based on qualitative literature review

In this section, we discuss the challenges of defining artificial intelligence in retail as presented in various literature on the subject. We also highlight how AI is defined in terms of its functions and applications in the retail industry.

1.2.1. Definitions of AI

Artificial intelligence is broadly described as the ability of a digital computer or computer-controlled robot to perform tasks typically associated with intelligent beings. The term often refers to efforts to create systems that possess human-like intellectual abilities, such as reasoning, understanding meaning, generalizing, and learning from past experience

(Gordon, 2023: 16). However, as Feher and Katona (2021) point out, artificial intelligence is understood in two general ways: in a technical way and in a socio-cultural way.

The dominant current in defining AI is of a technical nature. **Technical understanding of AI refers to a category of computational technologies that drive AI advancements**, emphasizing the STEM fields – science, technology, engineering, and mathematics – that underpin innovations like robotic automation and machine learning (Feher and Katona, 2021: 1). This approach focuses on using AI technology across various industries, with the development and application of AI serving as the ultimate goal to achieve a competitive advantage (Feher and Katona, 2021: 1). Nevertheless, as the authors point out, a second strand is also emerging in defining AI, focusing on the socio-cultural understanding of AI. The second proposed term focuses on the use of technology as a means rather than an end in itself. This category emphasizes **the incorporation of AI technology into social and cultural contexts**, considering factors such as human adaptation and ethical issues. The socio-cultural AI perspective is supported by increasing attention to public and corporate policy, cultural norms, and AI ethics, highlighting the broader implications of socio-cultural technology (Feher and Katona, 2021: 2).

To account for the social uses of AI in different contexts, including retailing contexts, we should focus on the socio-cultural strand of AI definition. When it comes to **defining AI by its social-alike characteristics**, Caluori (2023: 4-6) has formulated a set of definitional criteria:

- **Learning Ability:** learning ability is a key criterion for AI, particularly because machine learning is frequently used as a synonym for AI;
- **Human Likeness:** the resemblance to human beings is a major factor that makes AI intriguing, both in scientific and popular contexts. This criterion is the most frequently used in AI definitions, although its application varies;
- **State of Mind:** the evolution of AI can also be seen in the "state of mind" dimension understood as giving technology an intellectual state;
- **Solving Hard Problems:** the complexity of the problem which AI is able to solve is the least contentious criterion, as most definitions do not consider it essential;
- **Successful Solutions of Problems:** the criterion of successfulness shows a distribution like the "state of mind" dimension, indicating it is also contentious.

The above set of criteria for defining artificial intelligence has implications for how AI technologies are viewed in different social, cultural and economic contexts. The field of retail and studies of the application of AI in retail reflect all of the above criteria. Consider the **following definition of AI in retail** provided by Giroux et al. (2022: 1028):

> *One technology that companies (..) have started to embrace is AI, which refers to "programs, algorithms, systems and machines that demonstrate intelligence" (Shankar, 2018, p. vi) and is "manifested by machines that exhibit aspects of human*

> *intelligence" (Huang & Rust, 2018, p. 155). With its ability to accurately perform tasks and goals based on external inputs, AI is revolutionizing how companies and organizations create content, make recommendations, and interact within the store* (de Ruyter et al., 2018; Haenlein & Kaplan, 2019; Weber & Schütte, 2019)*. Robots are also promising avenues for frontline services. For the moment, robots are mainly implemented in the manufacturing and delivery of products and services (Ivanov, 2020), but we can expect their growing presence in frontline services.*

In the definition above, **AI is defined as computer programs in the broadest sense that exhibit intelligence and in this respect resemble human intelligence**. AI technologies are also defined in terms of their ability to solve problems and achieve goals, i.e. to successfully present solutions to specific problems. In the quote above, the authors also outline the potential applications of AI in retail, with a focus on content production and in-store recommendations. Moreover, various types of chatbots and virtual assistants are being used in the retail sector, capitalizing on their ability to mimic human interactions. Designers can strategically incorporate elements such as small talk, greetings, and conversational transitions to build user trust in the interface and encourage specific behaviors, including self-disclosure and persuasion (Schanke et al., 2021: 6). However, the use of chatbots in customer interactions brings with it additional dilemmas – which are discussed more in the section on co-creation workshops. As described by Giroux et al. (2022: 1030), the research highlights that the attribution of mental capacities to technologies significantly influences moral judgements and notions of responsibility, but they caution against direct comparisons with human-to-human interactions, ultimately emphasizing the peculiarities of the human mind and the challenges of applying human norms and moral responses to machines.

It is important to note that we are not dealing with a single artificial intelligence, but many different ones that manifest themselves in specific customer interaction tools. Pantano and Scarpi (2022: 586) presented the following **typology of forms of artificial intelligence used in customer interaction**:

- **Mechanical or operational intelligence:** the ability to learn and perform basic and repetitive tasks.
- **Thinking:** the ability to perform analytical and intuitive tasks (reasoning-based intelligence).
- **Emotional or affective:** the ability to recognize human emotions and adapt behavior accordingly.
- **Self-organizing cooperation:** the ability to coordinate with other AI to create a self-managed, autonomous, collaborative network (distributed intelligence).
- **Social cognition:** the ability to process, store, and apply information about others and behave accordingly.

- **Instance processing:** the ability to select, classify, and streamline large-scale instances (such as risks, images, or any other entity).

1.2.2. Classification of AI functions in the Retail Sector

Various forms of artificial intelligence are increasingly being used in the retail sector. Researchers highlight that the retail sector is undergoing a significant transformation with the application of these various AI technologies. **AI is profoundly transforming the retail sector, revolutionizing business strategies and the variety of activities from the implementation of key performance indicators to the management of the supply chain and the design of the interaction with consumers and employees within the company.** Major global companies in retail are investing heavily in these innovations to redefine the retail experience (Giroux et al.: 1027, 2022; Kaplan, 2020; Kats, 2020). At the same time, rapid advances in robotics and AI are ushering in new digitally centric business models that promise minimal staffing and maximum efficiency, but also pose significant risks and challenges, particularly in terms of job displacement (Malenkov et al., 2021: 18). These developments underscore the urgent need for proactive management of digitization efforts to balance competitiveness with socio-economic impacts, addressing the potential rise in global unemployment (Malenkov et al., 2021: 18). It is also directly related to the preparation and development of a range of skills that will be required in the retail sector.

Within the literature reviewed on AI and retailing, the anticipated functions of AI in specific areas of business activity played a crucial role, as summarized in the following table.

Table 7 AI Functions and Technologies in the Retail Sector

AI Functions in Retail	Technologies and means applied	Authors
Supporting business decision-making	• Predictive analytics by visualizing key performance indicators • Design plans based on future organizational conditions and its effects on the requirement to alter digital transformations	Kitsios and Kamariotou, 2021; Liu, 2013; Pappas et al., 2018
Automating inventory management and supply chains	• Insight engines of projected demand • Automated visual tagging of products based on deep learning	Oosthuizen et al., 2021
Improving customer relationship	• Automated recommendations • Personalized offers based on machine learning algorithms • Chatbots assistants	Kumar et al., 2019; Pantano and Scarpi, 2022; Silva and Bonetti, 2021; Xiao and Kumar, 2021
Tracking customer behaviors in offline stores	• Object detection • Customer heat map analytics and human trajectory tracking • Facial and emotion recognition • Detecting shop-lifting behavior	Gupta and Ramachandran, 2021; Nguyen et al., 2022
Automating job recruitment	• CV screening mechanisms • Psychometric analytics of candidates	Bursell and Roumbanis, 2024; Köchling and Wehner, 2020

Source: own elaboration

As detailed in Table 7, AI is playing a central role in the retail sector through a variety of current and emerging capabilities, influencing both strategic business design and workforce management, as well as the optimization of distribution and sales processes. Key among these applications is its support for managerial decision making, evident in the use of predictive analytics to measure key performance indicators and shape organizational strategies. AI is also significantly automating supply chain management and product warehousing, using insight engines for demand forecasting and automated visual tagging of physical inventory. Improving customer relationships is another critical area, involving advanced automation in recommendation systems, personalized offers driven by deep learning algorithms, and 24/7 customer interaction facilitated by chatbots and virtual assistants. Beyond digital applications, AI is extending into traditional retail environments and surveillance systems, enabling the tracking of consumer behavior within physical stores – including movement patterns and emotional responses to products – as well as the monitoring and prevention of theft. The literature also highlights the role of AI in recruitment processes, assisting with CV screening

and conducting psychometric analysis of potential candidates, underscoring its broad and transformative impact on various facets of retail operations.

1.2.3. Applications of AI technologies across the value chain

The literature review, encompassing both systematic and qualitative approaches, revealed significant conceptual complexity, which is not unexpected given the nascent stage of AI applications in corporate settings. The review and the introduction of generative AI underscored the importance of **distinguishing between various AI technologies** rather than treating AI as a singular, undifferentiated entity.

In this section, we propose a clarifying approach to the functions of AI technologies in retail companies from the perspective of different stages of their value chain, from the design process all the way to post-sale customer support and analytics, inspired by the categorization of Oosthuizen et. al. (2021). They propose that AI can be applied in each of the four main areas of company operation, namely:

A. ***Knowledge and insight management:*** *AI technologies refer to the ability to provide insights by managing, sharing, using, creating and processing information.*
B. ***Customer engagement:*** *AI technologies enable retailers to build relationships with their customers.*
C. ***Inventory management:*** *AI technologies refer to those that assist in the process of balancing demand to supply over large assortments to meet customer needs and financial objectives.*
D. ***Operations optimization:*** *AI technologies help retailers operate effectively and efficiently by minimizing costs and maximizing operational capabilities.*

The areas are not mutually exclusive and different processes intersect in the course of the company's activities, e.g. a valuable insight can prove to be the key to optimizing various operations, especially when real-time decision making is desired. The same applies to AI technologies themselves. There are many different and sometimes conflicting categorizations of AI technologies; the one presented here is only one of them. Additionally, some of them, such as Machine Learning, can be considered more basic, determining the effective functioning of, for example, a chatbot or an insight engine. Different tools are integrated to develop advanced solutions for context-specific tasks.

- Machine Learning
- Deep learning
- Augmented intelligence

- Insight engines
- Natural language processing
- Computer vision
- Speech recognition
- Chatbots
- Edge AI
- Robotic process automation
- Generative AI

The following summary provides an overview of these main AI technologies within the four major areas of a retail enterprise value chain.

1.2.3.1. Machine Learning

Machine Learning (ML) is "a branch of computational statistics where a system learns and modifies algorithms from input data without the need for explicit instruction from a human" (OECD, 2021). ML algorithms are developed through:

- **supervised learning** - an algorithm is trained on a labeled dataset in which input data are matched with corresponding output labels. It enables the resulting model to perform classifications and predictions through generalization.
- **unsupervised learning** - an algorithm is trained on an unlabeled dataset to identify patterns, relationships and structures in the data. A finished model is able to cluster the data, reduce its dimensionality and detect anomalies.
- **reinforcement learning** - an algorithm is interacting with a dynamic environment and, through a reward system, learns to develop decision-making strategies that enable the achievement of long-term objectives.

A. Knowledge and insight management

Machine learning enables a company to analyze large volumes of data in search for trends, patterns and anomalies that would be difficult to track manually. ML algorithms are able to organize and process data from various sources, ranging from company's documentation, operations' details, to behavioral data of customers and employees alike. Despite accumulating diverse information, Machine Learning can be developed to become sensitive to the context of analyzed pieces of data. As a result, ML-based tools produce knowledge that can be used for real-time decision making as well as comprehensive strategies for upcoming challenges and opportunities. Prediction models enable automation of many processes in the firm, leading to cost reduction and

freeing the labor force. Any implemented solution can provide more data to further train the algorithms and improve their performance.

B. Customer engagement

The data gathered through a Machine Learning model provides a comprehensive view of a single customer, including demographic details, geolocation, behavioral patterns of interactions and observed personality traits. Clients can be segmented into groups that will then be targeted by specific marketing campaigns. ML-based CRM (Customer Relationships Management) is, however, not only based on regular measurements and long-term predictions, but on immediate reactions motivated by the data insights. A model is able to develop personalized offers and promotions in real time, engaging the client as he/she interacts with the company's content. Practices of dynamic customer engagement include market basket analysis with frequently related entities, cross-selling as well as product matching for alternative recommendations and proper classification of newly uploaded offers. On the other hand, churn prediction enables companies to retain customers that are likely to be lost in the near future.

C. Inventory management

Extensive data, ranging from customers' past activities, detected market trends and purchase patterns, let the ML models forecast demand and predict the adequate inventory maintenance. That reduces the risk of both overstocking and stock-outs, minimizing cost, labor and adjusting company's resources to market fluctuations.

D. Operations optimisation

Well-maintained inventory levels along with other operations such as production and logistics allow for optimizing the supply chain of a company. Based on the identified demand, trends and bottlenecks, an ML model can help adjusting production schedules and resource allocation. When an enterprise uses or offers functional equipment, it can implement ML-based monitoring to perform predictive maintenance and report when to repair machines before they stop working. Both online and in-store operations can be better secured, when an algorithm is implemented to detect anomalies such as fraud, suspicious behavior and transactions. When it comes to marketing, the system can calculate the scope and direction of discount offers in order to maximize margin contributions from conversions and, in result, increase a company's profit.

1.2.3.2. Deep learning

Deep learning is "a subfield of machine learning, where large sets of 'neural network' techniques are used to replicate how a human brain processes information" (OECD, 2021). Artificial neural networks enable the processing of large datasets in search for intricate patterns between many feature-differentiated layers of data. Deep learning, in which case training is to a greater extent

automated, equips the finished model with abilities to identify much more extensive and abstract data structures and perform complex tasks based on its analyses.

A. Knowledge and insight management

Deep learning allows for processing of much larger amounts of unstructured data. Without the need for human intervention, it detects patterns that were not pre-defined by the programmers. Due to that, the analyses can be adjusted in real time and become very sensitive to the specific context of each task.

B. Customer engagement

Deep learning algorithms cluster and organize data from the point of view of every particular customer. It conducts dynamic scoring of an offer based on unique behaviors and preferences of a given client. That results in hyper-personalisation of the recommendation that is evolving in line with any changes to the criteria.

C. Operations optimisation

Both in the case of inventory and company's operations as a whole, deep learning enhances the possibilities of traditional ML algorithms. Through dynamic processing and identifying more complex data structures, the use of neural networks allows for more accurate predictions concerning supply chain management, pricing and promotions.

1.2.3.3. Augmented intelligence

Augmented intelligence is "a design pattern for a human-centered partnership model of people and artificial intelligence (AI) working together to enhance cognitive performance, including learning, decision making and new experiences" (Gartner, 2024a). Augmented intelligence provides support for humans to complement and optimize the use of their intellectual and technical abilities. It generates solutions based on cooperation with people rather than replacement of human labor.

A. Knowledge and insights management

Company's employees can use the help of augmented intelligence to structure and monitor data. This kind of tool provides real-time feedback, warning the team about anomalies, highlighting patterns and suggesting optimal solutions for faster and informed decision making.

B. Customer engagement

When interacting with a company's sales or communication channels, customers may be willing to benefit from optimized experience, but at the same time distanced from the idea of being guided by fully automated services. Augmented intelligence offers help through problem-solving and personalized recommendations without depriving a client of the sense of control over decision-making. It can contextualize a person's intentions and balance between the sufficiency of chatbots and the need for human support. Whenever suitable and desired, augmented intelligence performs complex analytical as well as the unengaging repetitive tasks, freeing up human labor on both sides of the shopping experience.

C. Inventory management

Augmented intelligence support can help organize an efficient supply chain. It enables the employees to easily access the detailed information on predicted demand and how the inventory maintenance, as well as other supply-related processes, can be adjusted to meet it in the optimal way. It is able to oversee the complex data and provide context-specific reports without independently interfering with the company's operations.

D. Operations optimisation

With augmented intelligence systems aid, a company's productivity is not as limited by its labor force capabilities. It may be easier for the enterprise to scale up its operations, when some of the activities are handled through intelligent solutions. Lower-ranked employees can become responsible for performing more advanced tasks without the need of extensive supervision, which in turn may contribute to increased trust inside the institution.

1.2.3.4. Insight engines

Insight engines "apply relevancy methods to describe, discover, organize and analyze data. This allows existing or synthesized information to be delivered proactively or interactively, and in the context of digital workers, customers or constituents at timely business moments. Products in this market use connectors to crawl and index content from multiple sources. They index the full range of enterprise content, from unstructured content such as word processor and video files through to structured content, such as spreadsheet files and database records." (Gartner, 2024c). Insight engines, backed by algorithms and natural language processing, are able to

process more nuanced and diverse data than traditional search engines, identifying relevant information, patterns and relationships for a real-time decision making.

A. Knowledge and insight management

Comprising knowledge based on data of different types and origins, insight engines provide relevant real-time information to respond to current trends, gaps and challenges. They can search through the information to check their regulatory compliance and detect possible anomalies. Insights from scientific, technical, legal and market data may efficiently advance a company's R&D (research and development). When all the relevant data is organized and appropriately distributed throughout the company, the decision-makers are able to collaborate and develop strategies based on the shared knowledge. On the other hand, insight engines' security measures include controlling access and encrypting sensitive supply chain information.

B. Customer engagement

Insight engines can help companies meet the needs and possibilities of their customers in a proactive manner. Analyzing extensive data on customers' characteristics and behavior patterns, engines can provide real-time solutions to delivering personalized content at the right moment. Tools powered by insight engines may improve the experience of customers, allowing for efficient self-service and faster order fulfillment.

C. Inventory management

Apart from providing data security, insight engines can process diverse information in real time and detect disruptions at different stages of the supply chain. Together with insights on the market fluctuations and customers' activity patterns, this can help the company to update its strategies, optimize stock organization, minimize lead time and quickly adapt to encountered difficulties.

D. Operations optimisation

Combined data of a company's operations, its consumers, competitors and the market may become a foundation for major strategies as well as specific problem-solving. Inefficiencies and opportunities can be detected and analyzed to create solutions for streamlined processes. Optimizing resource use not only contributes to cost reduction and overall agility, but also helps the company improve the sustainability of its practices.

1.2.3.5. Natural language processing

Natural language processing (NLP) "enables computers to understand, interpret, generate, and transform text. Current state-of-the-art models, such as OpenAI's GPT-4 and Google's Gemini, are able to generate fluent and coherent prose and display high levels of language understanding ability" (Maslej et al., 2024, p. 85). NLP allows for the communication between machines and humans, with AI systems interpreting natural language input and generating data accessible to people. Its analytical capabilities include classification of symbols, words and phrases, but also identification of underlying context, intent or emotion of the text's author.

A. Knowledge and insight management

NLP enables human agents to easily access knowledge with commands and queries formulated in natural language. With the help of speech recognition and optical character recognition tools (OCR), NLP helps analyze any kind of verbal data. It sorts unstructured bits of information into organized frameworks and can provide visualizations or summaries of complex datasets. Backed by ML or deep learning algorithms, NLP tools are able to identify relevant information in the data and the relationships between them. For example, named entity recognition (NER) is a technology used for finding specific elements in the text, such as targeted topics, proper names or values.

B. Customer engagement

Through natural language processing, it becomes easier to identify actual and potential customers' needs. It can analyze not only the lexical construction of the search phrases, reviews or messages, but also the meaning of the words and phrases in context. Due to this, NLP helps recognise the intentions of users, which results in a more accurate depiction of the products or services that may be of their interest. Further processing of the semantic content of texts allows for sentiment analysis. With ML-based classification, the statements are categorized by emotional features and attributed positive, negative or neutral value. That, in turn, provides more comprehensive feedback information and contributes to dynamic and personalized interaction with customers. Well-conducted natural language analysis also allows the automated support system to decide which queries or calls are suitable for chatbot service and which demand a human-consultant's intervention.

C. Operations optimisation

Semantic search is also beneficial for company's employees. With NLP technology it becomes easier to navigate through documentation or website's content. Along with

summary features this can speed up analytical tasks. When it comes to marketing, natural language processing tools prove to be beneficial in reviewing content and providing suggestions for optimized readability, tone, grammar as well as SEO-compliance. Finally, NLP enables content generation. Large language models contain enough data for the generative AI to produce texts that in many cases match the quality and effectiveness of human writing. Enhancing abilities of human agents in creating and reviewing content to meet company's policies and SEO strategies reduces the need for a costly labor force and can significantly improve marketing performance.

1.2.3.6. Computer vision

Computer vision "allows machines to understand images and videos and create realistic visuals from textual prompts or other inputs" (Maslej et al., 2024, p. 96). Backed by ML algorithms and deep neural networks, computer vision is used for tasks such as facial and object recognition, image classification, tagging, semantic segmentation and even image generation.

A. Knowledge and insight management

Through this technology, visual representations of a company's resources, including documentation and real-life processes, can be captured, attributed meaning and analyzed for improved, standardized performance. Connected to sensors in stores or warehouses, computer vision detects patterns and anomalies, providing a comprehensive view of a company's operations, highlighting gaps in efficiency or security.

B. Customer engagement

Computer vision enhances customer experience in new ways, allowing for closer and better informed contact with the virtual representations of products. A person can take or copy a picture of a desired object and upload it to a visual search tool. Image-based queries can be efficient when not enough textual information is initially provided, either at a store or in ordinary life situations. When combined with augmented reality applications or extensions, computer vision makes it possible to visualize a product in a real-life environment, e.g. a person's room, or perform a virtual try-on of a piece of clothing/equipment.

C. Inventory management

Computer vision enables constantly updated monitoring of the inventory. It analyzes stock levels and provides information on their compliance with predicted demand or

delivery schedules. When applied to store shelves, this technology can help optimize the placement of products, so that they are exposed in the most efficient way.

D. Operations optimisation

In-store operations can be tracked to improve the shopping experience and generate more sales. Heat maps and traffic patterns show the areas where customers' presence and attention may be increased, which helps with planning an optimal organization of stores. Computer vision is also used to track suspicious behavior or fraud, both online and offline. Security appliances range from detection of incorrect scanning, counterfeit products, to identifying fake reviews. Object recognition and image classification can become effective tools for a website's content moderation.

1.2.3.7. Speech recognition

Speech recognition tools "interpret human speech and translate it into text or commands. Primary applications are self-service and call routing for contact center applications; converting speech to text for desktop text entry, form filling or voice mail transcription; and user interface control and content navigation for use on mobile devices, PCs and in-car systems. Control of consumer appliances (such as TVs) and toys is also commercially available but not widely used" (Gartner, 2024e).

A. Knowledge and insight management

Speech recognition, when implemented into any communication system within the company, can collect and analyze metadata about interactions. Whether it is a conversation involving an employee or a customer, the system is able to distinguish patterns of activity (pauses, response-time) as well as emotional tones of different statements. An advanced type of this technology - voice recognition - allows for identification of a person taking part in the talk.

B. Customer engagement

Insights into clients' behavior and emotions may prove beneficial for optimizing their experience. A customer can dictate his/her demands or queries and engage in natural-language conversations with minimized loss of time and attention. Data gathered through these interactions enables better personalisation of an offer and automated, easy-to-scale-up support system. In parallel with traditional search engine query processes, companies can improve their answer engine optimisation (AEO) and provide an alternative software for shopping activities. Speech recognition tools reduce

the need for a client's technical abilities and efforts to search, order and reorder desired products.

C. Inventory management

Voice picking lets the employees control the supply without time-consuming manual inputs. Through a headset, a warehouse worker can give commands and receive guidance to easily navigate through the stock and be aware of its levels and precise locations.

D. Operations optimisation

Voice commands provide an additional channel of communication, as well as an easy access to company's operational data. Identified gaps and slowdowns in interactions may suggest solutions for speeding up the workflow. Since any recorded conversation can be transcribed in real time, the creation of up-to-date documentation becomes automated and full of detail.

1.2.3.8. Chatbots

Chatbots are an example of "a domain-specific conversational interface that uses an app, messaging platform, social network or chat solution for its conversations. Chatbots vary in sophistication, from simple, decision-tree-based marketing stunts, to implementations built on feature-rich platforms. They are always narrow in scope. A chatbot can be text- or voice-based, or a combination of both" (Gartner, 2024b).

A. Knowledge and insight management

Engaging in interactions with customers, chatbots may seamlessly introduce surveys to collect feedback. Along with gathered metadata, this provides real-time information on issues and preferences, which makes it easier to develop relevant sales and support strategies.

B. Customer engagement

The main advantage of chatbots lies in their availability. They offer non-stop customer assistance, managing multiple interactions simultaneously. Because automated support outruns the capabilities of employees working within limited hours, it enables easier scaling-up of the operations and, what is more, improves customer experience. Real-time analysis of clients' input and behavior may result in more personalized and

contextual offers. Chatbots are able to suggest instant follow-ups directed at a potential buyer's preferences and needs.

C. Operations optimisation

Successful implementation of automated services and collection of extensive customer data could contribute to increased lead generation, clients' attachment to the brand and, as a result, higher conversion rates. Chatbots release the human employees from performing repetitive tasks related to customer support and may lead to optimized order processes. As for the tasks still performed manually by a company's team, bots can be just as useful to assist workers in resolving issues and searching through the data.

1.2.3.9. Edge artificial intelligence

Edge artificial intelligence (edge AI) is "the implementation of artificial intelligence in an edge computing environment, which allows computations to be done close to where data is actually collected, rather than at a centralized cloud computing facility or an offsite data center. Edge AI lets devices make smarter decisions faster, without connecting to the cloud or offsite data centers" (Red Hat, 2024).

A. Knowledge and insight management

Edge AI speeds up the conversion of knowledge into decision-making. Smart devices process updated information on the spot without the need of sending them to data centers, which minimizes latency of resulting operations. Keeping the data within the equipment or a local server, edge AI ensures privacy of sensitive information and allows for immediate responses to critical issues.

B. Customer engagement

Fast processing of edge devices improves the efficiency of textual, visual and voice searches. Sensors gather information on customers' behavior and enable real-time personalisation of offers.

C. Inventory management

Edge AI keeps the inventory information up to date and in accordance with supply chain optimisation analytics. Applied in a warehouse or a store, smart shelves monitor the

products for their quantity, need to restock and abnormal activities. This ensures the right level of supply and proactive prevention of unnecessary loss.

D. Operations optimisation

Edge computation distributes the impact of extensive processing throughout smart devices. This not only reduces latency but also cuts the costs of transferring all the data to the cloud. It may become easier for a company to scale up, when additional computing tasks are performed within the installed devices. With the help of edge AI, in-store operations are also better secured. Radio-frequency identification (RFID) security tags prevent the products from being secretly taken through the security gates, whereas automated points of sale (POS) report on any mis-scans or ticket-switching almost in real-time.

1.2.3.10. Robotic process automation

Robotic process automation (RPA) can be understood as "the software to automate tasks within business and IT processes via software scripts that emulate human interaction with the application user interface. RPA enables a manual task to be recorded or programmed into a software script, which users can develop by programming, or by using the RPA platform's low-code and no-code graphical user interfaces. This script can then be deployed and executed into different runtimes. The runtime executable of the deployed script is referred to as a bot, or robot" (Gartner, 2024d).

A. Knowledge and insight management

RPA enables automating complex data-related tasks, including their collection from various sources, cleansing, categorisation and comparisons. The technology can be set to perform these actions regularly and provide updated reports for quick problem solving, strategy planning and decision making. Automated analysis involves real-time data and predictions to generate solutions for optimized pricing, marketing campaigns, new products, customer service or operations' workflow.

B. Customer engagement

Implemented into bots, RPA enables constant interaction with clients and generating immediate responses to simple queries. Automating order tracking provides customers with updates on every step that leads from the purchase to completed delivery. The feedback can be also collected automatically and return procedures - carried out without the delay. Gathered data on clients' experiences, past activities and behavior is

easily transferred between CRM and marketing systems to relevantly segment the target groups and deliver personalized content for repeated purchases.

C. **Inventory management**

With extensive data on supply chain actual and predicted dynamics, RPA automates planning and streamlines communication between different members of inventory and fulfillment systems. Regular tracking and reporting keeps the operating teams always up to date with stock information and ready for immediate response to encountered problems and opportunities.

D. **Operations optimisation**

RPA can handle mundane manual operations with better accuracy and in shorter time. It can be assigned with various accounting, recordkeeping and invoice processing tasks and ensure their organization, compliance and security. RPA systems are used to keep information up to date, harmonize operations of a company's sectors and develop dynamic solutions for pricing, order fulfillment and marketing strategies. Along with extensive customer data, RPA handles information on employees and automatically controls workforce distribution with scheduling and payroll insights.

1.2.3.11. Generative AI

Generative AI is a kind of artificial intelligence technology based on machine learning. It differs from other kinds of AI in its ability to create new data objects based on its training dataset rather than making predictions concerning correlations between data in its training dataset. This technology leverages neural networks and deep learning to generate content, such as text, images, and even complex data sets, making it highly versatile and innovative.

Introduced in 2022, companies are still experimenting with its potential. A more specific analysis of the impact of generative AI on the retail sector is lacking in the literature we reviewed. However, during interviews, workshops, and data collection for use cases, we confirmed that some companies are already using it to their advantage (see case 3.12). Current applications include personalized marketing campaigns, dynamic pricing strategies, and automated content creation for websites and social media.

Generative AI, such as ChatGPT, has the potential to enhance four main areas of company operations:

A. **Knowledge and Insight Management**: Generative AI can process and synthesize vast amounts of information, providing valuable insights and facilitating knowledge sharing

and creation. For example, it can summarize large datasets and generate comprehensive reports that help businesses make informed decisions.

B. **Customer Engagement:** Generative AI can enhance customer relationships by offering personalized responses, handling inquiries, and providing 24/7 support. It can simulate human-like conversations, improving customer satisfaction and loyalty through more interactive and responsive communication channels.

C. **Inventory Management**: Generative AI can analyze sales data and trends to predict demand, assisting in balancing supply and optimizing stock levels. This helps retailers maintain appropriate inventory levels, reducing waste and improving availability of products.

D. **Operations Optimization**: Generative AI can automate routine tasks, generate reports, and provide decision support, helping to minimize costs and maximize operational efficiency. It can streamline workflows, optimize resource allocation, and enhance overall productivity.

Despite its promising potential, implementing generative AI comes with challenges and ethical considerations. These include data privacy concerns, the need for significant computational resources, and potential biases in AI-generated content. Addressing these challenges is crucial for leveraging the full benefits of generative AI while ensuring ethical and responsible use.

1.2.3.12. Summary

Table 8 summarizes main uses of each of the described AI technologies in relation to the value chain in retail companies.

Table 8 Main uses of AI technologies in 4 retail areas

Technology	Main uses in retail value chain (Knowledge and insight management, Customer engagement, Inventory management, Operations optimisation)
Machine Learning	Data classification, analysis and predictions, data security Customer segmentation and personalisation Matching stock levels with demand forecasts Resource allocation, market trends, fraud detection
Deep learning	Context-specific data patterns, real-time analysis Dynamic marketing, hyper-personalisation
Augmented intelligence	Data monitoring and exploration, problem-solving Self-service Inventory reports and suggestions Employee support

Insight engines	Multisource data analysis, data security Self-service, dynamic personalisation Data monitoring, issue detection
Natural language processing	Textual data analysis and summarisation, NER Semantic search, sentiment analysis Data navigation, text optimisation, content generation
Computer vision	OCR, operations monitoring Image search, AR and VR try-ons Stock levels and placement Store traffic, fraud detection, content moderation
Speech recognition	Conversational metadata, transcription Voice search, personalized and automated support Voice picking, inventory navigation Automated documentation, communication
Chatbots	Data collection 24/7 support, lead generation, self-service Repetitive tasks, employee support
Edge AI	Fast processing, data security Faster searching, behavioral data Smart shelves, stock monitoring Cheaper transferring, distributed computing, RFID, POS
Robotic process automation	Real-time data management, distribution and reporting Fast responding, order tracking and management, customer data processing Supply chain tracking and reporting Repetitive tasks, recordkeeping, operations optimisation
Gen AI	More efficient stock management and supply chain optimization Smoother and more personalized customer relations (more natural communication through chatbots) Faster data analytics Automated content creation (e.g. for company website or in the process of product design)

Source: own elaboration based on classification by Oosthuizen et. al. (2020), with addition of genAI.

1.3. AI functions in retail according to the retail sector stakeholders

In this section we present the perspective of the retail sector stakeholders on possible applications of AI technologies in the retail companies, collected during the co-creation workshops.

During the co-creation workshop, participants shared their insights and predictions on how artificial intelligence (AI) might be implemented in the operations of micro, small and medium-sized enterprises (MSMEs) within the retail sector. Their insights highlight the potential for AI to transform retail operations, making them more efficient, customer-centric, and sustainable.

They identified four primary functions of AI in retail. Firstly, predictive function: AI can enhance supply chain and sales management by predicting demand, optimizing inventory levels, and forecasting sales trends. This predictive capability helps MSMEs anticipate market needs and adjust their strategies accordingly. Secondly, optimization of product storage and sustainability: AI can optimize the storage of products by analyzing patterns and suggesting the most efficient ways to organize and manage inventory. It can also contribute to process sustainability by identifying areas where resources can be used more efficiently, and waste can be reduced. Thirdly, automation of customer relationships and employee activities: AI can automate various aspects of customer relationship management (CRM), including personalized marketing, customer service interactions, and managing customer feedback. Additionally, AI can streamline routine tasks performed by certain types of employees, thereby increasing efficiency, and allowing staff to focus on more complex activities. Fourthly, support in "good service" delivery: AI is viewed as a valuable tool for enhancing service delivery, particularly in communication and customer support. It can provide real-time assistance, handle inquiries, and offer solutions to common problems, thereby improving the overall customer experience.

The four main themes – prediction, optimization, automation, and good service – that emerged from the workshop and the data analysis are discussed below.

1.3.1. Prediction

Workshop participants highlighted that a core function of artificial intelligence is its predictive capabilities, particularly for supply chain management, which directly links to the ability to respond to changing customer needs. Prediction thus applies both to the management of tangible products and to responses in the sales arena. This point was emphasized by one of the workshop participants from Germany:

> *I think AI can make it easier for all of the employees because they can just look at the data and do some prognosis for the amount, for the time when it's needed, or something like this, based on the experience before. I think we know all that when strawberry season is then we need more strawberries in the shop. Just based on the given data, some prognosis. So, it will be a little bit easier, I think.* (Workshop_Germany_1)

As a participant in the German workshop pointed out, artificial intelligence can significantly support staff in managing product orders, particularly through its advanced analytical capabilities and sophisticated data handling. For example, the participant considers the ordering of strawberries during the strawberry purchasing season. The participant highlighted the importance of AI's ability to analyze past data to draw informed conclusions and make accurate forecasts. By leveraging historical data on strawberry sales and purchasing patterns, AI can predict demand, optimize order quantities, and ensure timely restocking.

This predictive power helps businesses respond more effectively to customer needs, reduce waste, and improve overall efficiency in inventory management. However, what emerged most strongly from the workshop was the ability to go beyond analyzing historical data to predicting entirely new trends. For example, AI can use social media data to respond to the emerging behaviors of potential customers.

The predictive capabilities of AI in the retail sector enable businesses to effectively respond to customer demand and manage their supply chains. This function is crucial for addressing both logistical challenges and direct sales issues. By accurately forecasting demand, AI helps retailers optimize inventory levels, streamline logistics, and ensure that products are available when and where customers need them. Additionally, it assists in adjusting sales strategies to align with anticipated market trends, enhancing the overall efficiency and responsiveness of retail operations.

1.3.2. Optimization

Prediction leads directly to the other side of the process, optimizing the supply chain, also in terms of environmental and sustainability standards. Participants in the co-creation workshop from Poland presented how the issue of anticipating purchasing trends is a logistical dilemma for small and medium-sized enterprises:

> ***P1:*** *You have to be careful... In other words, stay ahead of trends, right? So ordering some products for the warehouse and optimizing them so that the artificial intelligence also suggests what has been sitting in the warehouse for too long, for example. So that it allows us to rotate the warehouse in the right way, yes? So that the goods come off, rotate. In your case with T-shirts, I don't know, some old lines so that they go down, some promotions, and so that the artificial intelligence suggests buying more than, say, new ones.*

> ***P2****: So that there is sufficient stock in each of these distribution companies. This is a perennial problem, and the first thing that was done was to create some programs to help*

people generate orders and keep an eye on that stock. Especially when it comes to non-food items, well, it's a slightly different problem than when someone sells food, isn't it?

P1: *Because you have expiry dates and so on and everything that goes with that, the FIFO principle and keeping an eye on everything. So, well, this is where I think artificial intelligence has a very big area to be used by artificial intelligence that can analyze all of that and keep an eye on trends. And there are so many factors that influence proper ordering and stocking that, well, artificial intelligence should be very applicable here.* (Workshop_Poland_1)

During this workshop, two participants discuss the benefits of artificial intelligence (AI) in inventory and warehouse management. P1 highlights the need to stay ahead of trends, suggesting AI can optimize stock rotation by identifying items that have been stored for too long and recommending promotions for older products, while also advising on the purchase of new stock. P2 expands on this by noting the challenge of maintaining adequate stock levels across distribution companies, particularly distinguishing between non-food and food items due to the latter's need for managing expiration dates. They both agree that AI's advanced analytical capabilities can significantly improve order generation, stock monitoring, and overall inventory management, ensuring efficiency and responsiveness to market demands.

Anticipating trends poses significant logistical challenges, particularly regarding product storage and coordination with third-party distribution companies. Workshop participants recognized that artificial intelligence is instrumental in optimizing warehousing and sales processes by integrating sales data analytics with logistics information. For perishable products like food, AI can account for additional variables such as expiration dates and adopt sales methods like FIFO (First In, First Out). By doing so, AI enhances inventory management, ensuring products are stored and handled efficiently to minimize waste and meet customer demand promptly.

However, an important element of optimization on the part of AI in retail is the alignment of small and medium-sized enterprises with sustainability and environmental standards, according to workshop participant from Italy:

I always say that unfortunately all the companies have to deal with the sustainability issues and because it's a lot of work for companies now, but companies have to deal with sustainability. And most of the sustainability assessments also ask for the digitalization level of the companies. So companies, If they want to survive in the future, will have to update their knowledge and their internal and external processes in a sustainable way. And these sustainability assessments ask for digitalization, for innovation processes, so companies will have to work on it. (Workshop_Italy_2)

During the co-creation workshop, participants expressed uncertainty about how to ensure compliance with environmental standards, particularly concerning sustainability and the carbon footprint of products. They recognized this as a crucial variable in supply chain management and envisioned that AI could support sustainability efforts for medium and small businesses by

leveraging large datasets on sales, inventory, and related factors. However, the discussions often revolved around the anticipated future uses of AI and how it might be applied for sustainability by larger companies in the retail sector. This highlights a significant area for innovation, presenting an opportunity for small and medium-sized retailers to harness AI for enhancing their sustainability practices. By integrating AI, these businesses could better manage their environmental impact, optimize resource use, and comply with evolving sustainability standards, thus contributing to a greener retail industry.

As one expert, the CEO of a Polish company, points out in an interview, optimization has a knock-on effect on the direct costs of doing business:

> *[We should] show what entrepreneurs like the most, i.e. numbers. What really appeals to us is how I can save the two greatest capitals we have, i.e. time and money. If we reach these people through these two indicators, I think there is a chance that we will somehow promote it more.* (Int_Exp_Poland-9)

The optimization and AI capabilities that facilitate optimization have a significant impact on two key metrics in business operations: the time required to conduct business activities and the associated financial costs. The application of AI in business operations has the potential to streamline processes and automate tasks, thereby reducing the time spent on both routine and complex tasks. This, in turn, can result in a more efficient use of resources. Concurrently, these advancements diminish operational costs by reducing the occurrence of errors, enhancing the precision of decision-making, and reducing the necessity for extensive manual labor. Consequently, the incorporation of AI into optimization processes is of paramount importance in enhancing both temporal efficiency and financial performance in business environments.

Artificial intelligence in retail, according to workshop participants, can be used to optimize supply chain processes, including responding to environmental and sustainability standards, to make better and more efficient use of available resources, while not losing sight of trends and the needs of potential consumers.

1.3.3. Automation

AI in retail extends beyond supply chain and product management; it also plays a crucial role in automating customer support and streamlining employee tasks. Automating these two areas represents significant advancements in leveraging AI within the retail sector.

Workshop participants indicated that AI is an enabling tool to automate certain activities, including customer support and after-sales care, but importantly, participants also identified the conditions necessary for automation, as discussed by a workshop participant from Italy:

> *I think that there are two good applications, very significant from this point of view in terms of immediate perception of the value that AI can bring. The first in terms of automatization and*

> *in order, as I said, to create a customer approach, customer-oriented approach. So imagine, I think that artificial intelligence can do a lot in all the activities in which there is no space between input and output. So from this point of view, all the... Many sales activities, customer assistance, and all the tasks that are very, very small, can be automated, from this point of view, they can free a lot of time for small, medium retailers. And so they can focus on the strategy, they can focus on insight from data, they can focus on other tasks. So it's an enormous and very powerful tool from this point of view. In the second application, there is a challenge, as I said, because in order to create a model that can perform better, you need the quality of data. So when you are working on a supply chain, you must be aware that you don't have silos, a lack of information in some processes, because what you put inside the input, the quality of the input is related to the quality of output. So if you want to automate, and you want a lot of information and knowledge that comes from all your infrastructure, digital infrastructure, you need a good integration of all your software and integration with the software of the third part.* (Workshop_Italy_2)

An Italian workshop participant highlighted two potential applications of AI focusing on automation. Firstly, AI could facilitate the automation of customer relationships, including the establishment of robust customer support systems. This automation would allow individuals within micro, small and medium enterprises (MSMEs) to redirect their focus towards strategic development and the analysis of supporting data. However, the participant noted that automating customer support is relatively straightforward because AI models leverage customer data directly for interactions. Conversely, more sophisticated automation challenges, such as those in supply chain management, require a well-developed data infrastructure that ensures seamless data flow across the organization without data silos. The participant emphasized that without this transformed data infrastructure and organizational structure, attempts at automation may lead to inaccurate or unreliable outcomes. Thus, the workshop participant from Italy cautioned that successful automation in retail necessitates not only advanced AI capabilities but also a robust foundation of integrated data infrastructure and organizational coherence.

The issue of automation also came up in the context of the challenge for small and medium-sized retailers to maintain a skilled workforce. From the perspective of one co-creation workshop participant, artificial intelligence could automate some jobs, especially those where there is a high turnover of staff or where it is difficult to find people willing to perform a specific set of activities:

> *As for the question here from a colleague, what about the workforce, well I think it is precisely in the retail segment that there is a shortage of these workers all the time. Therefore, the requirement of the moment, or of the times, is precisely to use artificial intelligence in those places where it is possible. And to use the existing human potential where it is needed. Therefore, the use of these workers in other areas is possible. And surely this will not immediately translate into any mass redundancies in retail, either, yes?* (Workshop_Poland_1)

Retailers often face challenges related to workforce availability and willingness to work in the sector. Artificial intelligence (AI) is therefore primarily considered a supplement to the current

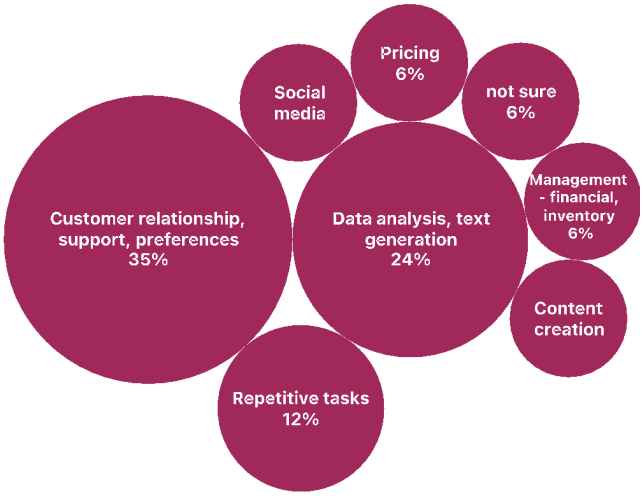
workforce. Workshop participants generally expressed a positive and calm perspective on the swift digital transformations driven by the rise of AI. Participants from Romania highlighted that AI does not aim to replace or automate tasks to displace workers from the labor market. Instead, AI enhances their existing activities:

> *During our research with some managers from stores like Metro, Cash and Carry, Selgross, etc. we realized that AI can be an extension of the employee, for the employees, so AI will not replace them, it will be an extension and also we can help with the training that I was talking about a few minutes ago. Because the AI can also be used by the employees, not only by the customer. So the customer comes, you know, to a store and interacts with an AI, let's say an in-store AI assistant, to get answers like price description, where it is placed in the store, the employee can also do the same thing. And that way they can learn and they can increase their knowledge base about the products in the store.* (Workshop_Romania_1)

During a workshop, a participant shared insights derived from research conducted in Romania, highlighting the dual role of artificial intelligence in customer interactions and employee enhancement. AI, exemplified by virtual or desktop chatbots, automates customer interactions, thereby streamlining processes. Furthermore, AI enhances the analytical capabilities and knowledge of employees across all experience levels. This multifaceted application of AI garnered a positive reception among workshop participants, fostering an optimistic outlook towards automation's potential benefits.

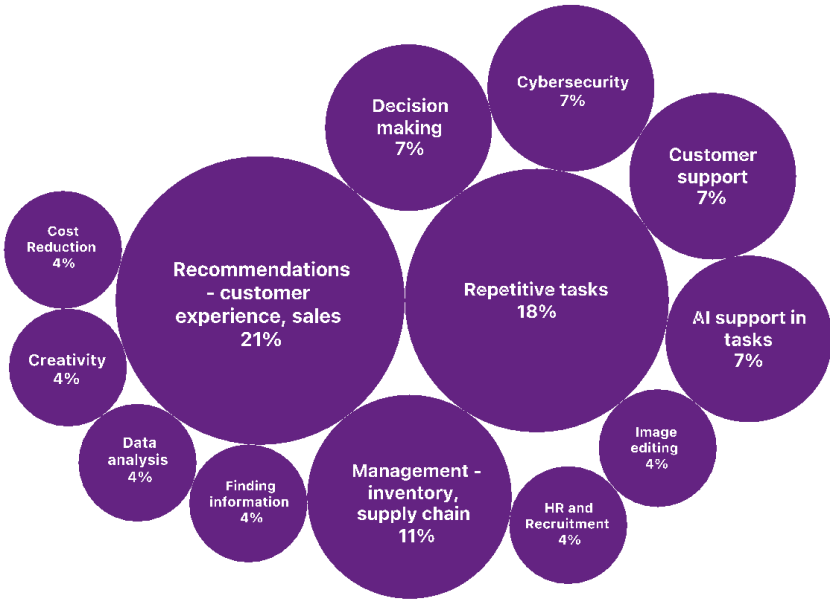
The theme of automation emerged from the analysis of survey questionnaires conducted in Cyprus. Respondents believe that AI can replace company employees in the case of repetitive and time-consuming tasks. One in three states that technologies such as chatbots can take over customer service and support tasks, and one in four believes that AI technologies can relieve employees of tasks such as data analysis and text generation (Figure 3). Moreover, AI can enhance employees' tasks by freeing them from repetitive duties. Additionally, it can create recommendations for customers, make decisions, and manage inventory.

Figure 3 In what aspects do AI technologies replace tasks performed by employees? (% of responses)



Source: own elaboration

Figure 4 In what aspects do AI technologies enhance the way tasks are performed by employees? (% of responses)



Source: own elaboration

Automation, according to workshop and survey participants, boils down to automating basic and repetitive activities, particularly in the areas of interaction and customer support, as well as more advanced work in the supply chain. Significantly, the latter area is more difficult to automate, as it requires adapting the data infrastructure or business structure for analytical capabilities and having large data sets on which to train differentiated AI models. A positive attitude towards change prevailed among the workshop participants, who pointed in particular to the positive role of automation in filling the gaps caused by the unavailability of certain types of employees, as well as strengthening the workforce in terms of knowledge and data analysis.

1.3.4. Good Service

The workshop participants explored not only the technical aspects of prediction, optimization, and automation but also the qualitative dimensions of artificial intelligence and its application in the retail sector. They viewed this as an opportunity to enhance service quality, which involves effective communication with customers and appropriate customer care throughout the sales process. These aspects are intertwined with the challenge of fostering trust in customer interactions and cultivating a supportive environment for MSME customers.

As presented by a workshop participant from Italy, the implementation of AI tools in retail has to take into account the issue of trust in customer relationships:

> *I would like to draw attention to trust: to introduce AI into the retail world, we need to build a relationship of trust. There is - and this is measured by numerous studies - a certain repulsion to innovations that imply a radical change in habits. Think of a customer where the presence of a human being is replaced by AI. The relationship with the customer changes. We need to know how to introduce a new relationship of trust into this workflow. This is achieved by choosing systems that can be tailored or fine-tuned to the context in which they operate. I believe it is essential to address how the customer experience will change, how their attitude may be altered, and how their propensity to trust may be modified. This is a critical element that developers and management adopting AI must address.* (Workshop_Italy_3)

According to one workshop participant, successfully implementing artificial intelligence involves integrating this technology not just with data infrastructures and organizational frameworks, but also with a robust service system. The cornerstone of this system is trust between small to medium-sized enterprises and their customers. Upholding trust necessitates the careful and skillful deployment of AI, which should be customized to suit the context and unique characteristics of customer groups throughout the sales process. This poses a significant challenge in terms of developing company-wide expertise and managing interactions with external stakeholders. It is therefore important to consider customers' perspectives and attitudes towards automated customer service when designing changes related to the implementation of AI. On the other hand, once contextual factors such as the identification and comprehensive understanding of customer groups have been considered, the participant points to the conditions of opportunity that allow for the valuable use of AI technology.

Based on trust in customer relationships and the thoughtful use of AI technology, effective customer care can be integrated into the sales process.

> *Yeah, I think that's where at least this market segmentation comes in. I mean, it's with chatbots, that's for sure, it's kind of basic, but it's precisely because of the aftersales care, somehow generating at least some messages that go out now of purchase or just: "Your product is still in the basket, maybe you still want to buy it". This is what many online shops do now. For example, I have an account with many platforms that sell digital books. I get these reminder emails all the time: "There is still a product in your shopping basket, maybe you would like to buy it". This is not done by anyone, not by some tired Mr Smith, it is done automatically. Sending newsletters, that's all .... should be doing by now.* (Workshop_Poland_2)

Among the key factors for providing excellent customer service are the judicious use of chatbots or virtual assistants, and the automation of marketing and customer care. However, as workshop participants pointed out, delivering good service necessitates high-quality technologies capable of responding to customer demands and establishing an appropriate care system for them. Customer care is understood here by maintaining constant contact at all

stages of sales and after-sales process. Therefore, the role of skills in enabling the appropriate use of AI in retail is important (as discussed in the next section).

Table 9 AI functions needed in relation to challenges in the retailing sector

AI functions needed	In relation to challenges in retail
Predictive functions	• Predicting demand in supply chains • Forecasting sales trends
Optimization functions	• Optimizing inventory levels • Sustainable use of resources and products
Automation functions	• Automating marketing and customer relationship • Managing customer feedback • Automating routine tasks or complementing workforce
"Good service delivery"	• Used skilfully, it helps build a relationship of trust with customers • Provides opportunities for holistic customer care during the sales process and afterwards

Source: own elaboration

Looking at this comprehensively, participants in co-creation workshops across selected EU countries highlighted four key functions of AI in retail. Firstly, AI's predictive capabilities enable better management of supply chains and sales. Secondly, it optimizes related processes. Thirdly, participants emphasized the automation of customer service and specific tasks, addressing workforce gaps or enhancing existing staff capabilities. Fourthly, AI's potential contribution to enhancing customer service, particularly in customer relations, was noted. Participants stressed the importance of applying AI within the context of MSMEs, considering their understanding of their customers to avoid undermining trust in these relationships. Only through this approach can automated and technology-enabled customer care, such as virtual assistants, be effectively implemented.

2. The state of AI adoption in retail sector

Key takeaways

- Over the last decade, the wholesale and retail trade sector has grown significantly.
- The retail sector is dominated by a high number of micro, small and medium-sized enterprises (MSMEs), especially in Romania. This structure can hinder competitiveness in international markets due to lower operational efficiency and challenges in achieving economies of scale, significantly impacting the digitalization process.
- The retail sector's digitalization lags behind other industries such as ICT and professional services.
- E-commerce sales in the retail sector vary significantly between countries, indicating different levels of digital technology adoption.
- Most MSMEs in EU countries do not use AI technologies, with Poland having the highest percentage of firms not using AI.
- In the retail sector, AI adoption is the lowest among the analyzed sectors. The most common AI applications in MSMEs are robotic process automation (RPA), speech recognition, and text mining.
- The main barriers to AI adoption are insufficient specialist knowledge, high implementation costs, and legal uncertainties, limiting the implementation of these technologies in MSMEs and the retail sector. Insufficient specialist knowledge and difficulties in hiring skilled employees are significant barriers to adopting digital technologies in the retail sector and MSMEs.
- While digital skills are increasingly necessary for implementing digital innovations, the level of these skills among employees remains low, particularly in Poland and Romania, which hampers digital technology adoption.

2.1. The main characteristics of the retail sector in the selected countries

In the last decade, the wholesale and retail trade sector has experienced growth, except during the COVID-19 pandemic. This growth is particularly noticeable in Romania and Poland, which lead in turnover, while Germany and Italy have fallen below the EU average, highlighting increasing disparities in growth rates across Europe.

A key feature of this sector is the high number of small and medium-sized enterprises (SMEs), especially in Romania, and to a lesser extent in Germany. This structure can limit competitiveness in international markets due to lower operational efficiency and difficulties in achieving economies of scale. Additionally, it plays a crucial role in the digitization process.

Data on turnover and sales volume in the wholesale and retail trade in selected countries show interesting trends. Romania and Poland have the highest turnover among the analyzed countries (Figure 5). The chart presents the annual index of turnover and sales volume in wholesale and retail trade in 2023, using 2021 data as the reference point (index = 100). Bulgaria leads among EU27 countries and shows an increase compared to the previous year. Germany and Italy have results below the EU average, with Germany also experiencing a decline compared to 2022.

Figure 6 shows the long-term trend in turnover and sales volume in wholesale and retail trade from 2014 to 2023 for the analyzed countries. The data reveal significant growth in this sector, particularly in Romania, which had an index of 55.10 in 2014 and reached 128.40 in 2023, indicating a dynamic market development. In contrast, Italy, which started from a higher index level of 87.70 in 2014, now occupies the last place. The data suggest a stable and growing development of the retail and wholesale market. Notably, since 2020, all analyzed countries have shown accelerated growth, likely due to economic recovery following the COVID-19 pandemic.

A notable characteristic is the very high number of small and medium-sized enterprises (SMEs) in the wholesale and retail trade sector (Figures 7, 8, 9). In the analyzed countries, over 97% of businesses in this sector are SMEs. On average, one in five SMEs operates in the retail trade sector, except in Germany, where the share is lower at 16.8%, and in Romania, where it is higher at 26%. This structure leads to significant market fragmentation, which can affect competitiveness and growth dynamics in these countries.

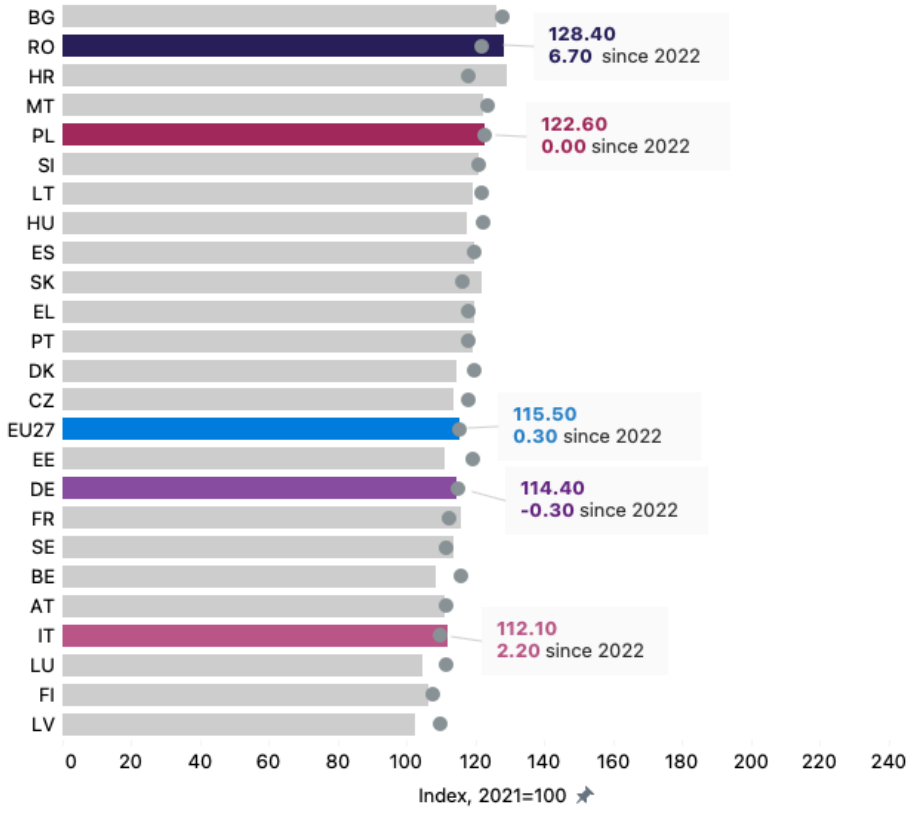
This fragmentation can result in lower operational efficiency and difficulties in achieving economies of scale, limiting international competitiveness. Additionally, a large number of SMEs can lead to greater market volatility and instability, complicating long-term strategic planning.

Furthermore, the high number of SMEs may face challenges in the digitalization process, as smaller businesses often have limited financial and technological resources, making it difficult

to implement advanced digital technologies. This can impact their ability to adapt to changing market conditions and their competitiveness in the digital era.

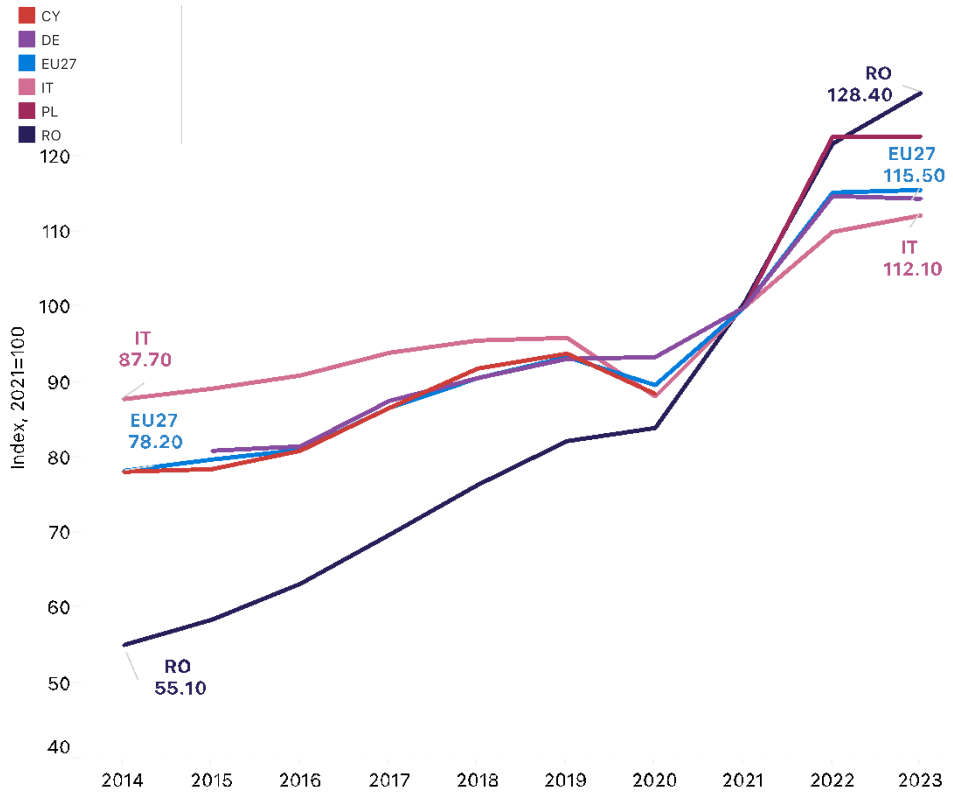
Indicators of digitalization levels among enterprises in the EU support this. The digitalization of SMEs in the analyzed countries (Poland, Cyprus, Romania, Germany, Italy) does not significantly differ from the EU average (24%) for small and medium-sized enterprises, except for Romania (9%) (Figure 9). However, these figures for SMEs are considerably lower than those for large enterprises. Among the analyzed group, Germany and Cyprus achieve the highest results, with about one in three SMEs characterized by advanced use of digital technologies. Romania stands out negatively in this regard, both among the analyzed countries and within the entire EU.

Figure 5. Turnover and Sales Volume in Wholesale and Retail Trade – Annual Data (2023)



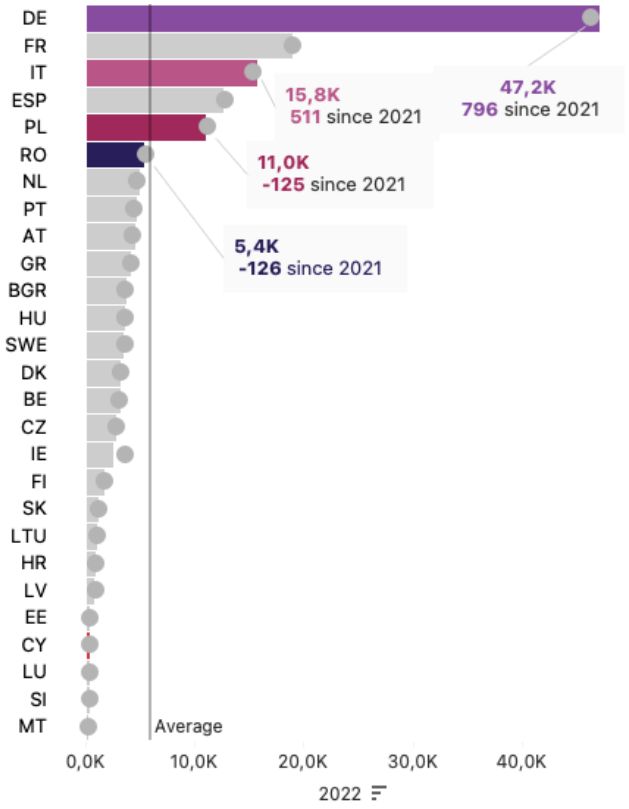
Source: Eurostat. Index of Turnover – Total, Unit: Index, 2021=100, Calendar Adjusted Data, Circles – Result from 2022.

Figure 6 Turnover and Sales Volume in Wholesale and Retail Trade – Annual Data (2014-2023)



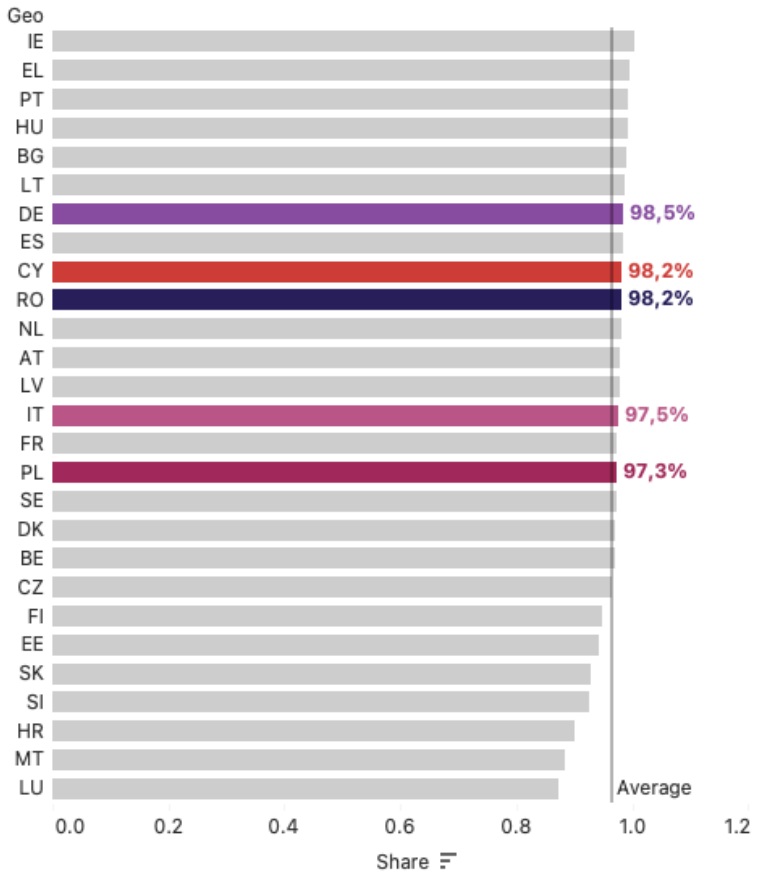
Source: Eurostat. Index of Turnover – Total, Unit: Index, 2021=100, Calendar Adjusted Data

Figure 7 Number of Small and Medium-Sized Enterprises in the Retail Sector (2022)



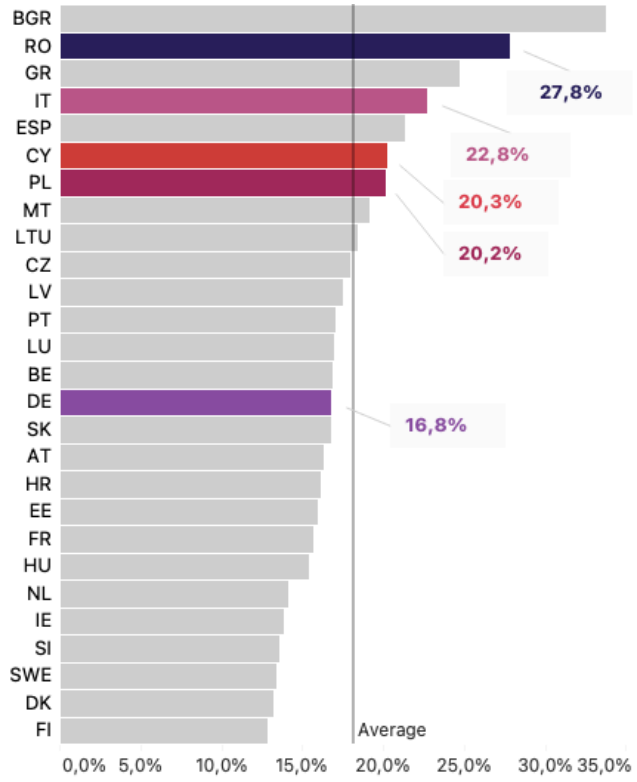
Source: Eurostat. Circles – Result from 2021

Figure 8 Share of SMEs in All Retail Enterprises (2022)



Source: Eurostat.

Figure 9 Share of SMEs in retail among all SMEs (2022)



Source: Eurostat.

2.2. The level of digitilization in the retail sector

The level of digitalization in the retail sector is not high compared to other industries such as ICT and professional services. German and Cyprus retail enterprises perform above the EU average in terms of digitalization. Polish companies, while not significantly deviating from the EU average, still have a low percentage of enterprises with a high level of digitalization, indicating the need for greater implementation of digital technologies.

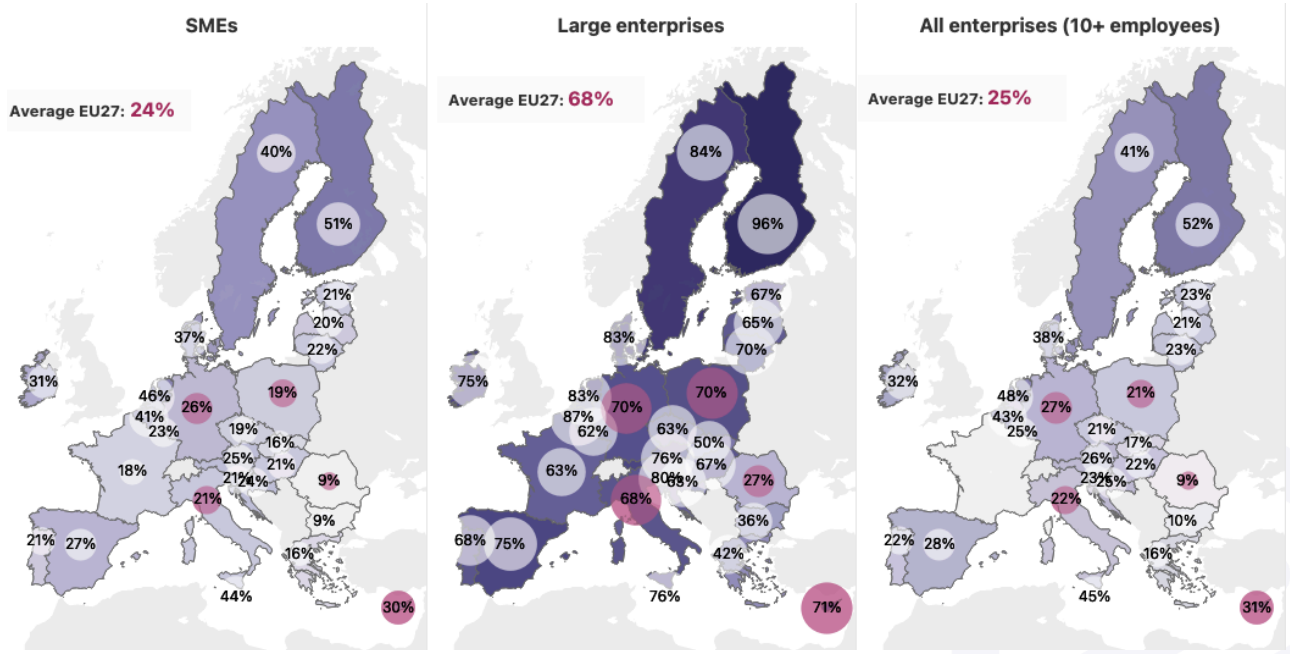
E-commerce sales in the retail sector vary significantly between countries, reflecting different levels of digital technology adoption. While some countries achieve high integration of e-commerce channels, others lag behind, requiring further digitalization efforts.

Retail enterprises exhibit a medium level of digitalization compared to other sectors (Figure 11). Digital technologies are more extensively used in sectors such as ICT, professional and scientific activities, and real estate. Within the retail sector, German and Cyprus enterprises lead in digitalization, with high and very high DII (Digital Intensity Index) scores exceeding the EU average. Polish and Italian retail enterprises are close to the EU27 average, except for Romania.

However, only one in five retail enterprises in Poland had high or very high DII in 2023. This means that only 23% of Polish enterprises have implemented at least 7 out of 12 digital solutions considered in the DII (Figure 11). There are significant differences among the analyzed countries, with a 28 percentage point gap between Cyprus (8th place in the EU27) and Romania (27th place in the EU27).

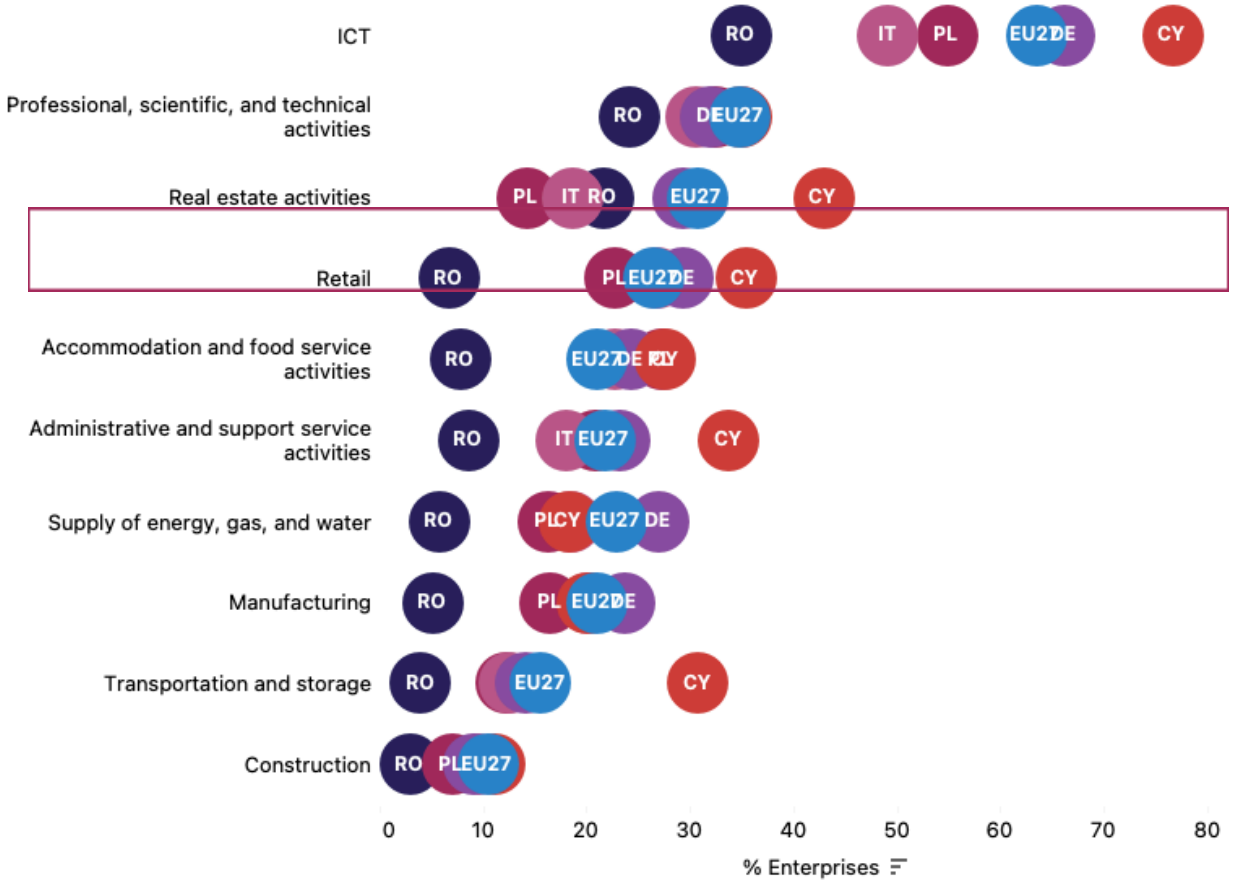
One indicator of advanced digitalization is the use of digital channels for sales. While the retail sector has substantial potential for e-commerce adoption, the level of engagement varies across countries. Germany has the highest share of e-commerce sales (20.9%), indicating strong integration of digital technologies and better market adaptation to modern sales channels. Poland and Romania lag below the EU average, with results of 7.7% and 13.4% respectively, highlighting the need for intensified digitalization efforts in these countries. Additionally, the share of retail enterprises using e-commerce channels is declining in these countries. Cyprus, with the lowest share (4.6%), may require special interventions and investments in e-commerce technologies to enhance its competitiveness in retail.

Figure 10 Enterprises with high and very high DII (2023)



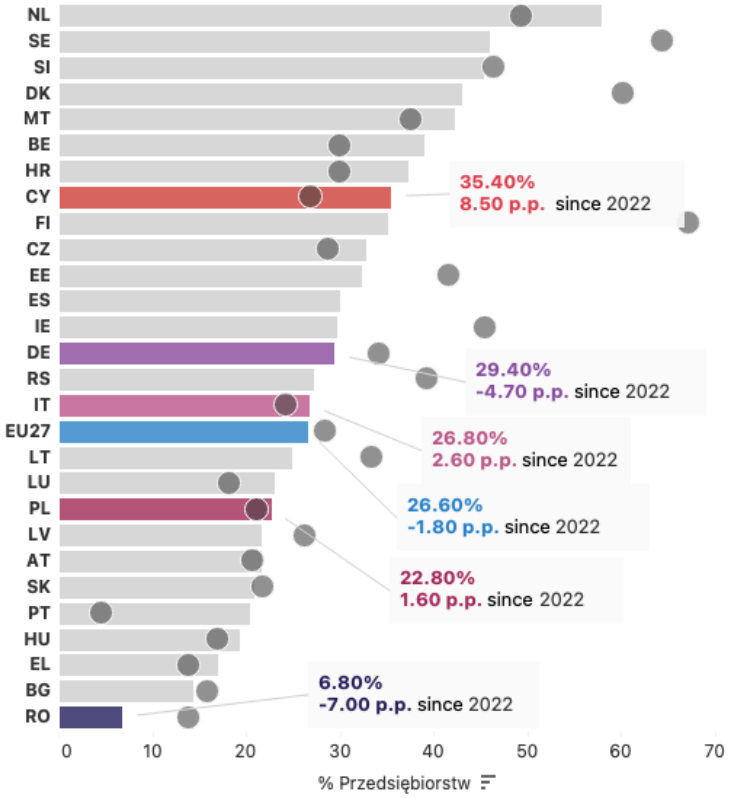
Source: Eurostat. Digital Intensity by class size of enterprise (Enterprises with high and very high Digital Intensity Index) Enterprises in EU countries that have high and very high DII (% of enterprises). The breakdown includes small and medium-sized enterprises (from 10 to 249 employees), all (from 10 employees), and large (250 employees and more).

Figure 11 Enterprises from various sectors with high and very high DII (2023)



Source: Eurostat. Digital Intensity by NACE Rev. 2 activity (Enterprises with high and very high Digital Intensity Index). Enterprises from Poland, Cyprus, Germany, Italy, and Romania that have high and very high DII (% of enterprises). Comparison to the EU27 average.

Figure 12 Retail sector enterprises with high and very high DII (2023)



Source: Eurostat. Digital Intensity by NACE Rev. 2 activity (Enterprises with high and very high Digital Intensity Index). Circles - DII in 2022, bars - DII in 2023.

Figure 13 E-commerce sales as a percentage of turnover (2023)

Nace R2	CY	DE	EU27	PL	RO
Information and communication	**33,8%** 27.40 p.p.	**13,6%** -14.80 p.p.	**21,6%** 0.90 p.p.	p.p.	**22,1%** 5.20 p.p.
Accommodation and food service activities	**28,1%** -0.60 p.p.	**17,0%** -1.20 p.p.	**17,8%** 6.10 p.p.	**7,2%** -13.00 p.p.	**12,3%** 2.20 p.p.
Administrative and support service activities	**28,5%** 7.40 p.p.	**8,6%** -3.10 p.p.	**14,4%** 4.70 p.p.	p.p.	**4,0%** -6.80 p.p.
Manufacturing	**3,3%** 0.80 p.p.	**19,9%** 0.10 p.p.	**20,7%** -0.70 p.p.	**25,0%** -2.50 p.p.	**11,5%** 2.30 p.p.
All sectors	**12,6%** 7.20 p.p.	**17,7%** 0.40 p.p.	**18,0%** 0.30 p.p.	**12,9%** -3.90 p.p.	**11,6%** 0.70 p.p.
Retail	**4,6%** 0.30 p.p.	**20,9%** 8.00 p.p.	**13,5%** 0.70 p.p.	**7,7%** -2.40 p.p.	**13,4%** -3.90 p.p.
Transportation and storage	**3,9%** 0.30 p.p.	**11,5%** -0.80 p.p.	**15,5%** 0.00 p.p.	**4,1%** p.p.	**9,0%** 2.00 p.p.
Professional, scientific, and technical activities	**10,1%** 2.60 p.p.	**13,2%** 9.50 p.p.	**8,9%** 4.30 p.p.	p.p.	**4,5%** 1.00 p.p.
Supply of energy, gas, and water	**0,0%** -0.70 p.p.	**10,3%** -12.50 p.p.	**19,8%** -3.80 p.p.	p.p.	**6,3%** -0.30 p.p.
Real estate activities	**6,9%** 5.90 p.p.	**1,3%** -0.90 p.p.	**4,7%** 0.30 p.p.	p.p.	**0,0%** 0.00 p.p.
Construction	**1,5%** 1.40 p.p.	**0,8%** -0.10 p.p.	**2,3%** 0.60 p.p.	p.p.	**0,8%** -1.30 p.p.

Source: Eurostat. Value of e-commerce sales by NACE Rev. 2 activity - percentage point change from 2022.

2.3. Use of advanced digital technologies

In 2023, the vast majority of SMEs did not use any AI technology. Among small and medium-sized enterprises, the highest percentages of firms not using AI were found in Finland (92%), Sweden (86%), and Poland (84%) (Figure 14). In other EU27 countries, these values ranged between 70% and 80%. Regardless of company size, Poland is among the countries with the highest percentage of enterprises not using AI. Larger enterprises show higher levels of AI adoption, likely due to greater financial and organizational resources enabling investments in modern technologies.

The retail sector ranks lowest in terms of AI usage (Figure 15). AI adoption in retail is significantly lower than in the ICT sector, where the EU27 average is around 30%. Among the analyzed countries, Germany has the highest AI usage in retail (about 10%), where one in ten retail enterprises uses at least one AI technology. Other countries fall below the EU average, with few firms employing such technologies. Furthermore, all the analyzed countries show low growth in AI usage compared to 2021 (Figure 16). Over the past two years, AI implementation has increased most rapidly in Cyprus (by about 2 percentage points). Retail enterprises in Romania have minimal AI usage.

When AI is used (both in SMEs and retail companies), it is most commonly for robotic process automation (RPA) based on AI. RPA automates routine, repetitive tasks and, when supported by AI, can also make decisions based on data analysis, pattern recognition, or natural language processing. This makes business processes more efficient, accurate, and faster (Figures 17 and 18). Other common AI applications in SMEs include speech recognition and text mining. Speech recognition converts spoken words into text, improving processes such as customer service and meeting transcription. This increases communication efficiency, documentation accuracy, and saves time and human resources. Text mining involves analyzing large text datasets to extract valuable information such as patterns, trends, or sentiments. In SMEs, text mining is used to analyze customer opinions and monitor the market. In the retail sector, machine learning is also frequently used, enhancing various business aspects. For example, analyzing customer behavior data allows for personalized product recommendations.

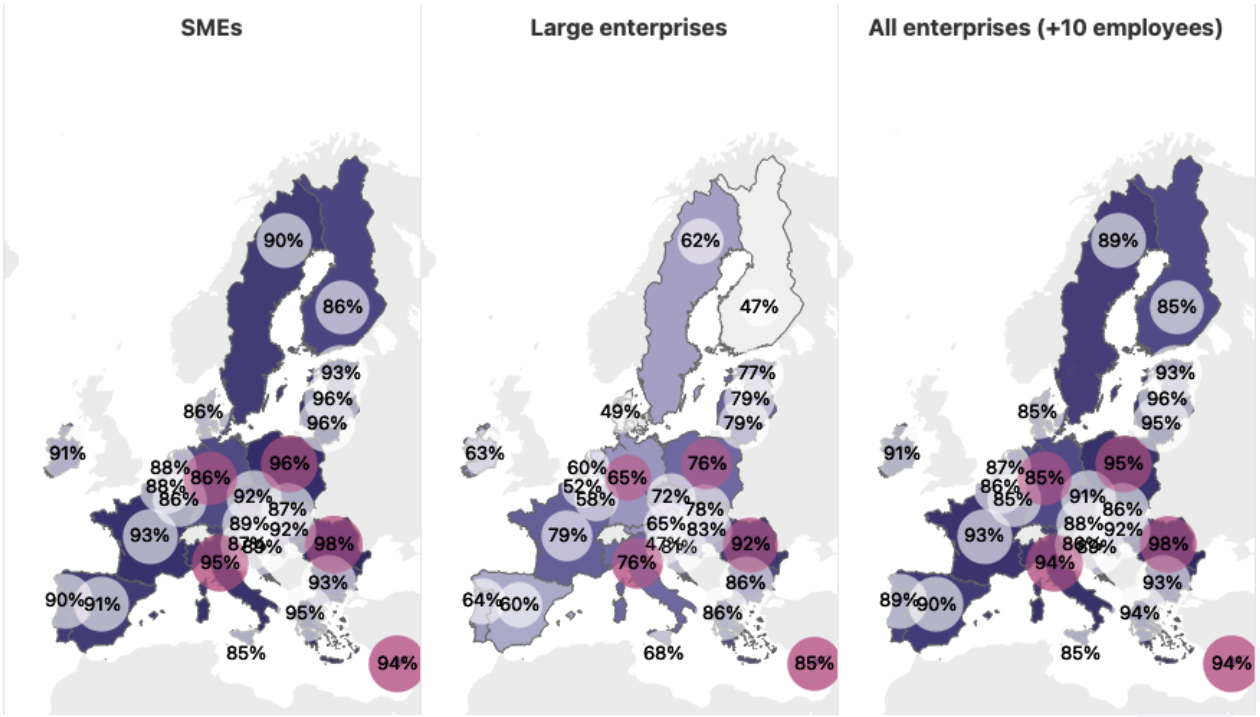
The main barriers to AI adoption in SMEs and the retail sector are insufficient specialist knowledge (Figure 19). Another significant barrier is the perceived high implementation costs of these technologies. Less frequently reported issues include incompatibility with existing systems and unclear legal consequences. On average, across all EU countries, the biggest barrier is insufficient specialist knowledge (Figure 20). Legal uncertainties and ethical considerations are also significant.

Similar differences are seen in the use of other technologies, such as cloud computing services (Figures 22 and 23). Poland and Germany have moderate cloud usage levels, both at 44.5%, while Cyprus and Italy have higher values, at 52.4% and 58.4%, respectively. Romania is at the

bottom with the lowest level (13.8%), indicating significant digitalization delays. In terms of purchasing office software, security, and file storage, Italy leads, while Romania scores the lowest, highlighting the differences in digital technology adoption in the retail sector among these countries.

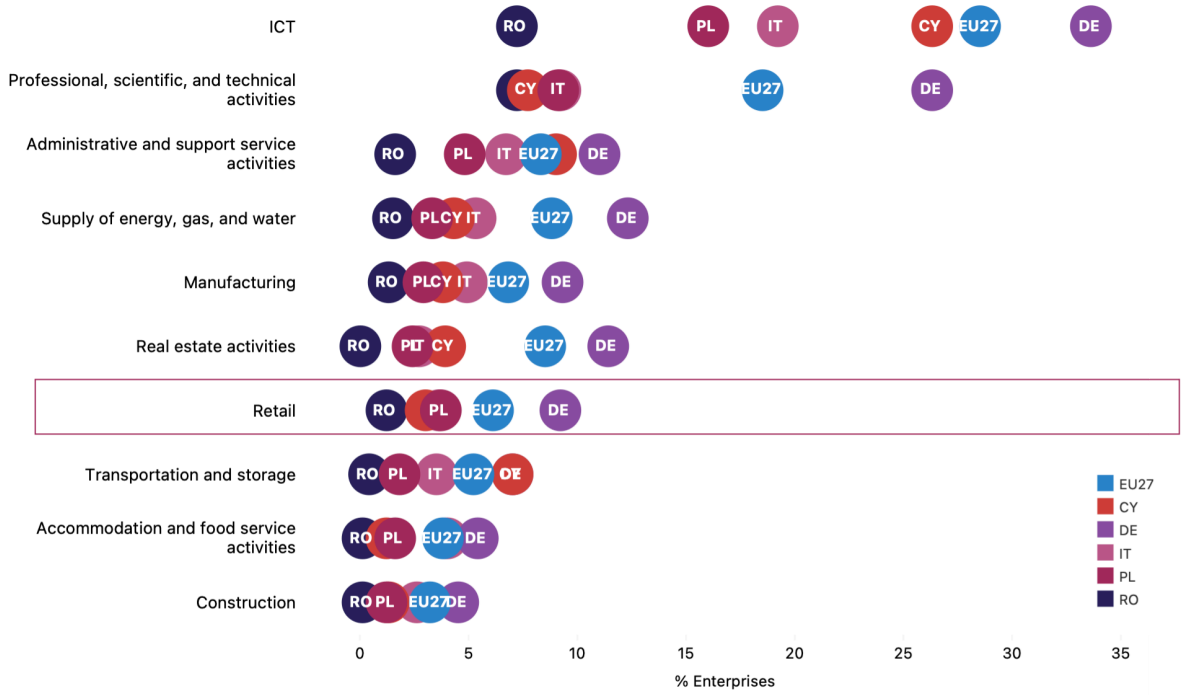
The countries also differ significantly in integrating IoT technologies (Figures 23 and 24). The highest IoT adoption in the retail sector is in Cyprus (40%), while Poland (11%) and Romania (13%) are far behind the EU average (26%). Cyprus excels in building security (39.1%) and energy management (13.9%). Germany is close to the EU average in building security (26.9%), while Poland and Romania show lower engagement in most analyzed IoT applications.

Figure 14 Enterprises not using AI systems (2023)



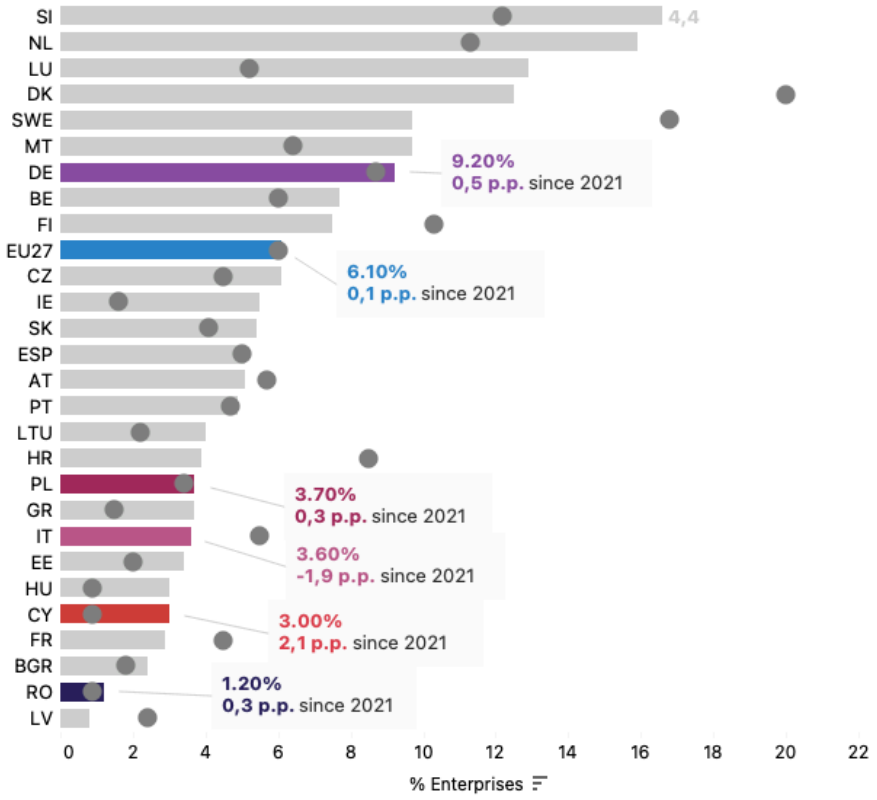
Source: Eurostat. Artificial Intelligence by Class Size of Enterprise (Enterprises do not use any AI technologies). The breakdown includes small and medium-sized enterprises (from 10 to 249 employees), all (from 10 employees), and large (250 employees and more).

Figure 15 Enterprises from different sectors that use at least one AI system (2023).



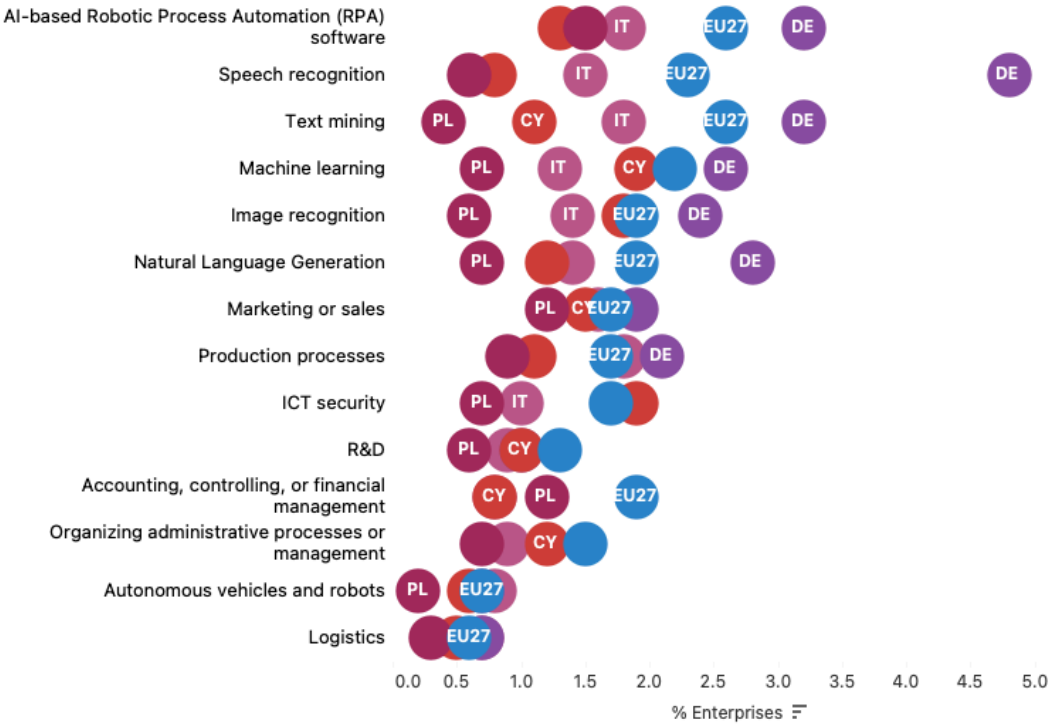
Source: Eurostat. Artificial Intelligence by NACE Rev. 2 activity (Enterprises use at least one of the AI technologies).

Figure 16 Retail sector enterprises using at least one AI system (2023)



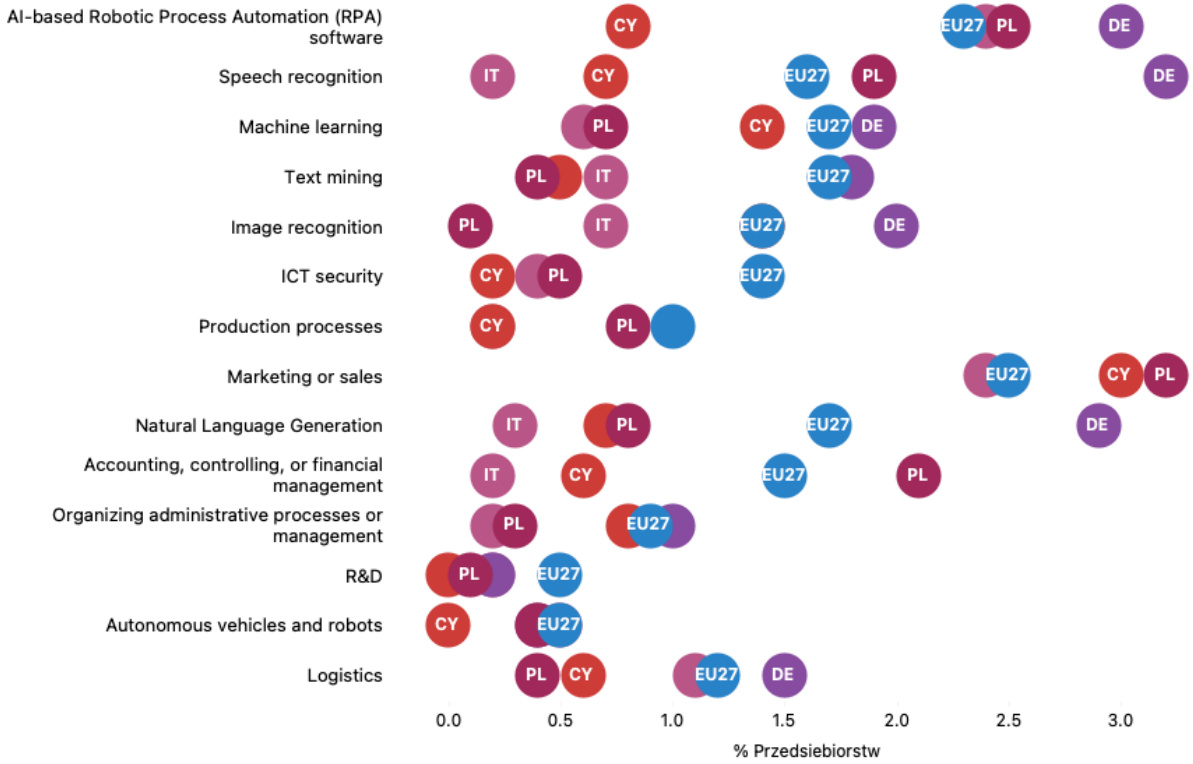
Source: Eurostat. Artificial Intelligence by NACE Rev. 2 activity (Enterprises use at least one of the AI technologies). Circles - result in 2021, bars - result in 2023.

Figure 17 AI applications in small and medium-sized enterprises (2023)



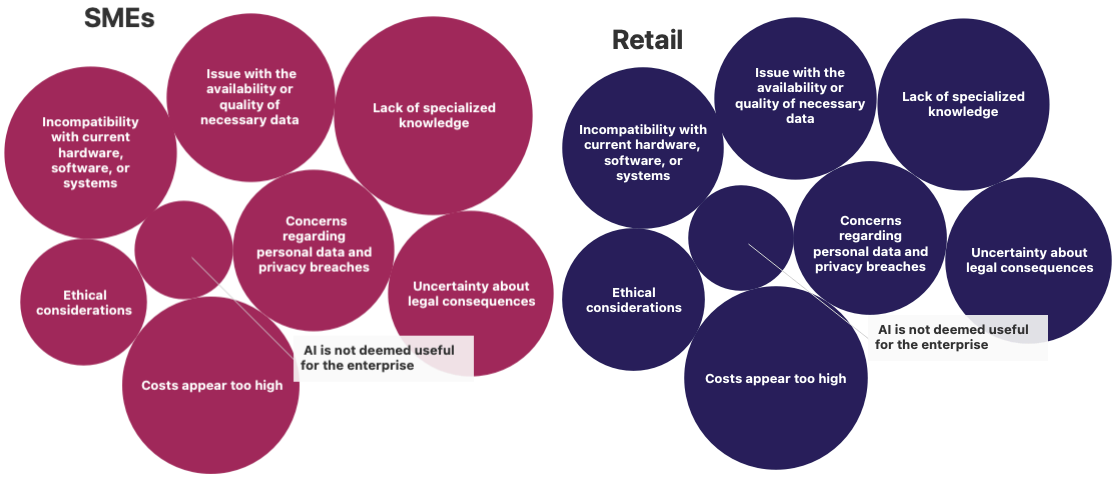
Source: Eurostat. Artificial Intelligence by Class Size of Enterprise.

Figure 18 AI applications in retail trade enterprises (2023)



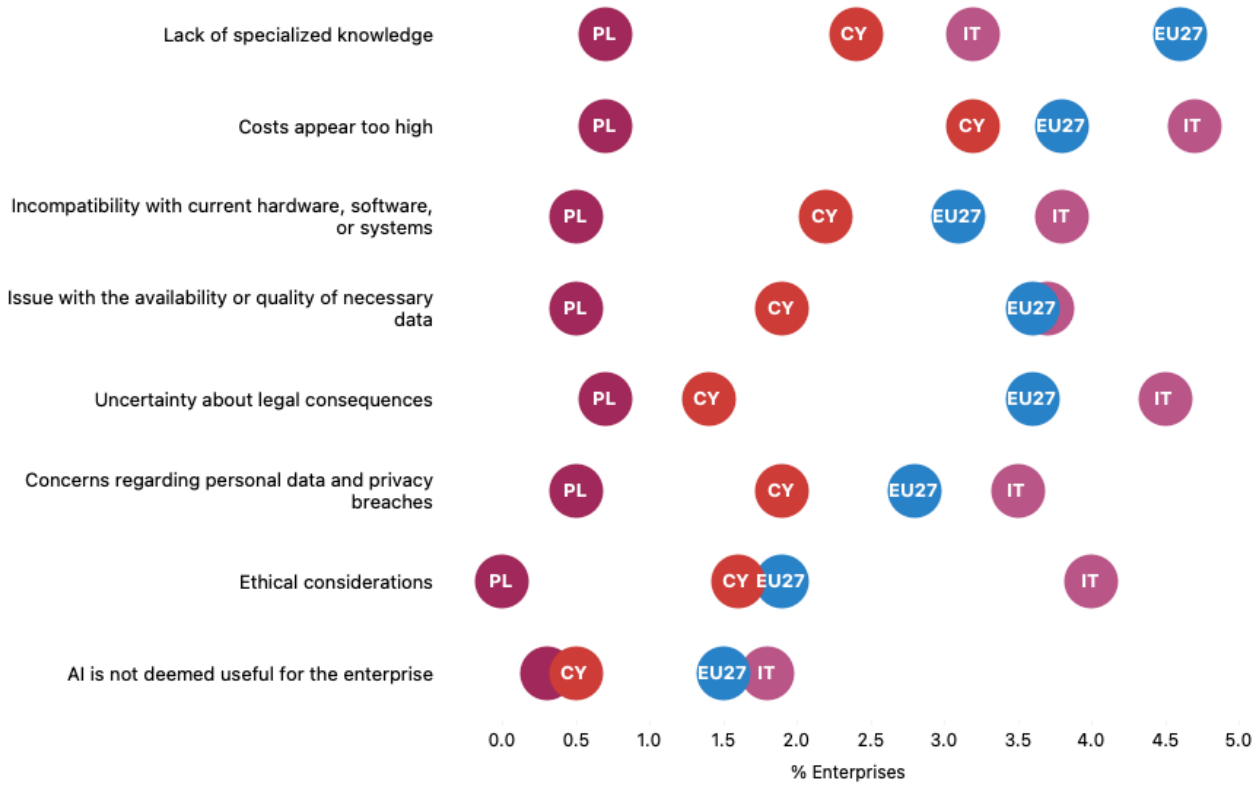
Source: Eurostat. Artificial Intelligence by NACE Rev. 2 activity.

Figure 19 Reasons for not using AI in SMEs and retail trade enterprises (2023)



Source: Eurostat. Artificial Intelligence by NACE Rev. 2 activity and Artificial Intelligence by Class Size of Enterprise.

Figure 20 Reasons for not using AI in retail trade enterprises (2023)



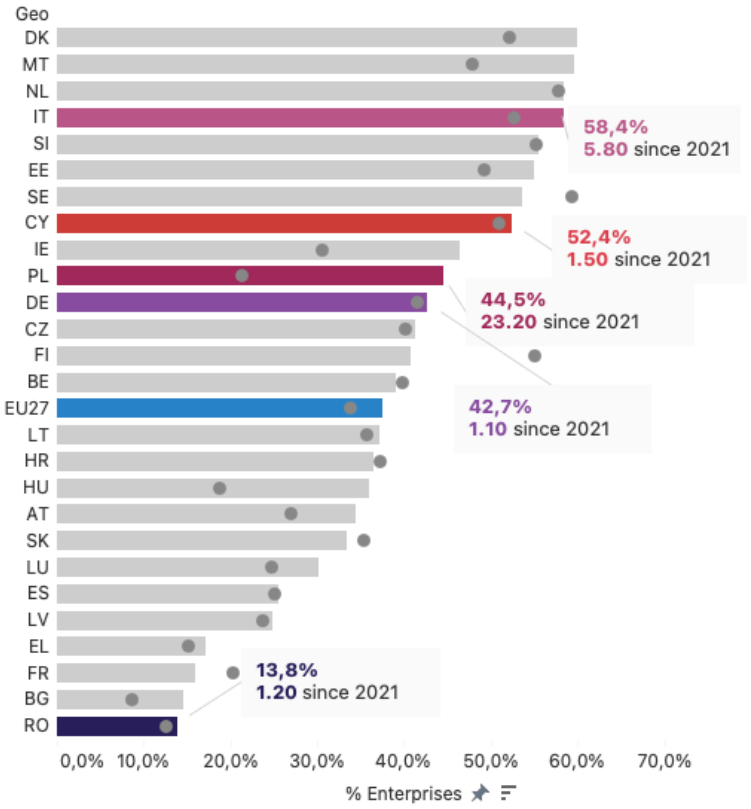
Source: Eurostat. Artificial Intelligence by NACE Rev. 2 activity

Figure 21 Sources of data analysis for retail trade enterprises (2023)

	PL	EU27	CY	DE	IT	RO
Any source	14,3%	26,4%	28,5%	31,4%	21,4%	14,9%
ERP - transaction records	13,3%	24,0%	26,5%	28,6%	16,2%	12,3%
CRM - customer data (e.g., purchases, preferences)	7,8%	16,2%	18,8%	17,5%	13,4%	7,6%
Location data from mobile devices or vehicles	2,4%	5,1%	4,4%	6,8%	4,0%	3,9%
Satellite data	0,8%	1,6%	0,7%	2,2%	1,4%	1,3%
Smart devices or sensors	1,7%	3,3%	4,1%	3,2%	3,4%	4,3%
Social media	6,5%	11,7%	10,9%	13,3%	11,1%	6,1%
Open data from government agencies	2,5%	4,6%	3,9%	7,1%	1,5%	3,5%
Websites	3,3%	10,2%	10,3%	12,4%	7,1%	6,8%

Source: Eurostat. Data analytics by NACE Rev. 2 activity

Figure 22 Use of cloud computing in retail trade enterprises (2023)



Source: Eurostat. Cloud computing services by NACE Rev. 2 activity

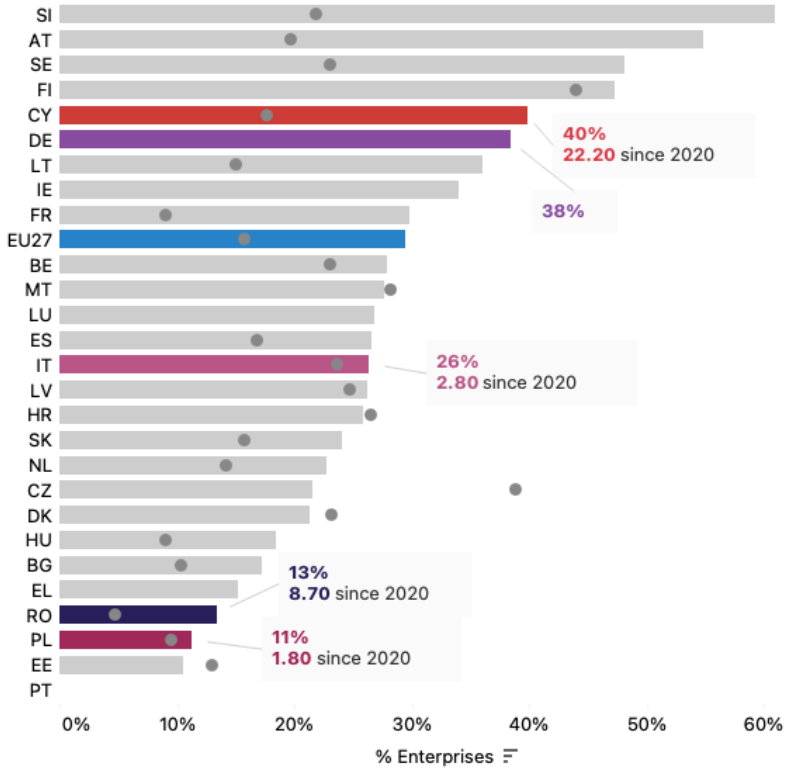
Circles: result from 2021

Figure 23 Use of cloud computing in retail trade enterprises (2023)

	IT	CY	DE	EU27	PL	RO
Purchasing office software (e.g., text editors)	43%	36%	26%	23%	22%	6%
Purchasing security software	46%	40%	19%	21%	17%	7%
Purchasing software for file storage	33%	33%	27%	24%	18%	9%
Purchasing hosting for enterprise databases	21%	11%	14%	15%	8%	6%
Purchasing computational power to support enterprise software	9%	4%	9%	9%	4%	3%

Source: Eurostat. Cloud computing services by NACE Rev.2 activity

Figure 24 Use of IoT by retail trade enterprises (2021)



Source: Eurostat. Internet of Things by NACE Rev. 2 activity (Enterprises use IoT)

Circles: result from 2020

Figure 25 Application of IoT by retail trade enterprises (2021)

	CY	DE	EU27	IT	PL	RO
Ensuring facility security	39,1%	26,9%	23,4%	21,6%	7,5%	10,5%
Energy consumption management (e.g., smart sensors)	13,9%	13,3%	8,6%	6,6%	2,6%	3,9%
Logistics management	7,0%	3,6%	4,2%	2,2%	4,2%	7,9%
Monitoring technical condition	2,3%	8,5%	5,6%	5,3%	2,6%	3,0%
Customer service	0,5%	4,2%	5,1%	5,6%	4,8%	5,1%
Production monitoring or automation	1,4%	4,4%	3,4%	2,4%	1,1%	1,7%

Source: Eurostat. Internet of Things by NACE Rev. 2 activity (Enterprises use IoT)

2.4. The level of digital skills

The main barriers to adopting digital technologies are insufficient specialist knowledge and difficulties in hiring employees with the necessary skills, which limit the implementation of new technologies. There is a clear relationship between the level of digital technology adoption and the digital skills of employees. In the retail sector and among small and medium-sized enterprises (SMEs), digital skills are increasingly necessary to implement digital innovations. However, the level of these skills among employees remains low. For example, Cyprus recognizes the importance of digital skills, but the actual level of these skills is relatively low. Poland and Romania rank at the bottom regarding advanced digital competencies, while Germany and Cyprus perform better in digital technology implementations, despite facing challenges in hiring employees with higher digital competencies.

There is a clear correlation between the digital skills of employees and the level of digital technology adoption in enterprises (Figure 26). Digital skills among employees are crucial for effectively implementing digital technologies in businesses. A high level of digital proficiency enables companies to efficiently use modern tools and technologies.

Most SMEs and retail sector firms recognize the growing importance of digital skills (Figure 30). However, there are significant differences between countries. Digital skills are most valued by SMEs in Cyprus, while enterprises in Poland and Romania rank lowest. In the retail sector, Romania performs better, with over half of the firms considering digital skills important, while Polish firms remain at the bottom of the EU ranking.

The digital skill level of employees in the retail sector is slightly lower compared to employees in general (Figure 31). In the analyzed countries, the skills of employees in the wholesale and retail trade sectors are below the EU average (Figure 32). Poland ranks highest among the analyzed countries, with 24% of retail sector employees possessing advanced digital skills. The leader is the Netherlands, where over half of the sector's employees have advanced skills. Cyprus, despite recognizing the importance of digital skills, has relatively low digital capabilities among retail employees. Romania ranks the lowest, with only one in ten retail employees possessing advanced digital skills.

Many SMEs and retail sector firms struggle to hire employees with the necessary competencies (Figure 34). This issue is most frequently reported by German companies, where the percentage of employees with above-basic digital skills is among the lowest in the EU. More than half of SMEs and retail enterprises have difficulty hiring employees with advanced competencies (Figure 35). Romania stands out, where over three-quarters of SMEs and retail firms struggle to fill positions for specialists, junior specialists, and technicians.

The shortage of employees with the necessary digital skills significantly impacts businesses in the EU. Over half of SMEs and retail firms admit that the lack of skilled human capital hampers the implementation of digital technologies (Figure 36). Romania stands out in this regard,

leading among the EU27 countries. Italy follows, where one in three small and medium-sized enterprises and retail firms face difficulties adapting to new digital technologies due to skill shortages. Cyprus performs the best among the analyzed countries, but still, over half of the firms report this issue.

Enterprises in Poland, Germany, Cyprus, and Romania have relatively low levels of digitalization and human capital skills (Figure 26). Additionally, a small percentage of employees in these countries engage in programming (Figure 27). Cyprus has a higher level of digital skills among employees compared to the mentioned group of countries but falls significantly short of the leader, the Netherlands. A higher level of digital intensity in the retail sector does not directly translate into higher digital skills in these countries.

Despite using at least one type of AI technology in retail enterprises, the analyzed countries show a similar, relatively low percentage of employees with advanced digital skills (Figure 28). A similar situation exists with programming skills (Figure 29). Overall, most EU countries are concentrated in the lower-left quadrant, indicating low levels of AI usage and digital and programming skills among employees.

In the retail sector, digital skills are becoming increasingly important, yet the level of these skills among employees is still lower than the average in other sectors. Small and medium-sized enterprises struggle to hire employees with the necessary digital competencies, affecting the adoption of new technologies. Cyprus stands out for its high recognition of the importance of digital skills, but the level of these skills among employees remains relatively low. There are significant differences between countries in the digital skills of employees. Romania and Poland are at the bottom, while Germany and Cyprus achieve the highest results.

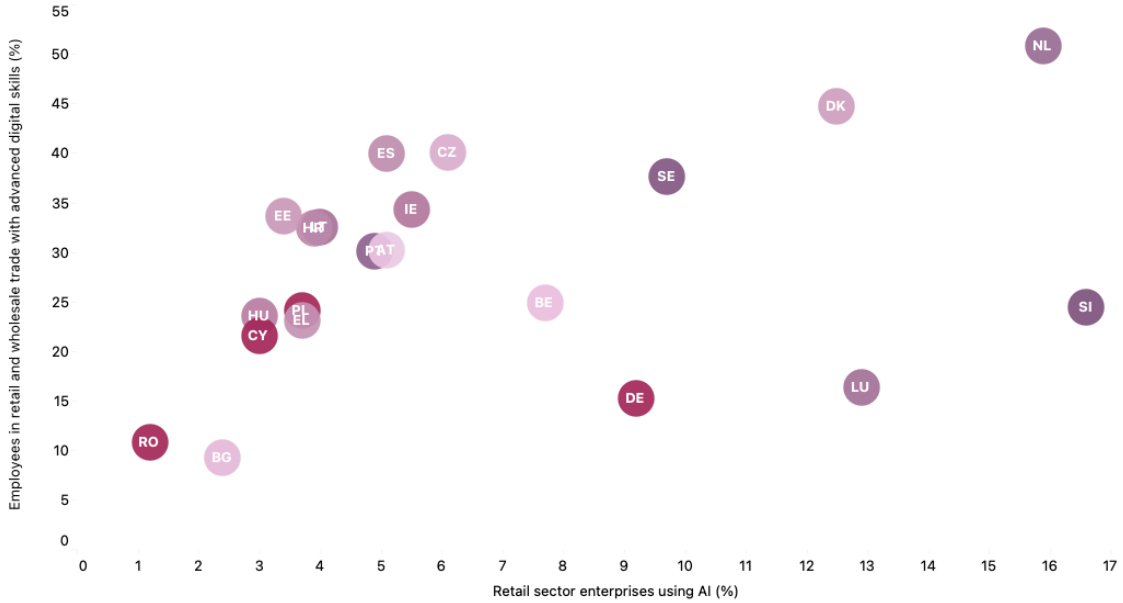
Figure 26 Level of digital intensity and advanced digital skills in retail trade enterprises (2023)

Source: Eurostat Digital Skills & DII

Figure 27 Level of digital intensity in retail trade enterprises and employees' programming skills (2023)

Source: Eurostat Computer Skills (Individuals who have written code in a programming language) & DII.

Figure 28 Use of AI and advanced digital skills of employees in retail trade enterprises (2023)

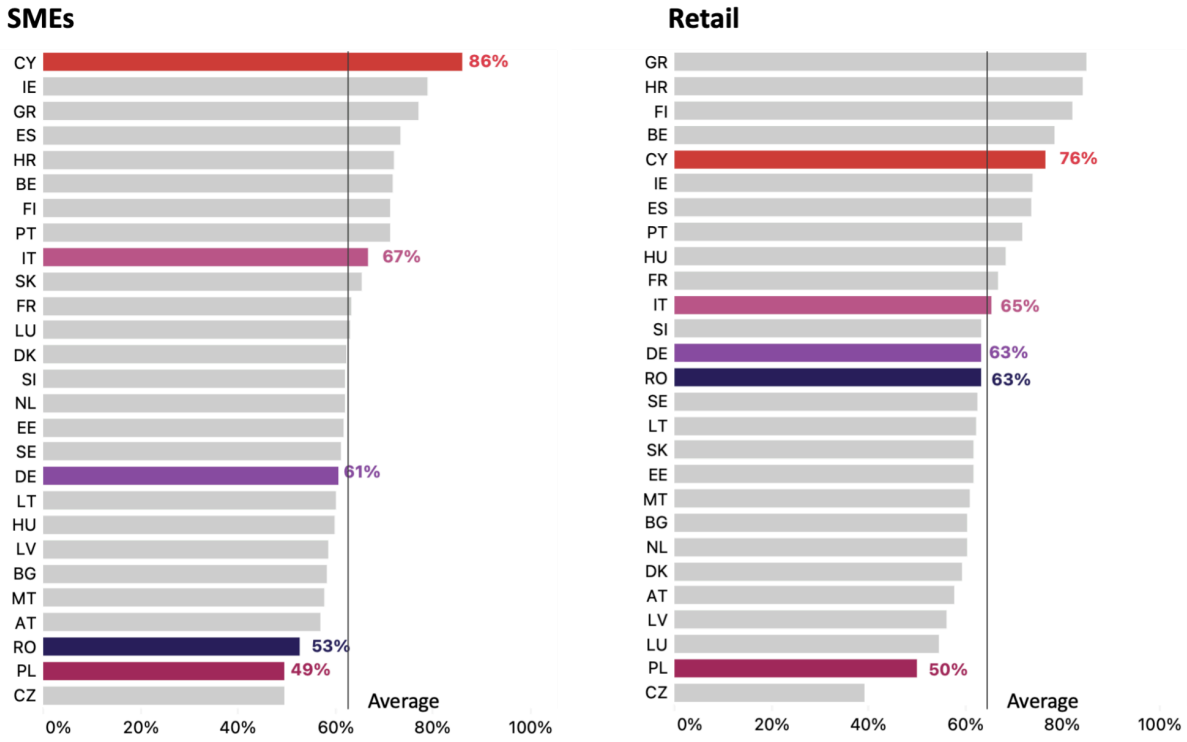


Source: Eurostat Digital Skills & Enterprises using at least one AI technology.

Figure 29 Use of AI and programming skills of employees (2023)

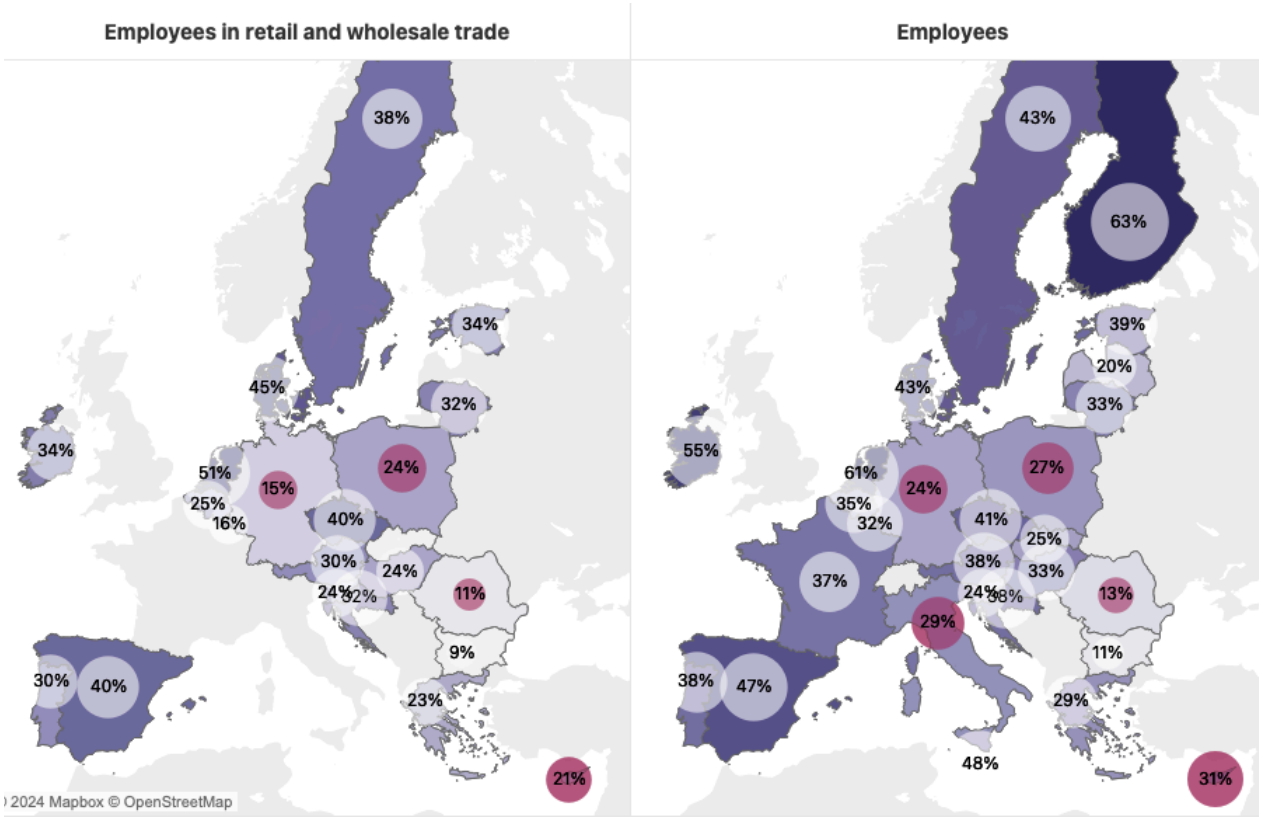
Source: Eurostat Computer skills (Individuals who have written code in a programming language) & Enterprises using at least one AI technology.

Figure 30 Companies where digital skills are becoming increasingly important - SMEs and retail trade enterprises (2023).



Source: Flash Eurobarometer 529 To what extent are the following skills becoming more or less important for your company? "Digital skills" (e.g., skills required for implementing or using digital technologies)

Figure 31 Employees with advanced digital skills in the retail and wholesale trade sector, compared to all employees (2023)



Source: Eurostat. (Digital Skills)

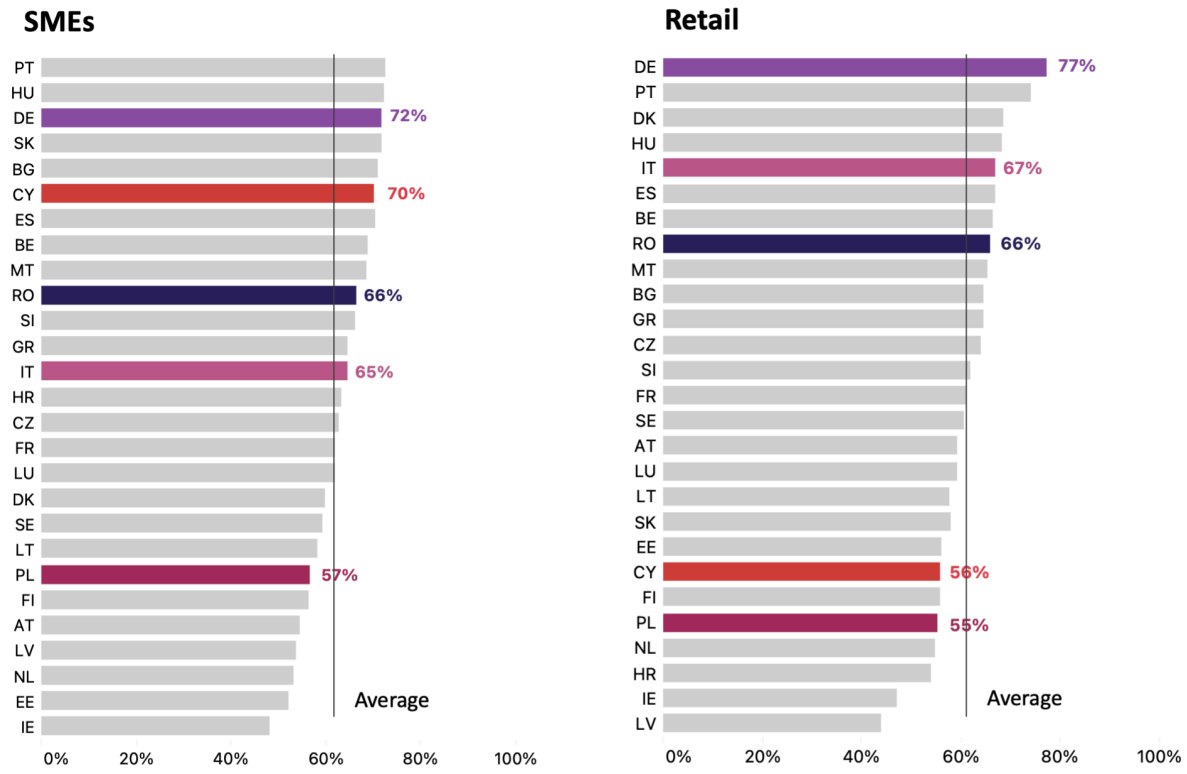
Figure 32 Employees in the retail and wholesale trade sector with advanced digital skills (2023). Source: Eurostat. (Digital Skills). Circles - Skills in 2021, bars - Skills in 2023.

Figure 33 Share of employees with advanced skills in specific groups of digital competencies (2023)

	PL	EU27	CY	DE	IT	RO
Communication and collaboration	84,3%	89,4%	95,6%	85,8%	89,2%	87,3%
Information and data literacy	80,9%	76,6%	88,8%	59,7%	70,9%	66,2%
Problem solving	64,3%	67,0%	61,3%	62,5%	61,6%	30,7%
Creating digital content	49,2%	55,0%	55,0%	51,5%	53,3%	29,1%
Security	39,9%	52,6%	42,9%	46,8%	42,2%	29,2%

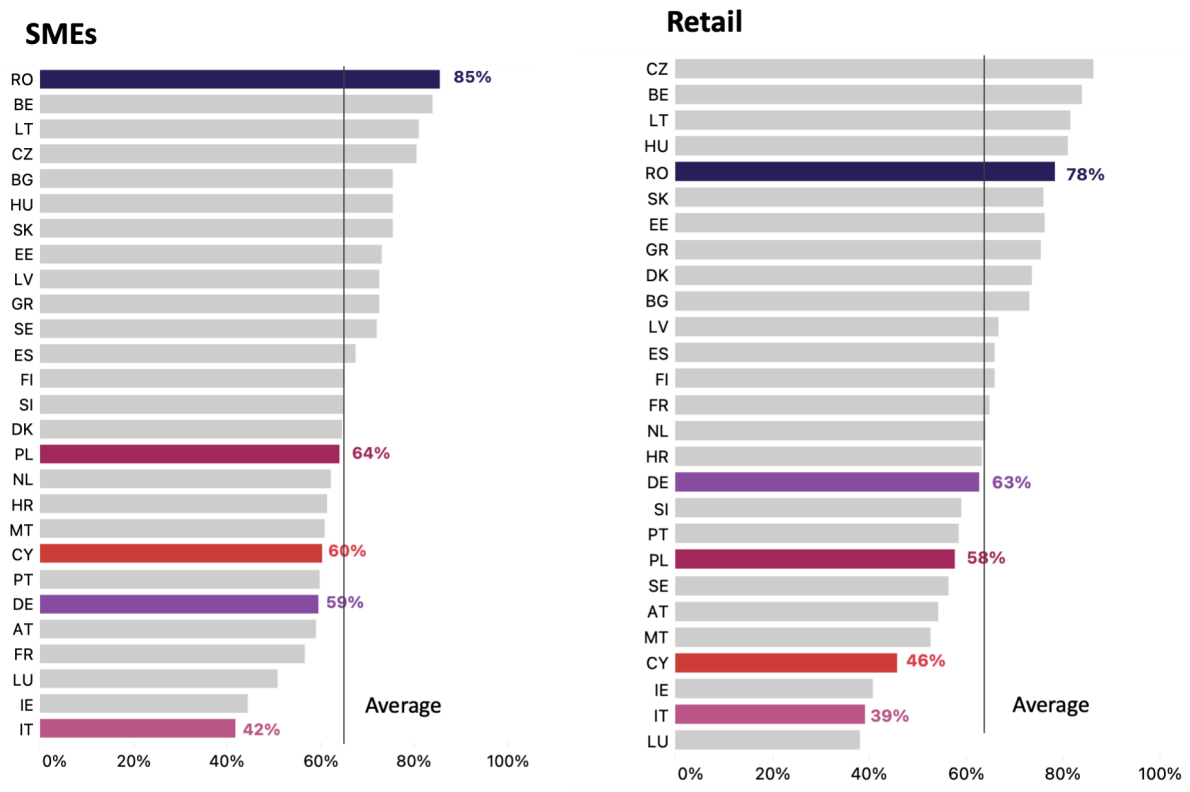
Source: Eurostat. Individuals' level of digital skills

Figure 34 Companies facing difficulties in hiring employees with the right competencies - SMEs and retail trade enterprises (2023).



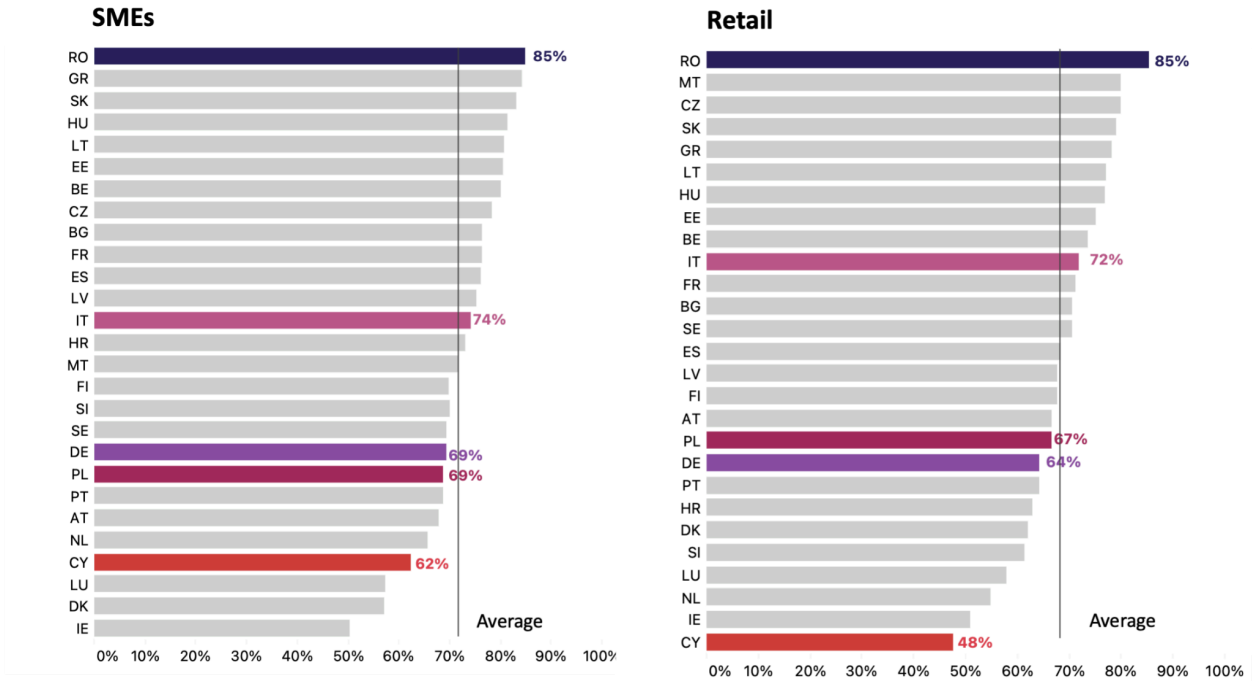
Source: Flash Eurobarometer 529 How difficult are the following tasks for your company? Finding employees with the right competencies

Figure 35 Companies facing difficulties in hiring specialists, junior specialists, and technicians - SMEs and retail trade enterprises (2023).



Source: Flash Eurobarometer 529 Does your company have difficulties recruiting employees for the following positions? Specialists, junior specialists, and technicians

Figure 36 Companies where the lack of digital skills among employees hinders the implementation of digital technologies (2023).



Source: Flash Eurobarometer 529 Lack of skills hinders the implementation or use of digital technologies in your company

2.5. Characteristics of selected states

2.5.1. Cyprus

Cyprus stands out for its high level of digital technology adoption, particularly in cloud computing (52.4%) and IoT (40%). While digital skills are highly valued, the actual level of these skills among employees remains low. The Cypriot retail sector uses advanced technologies for building security and energy management, demonstrating a proactive approach to integrating new technologies.

2.5.2. Germany

Germany has a moderate level of cloud computing (44.5%) and IoT (26.9%) usage but the highest share of e-commerce in the retail sector (20.9%). German firms show better advancement in

digital technology use but still face issues with the shortage of employees with above-basic digital skills. Despite this, Germany maintains a strong position in the digitalization of the retail sector compared to other countries.

2.5.3. Italy

Italy features the highest level of cloud computing usage (58.4%) in the retail sector and a high level of e-commerce adoption. However, Italian SMEs struggle with a lack of specialized digital knowledge, hindering the implementation of new technologies. Italy holds average positions in AI and IoT usage, indicating the need for further digitalization investments to enhance market competitiveness in Europe.

2.5.4. Poland

In Poland, the wholesale and retail trade sector reports high turnover but is characterized by a low level of digitalization, especially among small and medium-sized enterprises (SMEs). In 2023, only 7.7% of retail companies used e-commerce channels, and 84% of SMEs did not use AI technologies, indicating a need for intensified digitalization efforts. Additionally, Polish firms struggle to hire employees with the necessary digital skills, which hinders the implementation of new technologies and lowers market competitiveness.

2.5.5. Romania

Romania records the highest growth in the wholesale and retail trade sector but also has the lowest level of digitalization among the analyzed countries. Only 13.4% of retail companies use e-commerce, and 13% use IoT, indicating significant delays in adopting digital technologies. Additionally, Romanian firms face significant challenges in hiring employees with the necessary digital skills, limiting their adaptability and market competitiveness.

3. Real-life AI uses in retail companies: use cases and best practices

In this section, we present how selected retail companies incorporate artificial intelligence technologies into their everyday operations. We compiled these use cases and best practices through a review of academic and gray literature, consultations with industry experts, and participation in industry conferences. The descriptions are based on the information sourced through each company's website and, in several cases, through interviews with the company's representatives.

Key takeaways

- In the majority of cases, AI was specifically used for optimizing customer support, mostly through interactions with chatbots and automated personalization of offers.
- Other uses focused on automated SEO processes, supply chain management, content generation and moderation or general data organization and analytics.
- Outsourced AI tools are often offered as a service, therefore marketed as requiring no technical skills or maintenance efforts.
- Nevertheless, several cases suggest a need for basic understanding of the company's operational data, as well as the knowledge on AI tool's functionality and the benefits of it.
- Deeper insight into the implementation process revealed a need for critical thinking skills for evaluating tools' performance and communication skills for sharing the collected insights.
- The analyzed cases tend to portray automation of manual processes as a positive change, focusing either on human-machine cooperation or the change of employees' focus from repetitive to more complex tasks.

To be noted, while we refer to "use cases" to highlight the diversity of applications of different AI technologies, the research process revealed that in business practice the term is overused for marketing purposes. For technology providers, "use case" usually means a general description of any possible use of an AI tool. This, however, begs the question of how applicable, in reality, a given solution would be for an MSME with limited resources. That is why we focused on the data provided in more specific cases.

Frequently named "case studies" or "customer stories", these accounts described successful AI applications in actual companies with precise information on the implementation's results. This

could occur in the form of KPIs (e.g. conversion rate, customer satisfaction score) or an explanation by a company representative of the impact on the operations/employees. While using these measures may indicate a well-grounded success of the described AI uses, it should be remembered that the metrics could have been defined with the involvement of the technology providers, presumably in favor of their product's efficiency.

The companies in which AI was implemented were all categorized as MSMEs, using the number of employees (less than 250 employees) as an indicator. The turnover/balance sheet total criterion was omitted due to lack of available data[1]. Each firm was also identified as an EU enterprise, meaning that its headquarters were located within the territory of a Member State. This did not rule out the possibility of business operations spread internationally. All the above requirements did not apply to the technology providers described in the use cases.

3.1. ALOHAS

3.1.1. Description of the company

Source: https://www.gorgias.com/customers/alohas

Name	Country	Size
ALOHAS	Spain	<250 employees

Description: Founded in Hawaii and based in Barcelona, ALOHAS is a sustainable fashion brand specializing in locally handcrafted shoes. Despite having their products sold in numerous fashion stores all over the world, the company's uniqueness stems from its online on-demand collections. Through this approach, ALOHAS prioritizes quality and conscious use of resources over constant availability of overproduced supply.

Goal: Providing customer service that would engage and support users in the company's specific mode of ordering.

Strategy: Automated communication system providing sufficient number of non-delayed, meaningful interactions with customers.

Technology providers: Gorgias

[1] Source: https://single-market-economy.ec.europa.eu/smes/sme-fundamentals/sme-definition_en.

Tools: Automate add-on

3.1.2. The need

Setting up on a mission to support sustainable fashion consumption habits, ALOHAS created a solution that let them stand out from the competition and claim genuine concern about the environment. By moving away from traditional business models, however, the company faced a challenge of maintaining efficiency without compromising its core values.

The on-demand system was based on pre-orders that offered attractive discounts in exchange for extended order-fulfillment time of 6 weeks. This approach, opposing the instant demand-supply model of consumption, reduced the issue of overproduction but required much more customer support. Educating potential clients about the ethical benefits, answering questions and assisting throughout the whole process proved to be time-costly and exceeded the working capabilities of employees.

Customer care representatives received 10-15 thousand inquiries monthly, with customers demanding information on the details of ALOHAS' unique offer. Questions about return policies, shipping times and sizing were not difficult to answer but managing all this correspondence was a tedious, repetitive task, and too big for a small team of 15 people to complete on time.

That is when ALOHAS decided to use the help of automation technology. They reached out to *Gorgias*[2], a company offering a comprehensive e-commerce help desk offer.

> ⓘ ***Gorgias*** *is a customer service software for online stores. Its helpdesk performs a range of tasks, including automated ticket management, order tracking, as well as multichannel personalized communication with users.*

The main goal of ALOHAS was to create a customer service system that would let them manage all the communication without the delay, while maintaining and generating valuable connections with clients.

3.1.3. AI-based solution

On-time and faster with automated support

Handling multitudes of people interested in ALOHAS' offer turned out to be feasible with the aid of Gorgias' *Automate* add-on[3], which took over many tasks that were previously performed manually.

[2] https://www.gorgias.com/
[3] https://www.gorgias.com/products/automate

ⓘ ***Automate*** *is an AI automation tool that is used for optimized execution of customer support tasks. It enables building interactive conversation scenarios that are personalized in accord to a user's input. The system offers instant answers, delivers actual order-status data and processes reported issues or order modifications.*

Automate's features contributed to starting new conversations without the need of constant supervision of customer care employees. The system was able to quickly respond to clients' requests based on the predesigned interaction flows. With advanced analytics, it anticipated the preferences and needs of a given user and instantly reacted with appropriate support.

Whether it concerned pre-purchase inquiries, order tracking or post-sales matters, chat widgets were equipped with common questions' buttons, which allowed for a quick self-service. Different flows led the users through their interactions with the store and enabled monitoring of their order's status. Whenever automated conversations proved insufficient, customers could ask for additional help and be redirected to a human assistant.

Higher deflection rates resulted in more customers served, quicker communication and left human agents with more energy and time to conduct deeper follow-up conversations in more difficult cases.

3.1.4. Results

This one solution led ALOHAS to automating 83% of customer service interactions. As a result, responses could be provided 50% faster - 3,5 minutes in place of 7 minutes that would take employees to answer. 56% of chat tickets were resolved through self-service. When a conversation is continued by a support team member, he/she can work with the initial customer data already collected by the system. Not only more customers interact with the company but the improved CX translated to more actual transactions. Automated quick responses led the company to increase chat conversion by 12% and the overall revenue from the chat interactions reached a 250% growth.

3.1.5. Employee skills needed to adopt the solutions

Along with its technology, Gorgias offers an educational platform for employee training. The skills that are to be obtained through these materials include basic knowledge on automation, customer service metrics, navigating Gorgias' tools and working with rule-based systems.

3.2. Feed.

3.2.1. Description of the company

Source: https://www.zendesk.com/customer/feed-2/

Name	Country	Size
Feed.	France	<250 employees

Description: Feed. is a Paris-based company selling nutritional meals. Their bars, snacks, shakes and powders are promised to serve as a healthy, convenient source of all the required nutrients. The offer targets various dietary groups with products tailored for active lifestyles, weight loss and meeting the demand for vegan, gluten-free, lactose-free and non-GMO foods. Feed. meals are sold in popular convenience store chains all over France, as well as through the company's website - as individual products or a part of subscription programmes.

Goal: Optimized proactive customer service.

Strategy: Multi-channel communication system integrating various support and analytics tools.

Technology providers: Zendesk, Shipup, Adobe, Diduenjoy

Tools: Zendesk Service, Zendesk Talk Partner Edition, Zendesk Chat, Zendesk Explore, Shipup Customer Support, Magento Order Management System, Diduenjoy customer experience tools

3.2.2. The need

In order to meet the needs of a diverse range of clients and keep them engaged in a proactive manner, Feed. created a new customer service team. They hired an experienced specialist and started developing strategies for acquiring more interest and supporting the existing base of users. The team launched promotional campaigns with sample tastings and the ticketing processes were commissioned to the email-based tool - Front.

This approach turned out to be insufficient to manage emerging requests for the company's products. Too much time was needed for processing emails and responding to clients with suitable support and product offer. As a result, orders were fulfilled with an unnecessary delay.

Along with a significant amount of time, it required a lot of employees' manual work to handle all of the communication channels to track the queries and orders, and be ready to answer various

questions or solve any problems that arose during the transaction. It was not easy to handle all these tasks with only 6 members of the support team.

Eventually, the team decided to look elsewhere for a comprehensive customer service solution that would help them organize numerous tasks, spread all over their communication channels. That is when Zendesk[4] entered the frame:

ⓘ ***Zendesk*** *is a customer service software providing a complete CS solution that is both scalable and easy to use. Its range of tools are expected to improve customer experience, optimize employee productivity and provide valuable insights into companies' operations. Their service is based on original solutions integrated with external apps and technologies.*

The main goal of Feed. was to develop an efficient customer service system that would help them "treat their customers like royalty" through quick and multi-channel support.

3.2.3. AI-based solution

Supporting anywhere, anytime

To be able to fully control their customer support operations, Feed. tried Zendesk's Service tool[5] that is used for general management of communication with clients.

ⓘ ***Zendesk Service*** *tool enables creating and maintaining meaningful connections with customers across multiple channels. It handles personalized messaging, problem-solving, as well as self-service help centers. With its additional features it can become responsible for numerous tasks such as ticket and workforce management or data organization and analytics.*

Zendesk Service helped the Feed. team optimize their workflow, easily connect to different communication channels and proactively engage customers with automated and personalized messages. To understand the importance of this, however, it is necessary to dive deeper into specific task-oriented solutions that were part of Zendesk technology.

Proactive engagement with real-time insights

One of the main changes within the company occurred through implementation of Zendesk's live chat. Although Feed. used chats before, they carried it out passively, without the help of precious insights into customers' personal preferences and needs. Then, Zendesk's live chat[6] was introduced:

[4] https://www.zendesk.com/
[5] https://www.zendesk.com/service/
[6] https://www.zendesk.com/service/messaging/

ⓘ ***Zendesk Chat*** *is a live chat software that uses chatbots and data analytics to maintain omnichannel proactive communication. It provides customized chat windows that are easy to use and deliver personalized content based on data collected in real time.*

Live chat, activated by proactive triggers, enabled the customer service team to quickly solve problems with some simpler issues handled automatically. Constant collection and processing of user data became a basis of personalized recommendations that improved customer experience. Operational capabilities resulted in the support system handling over 100 chat requests a day, compared to 10-15 requests through passive chat functions.

The meaningful interactions would not be possible without the help of Zendesk's Explore tool[7] that conducted constant monitoring of Feed.'s communication with customers.

ⓘ ***Zendesk Explore*** *processes and analyses data of customer experience within different communication channels to generate reports of real-time activities, encountered issues and possible interests of a particular client. It reduces response time, which results in more solved requests, and provides more accurate content that is backed by insights from collected data.*

This tool helped the company quickly deliver personalized content that was matching a given user's actions, for example, the blog content that he or she was reading. Getting regular reports on the operations workflow, Feed.'s employees could keep track of their performance without constant supervision of the team leader. Meanwhile, Zendesk conversion tracking enabled the management to monitor the results of new solutions and strategies.

Beyond Zendesk

What stands out in services like those offered by Zendesk is the flexible Application Programming Interface (API) that facilitates easy integration with technologies from other sources. For instance, one of the communication channels managed by Zendesk was phone support.
The *Talk Partner Edition*[8] significantly enhanced Feed.'s contact center.

ⓘ ***Zendesk Talk Partner Edition*** *is a voice software that enables implementing a call console connected to a chosen Computer Telephony Integration (CTI) provider. It allows for easy phone support management built in the company's current workspace.*

In the case of Feed., many external tools were integrated into the customer support system to further improve its efficiency.

[7] https://www.zendesk.com/service/analytics/
[8] https://www.zendesk.com/service/voice/talk-partner-edition/

The Shipup tool[9] proved to be a valuable addition to the company's new proactive approach.

ⓘ ***Shipup*** *is an order monitoring and communication tool that allows for tracking of shipping processes and providing real-time alerts to contact customers before they experience inconveniences of delayed order.*

Through Shipup, Feed. could automatically inform clients about order issues. This, in turn, reduced the number of tickets received by the support team and enabled quick solving of encountered difficulties.

Additional use of Magento[10] and Diduenjoy tools[11] helped the company collect more valuable information on their customers. The first software was used to obtain order details, while the other one became a source of feedback and customer experience data.

ⓘ ***Magento Order Management System*** *(OMS) is a solution for monitoring and managing inventory, ensuring its visibility on different stages of supply chain and responsive customer service.*

ⓘ ***Diduenjoy*** *offers solutions for optimized customer experience through actionable feedback. It enables survey creation and multichannel distribution, as well as organized feedback collection from different sources.*

Extensive customer experience data proved to be helpful not only for the streamlined support system. Effective communication within the company resulted in transferring valuable insights that influenced future marketing strategies, newsletter writing and even product design.

3.2.4. Results

The implemented solutions led to a significant increase in Feed.'s sales. In less than a year, the live chat conversion rate reached 6%, which resulted in €180,000 revenue. The ticket management was optimized, releasing the employees from excessive workload. Tickets that required multiple touchpoints (employee's actions), once adding up to 80% of all tickets, were now reduced to 10% and to a great extent replaced by one-touch tickets. Optimized customer support eventually proved to realize the idea of genuine "royalty experience" with Customer Satisfaction (CSAT) scores jumping from 75 to 94%.

3.2.5. Employee skills needed to adopt the solutions

Despite limited resources, Feed. was able to easily adopt new technologies and make use of them through the team of 6. No developer skills or additional support were required to benefit from Zendesk's system. Analytics tools were equipped with data visualization and reporting

[9] https://www.zendesk.com/marketplace/apps/chat/141470/shipup-for-zendesk-chat/
[10] https://www.zendesk.com/marketplace/apps/support/321722/magento-2-by-zenplate
[11] https://www.diduenjoy.com/en/integration/zendesk

features and the company only needed a proper communication system to share the acquired knowledge for informed decision making.

3.3. Grünewald

3.3.1. Description of the company

Source:
https://foodforecast.com/en/references/herr-gruenewald-von-der-baeckerei-gruenewald/

Name	Country	Size
Grünewald	Germany	<250 employees

Description: Grünewald is a Waldlaubersheim-based bakery that has existed in the German market for over 125 years. Today, with 29 branches in the region, the company preserves tradition while embracing changes of the modern world. It provides an example how new technologies can work in favor of sustainability, keeping the business safe for the future generations.

Goal: Optimizing ordering processes to better match the demand for specific items.

Strategy: Automated ordering system based on regular forecasts and centrally controlled.

Technology provider: foodforecast

Tools: ML- and DL-powered software for order automation.

3.3.2. The need

As a company with long traditions, Grünewald made considerable efforts to keep the business local. In spite of scaling up, the bakery procures raw materials from suppliers within the region. Caring for the environment and financial sustainability of the business, Grünewald wanted to use their resources prudently, while maintaining the established quality. With the energy and

raw materials prices growing, optimal supply chain management was indeed a matter of survival.

Having developed a sizable chain of stores, however, the company's management realized that some organizational practices were not fit for the new business model. To date, individual sellers fulfilled orders by themselves based on their intuition and experience. Even if there were instructions from above as to which products in what quantities should be ordered, the decision was eventually determined by a worker's, some better some worse, personal judgment. With the number of branches increasing, new sellers had to be hired. This made the ordering process even more prone to errors.

As a result, the inventory preparedness varied in time and place. On the one hand, unexpectedly high returns of unsold products occurred, while in different cases some products were out of stock too soon. Lastly, manual order generation engaged employees' time and blocked the cash registers used in the process.

In this particular case, it was the technology provider, *foodforecast*[12], that reached the potential customer:

> ⓘ ***Foodforecast*** *(formerly werksta.tt) is a German company that "uses artificial intelligence (AI) to reduce food waste" through their Software as a Service (SaaS) model. It combines a given company's historical data with external factors to predict future demand and automatically optimize production, ordering and store planning.*

The main goal of Grünewald was to refine their ordering system with automation, reducing the consequences of human errors and overcoming demand uncertainty.

3.3.3. AI-based solution

Convincing automation

Grünewald's POS data was analyzed with foodforecast's software in order to implement the *Order optimisation* solution[13]:

[12] https://foodforecast.com/en/
[13] https://foodforecast.com/en/unsere-loesungen/

ⓘ ***AI-based Order optimization*** *is one of the tools built on foodforecast's algorithm that provides daily forecasts at order item level. The predictions of sales volumes are automatically translated into order proposals, ready to be triggered or manually adjusted by employees.*

After successful testing in one of the Grünewald's stores, the solution was introduced in other locations. Each day, the system generated orders based on the forecast of the following day's sales of different products. Initially, the more experienced employees were skeptical and modified the automatic orders. As the time passed, the predictions made by AI software turned out to be so accurate that the change was uniformly embraced. Eventually, the entire ordering process was automated. The employees could stop bothering with manual calculations and their uncertain predictions and fully concentrate on selling the products.

More control with less effort

All of the data became organized and easily available for the management to overlook the operations and set strategic targets, e.g. concerning the desired balance between returns and stockouts, although as the system proved successful and consistent, the top-down adjustments could also become less frequent. Transparency of information enabled unprecedented insight into discrepancies and became a reliable basis for theft prevention.

3.3.4. Results

The implemented solutions led Grünewald to better financial outcomes. The returns became smaller in size, and demanded products were sold in larger quantities, in some cases reaching 80% increase in sales. With reduced loss of resources, the company had strong evidence to claim sustainability in front of its clients.

3.3.5. Employee skills needed to adopt the solutions

Since the success of the AI system was based on lower levels of employee intervention, it may suggest little to no need for additional skills. Grünewald's manager also claimed that in case of troubles, foodforecast's support was always available. However, he then stated that the technology provider could "reduce the complexity even further". Convincing skeptical employees towards the system was said to be enabled mostly due to technology's efficiency but the mere occurrence of the problem may point to the need of adaptation and change management skills.

3.4. Kerrigans

3.4.1. Description of the company

Source:
https://www.shopbox.ai/casestudies/shopbox-ai-transforms-the-shopping-experience-for-craft-butcher-kerrigans-boosting-conversions-by-250

Name	Country	Size
Kerrigans	Ireland	<50 employees

Description: Kerrigans is a family-run craft butcher. Along with 5 locations in northern Dublin, the company conducts its sales online, delivering products all over Ireland. The offer ranges from traditional cuts to ready-to-eat low-fat meals, along with barbecue and cooking condiments. Owners take pride in the quality of the meats, assuring a fully transparent farm-to-fork supply chain.

Goal: Engaging and profitable e-commerce with limited resources.

Strategy: Personalized customer experience through automation tools.

Technology provider: Shopbox AI

Tools: AI Curated Homepage, AI Shop Assistant

3.4.2. The need

Brendan Kerrigan valued locality and direct contact with the customers since he founded his family business in 1973. In the present, the company operated by his two sons expanded its operations to the ecommerce model.

Keeping up with modern requirements of the retail industry could not, however, be limited to launching an online store within the Shopify platform. The owners wanted to preserve the quality of service provided by their small team in the physical locations. This traditional approach was also motivated by the company's limited resources.

Kerrigans entered into partnerships with alliance groups for national retailers that, to a point, helped them become fair competition to large companies. Yet, for the new ecommerce channel to serve its purpose in an efficient way, some change in operations management was

necessary. Kerrigans needed more online presence and conversions without overly exploiting its staff and finances.

The solution to this challenge emerged when the company came across *Shopbox AI*[14] services.

> ⓘ ***Shopbox AI*** *is a sales engine for optimizing traditional customer experience in ecommerce environments. Fully automated and maintenance free, the software generates conversions through personalisation tools, intelligent merchandising and unobtrusive assistance starting from the user's first click within the website.*

The main goal of Kerrigans was to maintain the in-store quality of its customer service, while engaging more online customers to purchase the products.

3.4.3. AI-based solution

Personal website

After only 3 days of preparations, Shopbox AI implemented their first technology into Kerrigans' *Shopify store - Curated Homepage*[15].

> ⓘ ***Curated Homepage*** *is a feature that performs dynamic personalisation based on a user's every interaction with a website. Through targeted layout and product offers it provides a unique shopping experience for each customer.*

Curated Homepage displayed recommendations, promotions and recently viewed or trending items. As a result, new clients could become engaged from the very first visit to the online store, whereas previous users gained quick access to the products they were interested in.

Recommended items shown in product display page (PDP) carousels not only followed customers' preferences but were also linked to Kerrigans' inventory and marketing data. Stock levels, repricing and promotions were automatically integrated with the actual offer. This way, the process required no intervention on the part of the company's small team.

Maintaining excellent service

As Kerrigans' offer is designed to outmatch the regular supermarket supplies' quality, it must also come with the proper customer support. In physical stores, employees made sure that the clients were served with care for their individual needs.

To match the level of online shopping experience with traditional in-store encounters, Shopbox AI introduced its *AI Shop Assistant*[16].

[14] https://www.shopbox.ai/
[15] https://www.shopbox.ai/shopbox-demo
[16] https://www.shopbox.ai/blog/how-ai-shop-assistants-are-changing-the-retail-industry

ⓘ ***AI Shop Assistant*** *is a customer service tool providing personalized follow-ups for similar products, up-selling and cross-selling. Through tailored offers it helps increase the average order value (AOV) and reduce the bounce rate.*

AI Assistant enabled Kerrigans to present its wide range of products without bringing the clients to one of their locations. The fully automated process not only reduced the demand for employees' customer support but also did not require any technical maintenance. The distinctive quality of this approach was that it allowed for advanced customer experience without the need for substantial amounts of historical data that are usually used for personalisation.

3.4.4. Results

The implemented solutions led the small company to reach growth. Shopbox tools, while still engaging only 39% of the online customers, now mediate 59% of transactions. Spending twice as much time on Kerrigans' website and users view three times more products. This translated to a 250% increase in conversions and an average order value higher by 9%.

3.4.5. Employee skills needed to adopt the solutions

Since the solutions offered by Shopbox AI are based on full automation, the technology provider claims that no IT support or maintenance is required to benefit from its services.

3.5. Kuchyne Valent

3.5.1. Description of the company

Source: https://pl.semrush.com/company/stories/kuchynevalent/

Name	Country	Size
Kuchyne Valent	Slovakia	<50 employees

Description: Kuchyne Valent is a family-run kitchen and furniture manufacturing company based in Bratislava. KV offers their products to individual customers through the company's website https://www.kuchynevalent.sk/ which combines an online store and a blog.

Goal: "Creating exceptional blog content and ensuring its widespread distribution."

Strategy: SEO, image optimization

Technology provider: Semrush

Tools: Site Audit, Keyword Magic Tool, Keyword Gap, Keyword Overview

3.5.2. The need

After expanding their sales channels to the digital environment, Kuchyne Valent faced new challenges of reaching the online customers. With limited resources, and little SEO experience, they set on a task to develop a successful marketing strategy that would make the company visible and its offer - matching potential clients' searches.

The company's website serves two purposes. Its online store provides a sales channel positioning it in an e-commerce model. The blog, on the other hand, acts as a marketing tool helping Kuchyne Valent showcase its solutions and finished products. It also became the main source of shared content contributing to visibility of the company's offer.

Initially, the team running KV made independent efforts to promote their company using different SEO techniques. The results, however, proved to be unsatisfactory and Kuchyne Valent reached out for analytic tools offered by Semrush[17]:

> ⓘ ***Semrush*** *is the online visibility management and content marketing SaaS platform. It provides services such as website auditing, keyword research, backlink optimization, competitive analysis, content creation and ranking monitoring.*

The main goal of the company was to improve their blog content so that it generated more leads which, in effect, would increase sales and company's revenue.

[17] https://www.semrush.com/

3.5.3. AI-based solution

Understanding the problem

First step taken by the Semrush team was to understand the problems that Kuchyne Valent was facing and find a solution tailored for their specific needs. Using the *Semrush Site Audit*[18], the team identified specific influence of various SEO techniques on the company's organic traffic. The audit proved that the former strategy, which favored copywriting, could be improved by an approach that put more emphasis on image optimization.

ⓘ ***Site Audit*** *- SEO analysis tool, crawling and checking every page on a given website. It produces regular reports on website's issues, their levels of priority and solutions to fix them.*

Optimizing content with keywords

Well-selected keywords helped Kuchyne Valent organize their web content in accordance with SEO demands. With the help of *Semrush Keyword Magic Tool*[19], they were able to find the most efficient keywords for image titles. All the keywords were categorized, creating clusters with relevant subcategories and related searches. That helped define the structure of the whole blog content and distribute images across different categories and subcategories.

ⓘ ***Keyword Magic Tool*** *- topic-based keywords suggestions for optimized and structured content organization. Shows possible links between more general topics, subgroups and related searches, including long-tail keywords.*

Understanding competition

Using the *Semrush Keyword Gap*[20], KV could analyze their competitors' best-performing keywords that were not as efficiently used by the company. Identified gaps and strengths acted as a basis for target keyword masterlist.

ⓘ ***Keyword Gap*** *- enables a comparison of keyword profiles between competing companies. Lists all common and unique keywords (including organic, paid and PLA) a given firm ranks for with values and cross-company differences and intersections.*

Understanding trends

Keyword Overview[21] helped KV identify trending keywords which resulted in developing a specific product line that met the demand, increased blog's SERP score and let the company achieve expert status in the specific area.

[18] https://www.semrush.com/siteaudit
[19] https://www.semrush.com/analytics/keywordmagic/
[20] https://www.semrush.com/analytics/keywordgap/
[21] https://www.semrush.com/analytics/keywordoverview/

ⓘ ***Keyword Overview*** *- keyword research database with general information on a given keyword, including search volume, difficulty, intent and CPC value.*

3.5.4. Results

The implemented solutions helped Kuchyne Valent achieve 250% revenue growth. Over the next 5 years, the website's organic traffic remained the primary source of lead generation. Later on, the company expanded its intake of marketing technologies and started PPC advertising using Semrush PPC insights and Google Transparency Center.

3.5.5. Employee skills needed to adopt the solutions

Overall, main gaps in KV's resources were: a) lack of data, b) lack of understanding of off-page SEO (search engine rankings influenced by processes conducted outside the website).

3.6. L Cosmetics

3.6.1. Description of the company

Sources: https://www.leafio.ai/case-studies/l-cosmetics/, an interview with Leafio representative

Name	Country	Size
L Cosmetics	Estonia	<250 employees

Description: L Cosmetics is a drugstore retail chain selling hygiene, health and personal care products for women, men and children. Their offer includes over 90 brands from global and domestic producers. Sales take place through over 25 stores located all over Estonia and an e-commerce website.

Goal: Creating an optimized inventory management system.

Strategy: Automation of order processing and stock management.

Technology provider: Leafio

Tools: Smart automated ordering system

3.6.2. The need

L Cosmetics managed their wholesale and retail inventory through several different sectors of the company. Orders from every store were dependent on a decentralized network of departments that shared the control over the supply chain. The analyses and calculations conducted by the employees from various teams overly exploited the company's labor power, took a significant amount of time and were far from accurate.

Delayed decision-making and difficult communication between the departments resulted in both overstocking and supply shortages. Stores were logistically unprepared for planned promotion campaigns, while large amounts of other products remained unsold, taking up precious storage space.

Since the tasks carried out manually were already time-consuming and limited by human processing capabilities, the company lacked resources to review the current workflow and develop strategies for optimizing it. The reasons for persisting inefficiencies remained obscure, but their effects kept influencing the operations and financial outcomes.

To improve their performance in the drugstore retail sector, L Cosmetics team reached out for help from a professional service provider, *LEAFIO*[22], specializing in optimization solutions for retail enterprises.

> ⓘ *"**LEAFIO AI Retail Platform** is a cloud AI-based retail management system. The system was created for inventory and supply chain optimization, assortment planning, and merchandising management in the face of constant change and unpredictability, which is typical for small and medium retail companies."*

The main goal of L Cosmetics was to develop an organized system for inventory management that would streamline their order fulfillment and reduce unnecessary stock, eventually releasing part of the workforce, cutting costs and increasing overall sales.

[22] https://www.leafio.ai/

3.6.3. AI-based solution

Getting the insight

All the operations were conducted remotely, without the need of arranging meetings in-person. The process began with analyses planned by LEAFIO specialists. Current inventory management operations were audited for their influence on the business. Data from the company's Enterprise Resources Planning (ERP) system were collected and transferred in order to be integrated with Leafio solutions.

In the course of developing and implementing the new strategy, several impediments were identified and modified to optimize the flow of operations. The task of generating new orders was decided to be unified within one system, reducing unnecessary delays in the processing. As for delivery procedures, Leafio encouraged stronger data transparency through eliminating backdating of the documentation. To further improve the order fulfillment process, however, an advanced technology was needed.

Automating orders

Leafio offered L Cosmetics the services of their *smart auto-ordering system*[23] that would optimize the company's order processes. This solution allowed for automated generating and scheduling orders. Due to this, new demand information can be processed quickly and sent directly to the supplier.

ⓘ ***LEAFIO AI Automated Inventory Replenishment System*** *- a comprehensive function that provides a complete process for ordering goods to the point of sale/distribution center without manual intervention. It includes automatic calculation of quantity requirements per order, automatic generation of orders, automatic dispatch of orders, automatic editing of submitted orders based on feedback from the supplier, and control of order execution. By leveraging precise demand forecasting, it streamlines the creation and dispatch of orders, enhancing supply chain efficiency.*

After training the staff to use new tools, the solution could be easily scaled up and integrated with a larger share of L Cosmetics' products and operations. The employees, now equipped with skills to operate the evolved system, were released from carrying out many routine tasks that are now handled automatically

[23] https://www.leafio.ai/automatic-replenishment-software/

3.6.4. Results

The implemented solutions led to the automation of order processing, including their generation, scheduling and distribution. This minimized the amount of errors that come with manual calculations. 3 months after the implementation, all the assortment within the stores is now connected to the ordering system, along with a significant part of warehouse supplies. As a result, spikes in demand can be met, with a 25% increase in the inventory turnover rate. On the other hand, L Cosmetics is finally able to limit overstocking, achieving a 6% reduction in its average surplus. The company continues cooperating with Leafio, expanding the use of the platform's services to gain more analytical insights.

3. 6.5. Employee skills needed to adopt the solutions

Throughout implementation, a special attention was given to the adequate training of L Cosmetics employees. Leafio points out several skills that are crucial for successful adoption of the provided technologies. System's users need to acquire knowledge about the data that will be used - their collection, processing and interpretation - as well as the algorithms that are put to work. Understanding the role of Leafio systems and Business Intelligence (BI) systems in general for the company's operations is also considered vital. On top of that, communication, collaboration, problem solving and leadership are among the soft skills that may prove useful.

3.7. Pet Media Group

3.7.1. Description of the company

Source: https://www.nyckel.com/blog/pet-media-group-case-image-classification-study/

Name	Country	Size
Pet Media Group	Sweden	<250 employees

Description: Pet Media Group (PMG) operates some of the world's largest online pet marketplaces, connecting reputable breeders with future pet parents. PMG is deeply committed to operating ethical online pet marketplaces and doing its part to support animal welfare.

Goal: Efficient moderation of visual pet advertisements in accordance with the company's animal welfare policies.

Strategy: computer vision, image classification

Technology provider: Nyckel

Tools: Content Moderation API

3.7.2. The need

Intermediating in the online pet trade Pet Media Group receives thousands of new advertisements each day. As a firm dedicated to animal ethics, PMG is reviewing all of the uploaded content so that it complies with their standards. The challenge remained in keeping the moderation successful without overusing company's resources or spending too much time in the process.

Reviewing pet advertisements in the PMG marketplace includes the search for pictures of dogs with cropped ears and emojis used for covering them. Holiday-themed pictures are not allowed due to widespread abandonment of pets bought as seasonal gifts. For each ad of puppies there is also a need of at least one photograph showing them alongside their mother as a confirmation of breeder's authenticity.

As in Eyass Shakrah, PMG CEO's former successful companies, a sizable group of moderators were employed to perform the task manually. This strategy, however, proved to be labor-intensive, time consuming and costly. Based on his previous experiences, Shakrah was eager to look out for automated solutions to improve the moderation of his websites.

Many companies are seeking AI professionals to operate Machine Learning technologies within the structures of a given firm. In order to save time and financial resources, PMG decided to outsource the services to a specialized provider. Solutions offered by Amazon Rekognition and Google AutoML, as well as some smaller companies, proved to be unfit for PMG's specific needs and capabilities. After several trials, the company decided to turn to *Nyckel* platform[24] which specializes in content moderation.

> ⓘ *"**Nyckel** isn't trying to be everything to everyone. Instead, we are hyper-focused on one powerful AI use case: image and text classification. Our goal is to make it easy for anyone, no matter their technical experience, to build classification models in just minutes".*

The main goal of Pet Media Group was to develop an effective content moderation system that would reduce unnecessary labor and cut the costs.

[24] https://www.nyckel.com/

3.7.3. AI-based solution

Creating the model

To encourage smaller companies to try out their services, Nyckel offers a scalable pricing plan, processing a limited amount of data free of charge. With a set of already moderated content, PMG was able to upload a part of their data to Nyckel's servers and train a model adjusted for their purposes. Nyckel's content moderation API[25] enables a quick creation of models based on provided samples. Within the same day the PMG's model was ready to operate.

ⓘ ***Content Moderation API*** *- instead of relying on imperfect static classification models, allows building a custom tool with one's own labels. Automates manual flagging of text and images and assesses the outcome's confidence level.*

Working with the model

In the course of a few months, automated processing was integrated into the existing reviewing system. PMG' s moderators still performed some of the reviewing, especially monitoring the predictions that were marked with low confidence level. They also further trained the model with noted errors. Over time, the precision of automated moderation increased, entrusting Nyckel's technology with a majority of PMG's reviewing tasks.

3.7.4. Results

The implemented solutions led to the automation of almost 90% of all the content reviews performed at Pet Media Group. This reduced the need for manual work and helped the company save $120k annually, which translated to 20x ROI. The improved model reached and surpassed the accuracy of manual moderators. PMG expands their use of Nyckel's technologies, trying out solutions for:

- Moderating user-to-user chat messages,
- Scanning ads for near-duplicate image content,
- Using classification to determine the likelihood of an ad resulting in a sale,
- And using regression to recommend a sales price.

3.7.5. Employee skills needed to adopt the solutions

The outsourced technology, its integration, maintenance and improvement did not require any additional work on the part of PMG's engineering and data science specialists. Nyckel states

[25] https://www.nyckel.com/products/content-moderation/

that "no ML expertise" is required to use their products and the platform makes machine learning "approachable to non-developers".

3.8. Procosmet

3.8.1. Description of the company

Source: https://www.tidio.com/blog/procosmet-case-study/

Name	Country	Size
Procosmet	Italy	<50 employees

Description: Procosmet is a cosmetics company from Bologna offering haircare and beauty products. They take pride in their care for the environment and use of natural ingredients, including special blends of essential oils in the characteristic blue glass vials. Napura and MTJ are the main brands representative of the company's ethical practices that promote well-being, transparency and sustainability of luxury cosmetics.

Goal: Optimised customer service and order management system.

Strategy: analytics, integrated auto-support tool

Technology provider: Tidio

Tools: chatbots, live chat

3.8.2. The need

As the company's online activity increased, Procosmet started using the services of Shopify platform to promote and sell their products. They also reached out to a professional customer service provider and developed two apps for managing interactions with clients.

The results of this strategy proved to be uneven and difficult to supervise. Each year, conversions fluctuated throughout the different time periods with the metrics spiking or falling beyond control. Plurality of contact channels made the flow of the operations challenging to analyze. Orders were not easily monitored and any change in them cost additional time of manual identification and processing.

Without efficient oversight of sales, Procosmet's team could not gain an adequate insight into their performance and develop strategies that would optimize the workflow. Because of the

dependency on human support agents, the company was unprepared to meet the periodically rising demand without the delay of service.

Dissatisfied with former providers and modes of operation, Procosmet decided to try out the offer of *Tidio*[26], a platform providing AI-based tools and solutions for optimized customer service.

> ⓘ ***Tidio*** *- "Our suite of live chat, chatbots, helpdesk tools, and AI solutions helps brands of all sizes drive their businesses forward by offering quick and qualitative support and creating real connections with their customers."*

The main goal of the company was to implement a single app that would handle all the customer service tasks and be accessible to the employees and clients alike. As a result, new contacts would be generated to create "a healthy community" of interested and satisfied users.

3.8.3. AI-based solution

One app for all

To adjust Tidio's technology to their specific needs, the Procosmet's team decided to choose *Tidio+ plan*[27] with customized analytics and automation solutions.

> ⓘ ***Tidio+*** *provides a set of tailored customer services, including dedicated support team, live chat, chatbots and ticketing system. It allows the companies to improve the rates of their leads, conversions, sales and customer satisfaction with quick return on investment and easily scalable solutions.*

With Tidio+, the company was able to carry out all the necessary tasks within one environment. Order management, data collection and customer support could now be conducted in an efficient and consistent manner.

Consolidating communication through live chat

Live chat feature[28] enabled employees to gain easy access to order information. Any modifications, cancellations and refunds can be quickly processed through the conversation panel. Streamlining communication through one tool sped up the reaction time and unified conversational data for further analyses.

[26] https://www.tidio.com/
[27] https://www.tidio.com/tidio-plus/
[28] https://www.tidio.com/live-chat/

ⓘ ***Tidio's live chat**, tailored for e-commerce and small businesses, is a customer support tool for managing communication channels. It provides access to multiple interaction platforms from any workplace, which leads to quicker responding, increased customer engagement and constant tracking of users' activity for better personalisation and higher sales.*

Automated interaction

One of the major changes that occurred through implementation of Tidio's system was the introduction of chatbots[29]. Connected to the company's operations they proved useful in carrying out numerous tasks with unprecedented efficiency and speed.

ⓘ ***Tidio's chatbots** automate sales support and customer service through engaging in interactions with clients and collecting data generated in the process. Through personalized assistance, they can simplify lead generation, increase average order value and reduce cart abandonment. Real-time multi-language conversations allow for effective communication further improved by advanced problem-solving and targeted recommendations.*

In Procosmet's case, there are five chatbots serving a diverse range of functions, such as FAQ answering, newsletter management, data collection and customer service. They are able to perform their tasks outside regular working hours and assist many clients at the same time. Through friendly interactions, chatbots greet users, offer help and create an inviting atmosphere to keep the customers engaged and inclined to finalize the transactions.

Getting the data

Chat interactions allow the potential clients to get to know the offer that might suit their personal needs, resolve issues, as well as subscribe to the newsletter and give their contact information. The efficiency of these processes is both enabled by and further beneficial for analytical tools offered by Tidio[30].

ⓘ ***Tidio's analytics** tools collect and process data to monitor performance and provide actionable insights. They keep track of the chat flows, activity patterns and emerging issues to optimize operations and improve customer engagement.*

Detailed analytics allow for constant monitoring of sales data and details of customers' behavior and preferences. Information from previous transactions results in deeper understanding of obstacles and opportunities that could be used for quick problem-solving and up-to-date workflow optimisation. Real-time improvements and data-based support were key to increased satisfaction of the customers.

[29] https://www.tidio.com/chatbot-ai/
[30] https://www.tidio.com/analytics/

3.8.4. Results

The implemented solutions led to improved Procosmet's KPIs in many areas. They were able to launch a marketing campaign that resulted in over €1000 return on investment. The overall conversion rate was not only stabilized but systematically increased by 27% in a year. Along with that the company achieved a 23% growth in sales. Monthly lead generation changed from 10-30 to over 100. Email opening rate reached an average of 18-22%. According to Procosmet's team, Tidio's solution helped generate over ⅓ of their current ecommerce revenue. The changes were also appreciated by the clients. Average ratings of their reviews grew from 3.8 to 4.75 out of 5 stars.

3.8.5. Employee skills needed to adopt the solutions

After having issues with the complexity of previous operating systems, Procosmet's team seeked "an easy-to-teach app" to serve their needs. Tidio promotes their products as accessible, without a need of programming that would require IT specialists to work with.

3.9. Purelei

3.9.1. Description of the company

Sources: https://www.ultimate.ai/customer-stories/purelei, https://www.zendesk.de/blog/die-zielgruppe-an-der-richtigen-stelle-abholen/

Name	Country	Size
Purelei	Germany	<250 employees

Description: Founded in 2016, Purelei offers jewelry and lifestyle products inspired by Hawaii. The people behind the company take pride in the durability of materials, collaborative design process and the guiding "Aloha way of life". Through various sales channels and communication media, Mannheim-based Purelei reaches customers across Europe.

Goal: Quality customer experience without overexploiting the support team.

Strategy: Personalized self-service and automation of repetitive tasks.

Technology providers: Zendesk, Ultimate

Tools: Zendesk Explore, Ultimate Zendesk integration, UltimateGPT

3.9.2. The need

"Be your own customer" - is the motto of Purelei's customer service team. With an international group of clients and numerous forms of communication ranging from telephone, e-mail to different social media chats, the company needed an organized system of support.

The idea of providing comfort and care to every client resulted in a help center developed through Zendesk platform[31]:

ⓘ ***Zendesk*** *is a customer service software providing a complete CS solution that is both scalable and easy to use. Its range of tools are expected to improve customer experience, optimize employee productivity and provide valuable insights into companies' operations. Their service is based on original solutions integrated with external apps and technologies.*

The help center gathered data from various communication channels and contained a knowledge base of FAQs and helpful information in 4 (now 5) languages. However, aiming for high quality service, Purelei's team wanted to personalize its communication with every customer. At the same time, they were aware that supporting so many requests with adequate care was laborious and oftentimes involved repetitive work, let alone time.

Purelei looked for a way to optimize the execution of some of these tasks. First of all, a deep insight into customers' behavior was needed. Then, with enough data, the support team planned to automate part of the processes they were involved in. Purelei decided to expand the help obtained from Zendesk by integrating its services with the tools provided by *Ultimate*[32]:

ⓘ ***Ultimate*** *is an AI-powered customer support automation platform that offers "the tools, the team, and the tactics that can take you from 0 to +60% automation across digital support channels, including chat, email, messaging, and more". With the help of large language models (LLMs) and generative AI, Ultimate offers services in up to 109 languages.*

The main goal of Purelei was to create a proactive support system that would encourage self-service and free-up the human agents, while maintaining quality of personalized customer experience.

3.9.3. AI-based solution

Getting the most out of the data

Zendesk equipped Purelei's support team with a help center designed for multichannel, multilingual communication. Service chat, now working 24/7, along with other transactional

[31] https://www.zendesk.com/
[32] https://www.ultimate.ai/

data provided knowledge about consumers' activities, preferences and most frequently encountered problems. To access all these information, *Zendesk Explore*[33] was introduced:

ⓘ ***Zendesk Explore*** *processes and analyses data of customer experience within different communication channels to generate reports of real-time activities, encountered issues and possible interests of a particular client. It reduces response time, which results in more solved requests, and provides more accurate content that is backed by insights from collected data.*

These insights became a basis for most of Purelei's customer service decisions. Getting to know the patterns and trends of support requests enabled the employees to adopt a proactive attitude towards the clients. The foreseen fulfillment challenges or potential concerns could now be addressed in advance, providing customers with "the greatest added value with the lowest contact hurdle".

Automating service

Purelei was now equipped with a responsive help center and a sizable knowledge base. Their proactive customer care approach, however, not only required much work on the part of the support team, but also involved mostly repetitive tasks. Despite having an exhaustive list of FAQs, the help center was still flooded with simple inquiries.

Although Zendesk does include in-house chatbots in their offer, it has also a broad offer of integrations with partner companies. Based on the suggestion by Zendesk's team itself, Purelei decided to include Ultimate's tools[34] in their work:

ⓘ ***Ultimate Zendesk*** *integration combines extensive CRM knowledge with optimizing capabilities of virtual agents. It allows for automated ticket handling, interactions with customers and workflow monitoring, while not sacrificing advanced personalisation coming from data analysis. Ultimate's conversational AI is developed through the company's own multilingual GPT model.*

By choosing the integration-based solution, Purelei was able to launch their chat automation within 3 weeks. Ultimate, as opposed to simpler forms of automation, was not solely dependent on predefined buttons. In the upgraded chat windows, customers were able to input free text, as well as images, that were then processed by the bot. This meant that they were able to engage in much more complex conversations.

Due to integration, Ultimate had access to Zendesk's data, including their CRM and order management system (OMS). Therefore, chat interactions, although automated to some extent, still benefited from detailed customer information to generate personalized messages. As for the simple requests, these were automated completely. The customer experience maintained its quality, all while requiring less repetitive effort from the support team.

[33] https://www.zendesk.com/service/analytics/
[34] https://www.ultimate.ai/integrations/zendesk

3.9.4. Results

The implemented solutions led to positive outcomes on both sides of Purelei's transactions. A majority of clients opted for automated self-service, with a deflection rate surpassing 50%. Resolution times dropped. The employees could now save their attention and time for more complex issues, while customer satisfaction was claimed to remain stable over the 93% mark. Further, yet undisclosed benefits were attributed to the accompanying Ultimate Shopify integration.

3.9.5. Employee skills needed to adopt the solutions

"No developers, no coding, no worries." - concludes the promotional video of Ultimate one-click integration into Zendesk. Nevertheless, it is worth noting that in the case of Purelei the in-house team included "2 experts for automation processes and reporting". One of them even mentioned the benefits of her recognising links between the processed customer data, but did not specify if it was done in cooperation with or in spite of AI tools. As for the process of implementing the solution, the team was "kept in the loop" when it came to the data imported for testing.

3.10. Repeat

3.10.1. Description of the company

Source: https://www.semrush.com/company/stories/repeat/

Name	Country	Size
Repeat	France	<50 employees

Description: Repeat is an e-commerce company, based in Paris, selling sustainable menstrual underwear. Motivated by care for the environment and customers' economic stability, they offer reusable products to replace sanitary towels, tampons and cups.

Goal: Launch a new eCommerce brand in paid and organic channels.

Strategy: computer vision, image classification

Technology provider: Semrush

Tools: Backlink Analytics, PLA Research, Site Audit, Keyword Overview, Keyword Magic Tool, SEO Writing Assistant

3.10.2. The need

Menstrual underwear in France is a trending market. When starting out their digital store, the team behind Repeat, with 3 members and limited budget, was facing a challenge of attracting the customers to their product. They needed a marketing strategy that would ensure a long-term reach of the company's offer.

Inexperienced in the field of marketing, Repeat founders tried different approaches and channels to sell the underwear. They started out partnerships with influencers in paid media but without the adequate insight into performances the method proved to be time-consuming and generated too big of a cost without sufficient and timely ROI.

The idea to market through paid traffic on Google and Facebook required technological knowledge that the team was lacking. Without efficient keywords, this strategy would not bring the desired immediate results.

To go beyond influencers and paid advertising, Repeat wanted to channel their marketing through organic traffic. For this to be effective, however, they needed a structured plan that would ensure long-term sustainability. To analyze the company's possibilities and develop a strategy that would fit them, the team reached out for help from Semrush[35] with their broad range of AI-based tools.

ⓘ ***Semrush*** *is the online visibility management and content marketing SaaS platform. It provides services such as website auditing, keyword research, backlink optimization, competitive analysis, content creation and ranking monitoring.*

The main goal of Repeat was to develop a long-lasting marketing strategy that would involve multiple channels and bring notable results in the website's traffic performance.

3.10.3. AI-based solution

Finding the verified influence

To limit the risk of investing in the wrong paid channel of communication, Semrush experts convinced Repeat to search for solutions that already worked for the company's competitors.

[35] https://www.semrush.com/

Using Semrush's Backlink Analytics[36], the team was able to search through other firm's backlink portfolios and provide a list of sites and bloggers that efficiently connected users to e-stores. Repeat could then reach out to potential partners with collaboration proposals. Backlink analysis also allowed for successful affiliate programs, in which some partners received a % from sales of the products that were purchased by their audience through the provided link.

ⓘ ***Backlink Analytics*** *- composed of a backlink database and discovery tool, it enables evaluation and comparison of link profiles of any domain. Provides up-to-date insight into backlinks' type, lifespan, quality and monitors marketing strategies of competing firms.*

Paid advertising

Paid campaigns remained a part of the strategy to provide initial traffic for the website. Although the main channel of Repeat's advertising was Facebook, Semrush tools helped the company plan and run a successful campaign in Google Shopping. Semrush's PLA Research[37] was used to create a list of valuable keywords based on the metrics and strategies of competitors. The keywords could then be used in copywriting for the implemented paid campaigns.

ⓘ ***PLA Research*** *- product listing ads analysis for optimizing Google Shopping campaigns. Enables researching competitors' rankings, strategies along with detailed data on ads and keywords.*

Organic traffic

Competition analysis proved that other companies were benefiting from efficient SEO strategies. Domain Overview[38] gave insights into channels that generated traffic for Repeat's rivals. The firm became convinced that improving organic traffic could truly complement their strategy and provide its sustainability.

ⓘ ***Domain Overview*** *- providing a full overview of a domain and its online visibility. Comprises data on representation in specific markets, top keywords and growth trends for different traffic channels. Also includes competition analysis and comparisons by country or market type.*

Building organic traffic required several refinements of Repeat's website. Through Site Audit[39] Semrush conducted checks of site's health in search of problems that would influence crawling and Google rankings.

[36] https://www.semrush.com/analytics/backlinks/
[37] https://www.semrush.com/analytics/pla/positions/
[38] https://www.semrush.com/analytics/overview/?searchType=domain
[39] https://www.semrush.com/siteaudit/

ⓘ ***Site Audit*** *- SEO analysis tool, crawling and checking every page on a given website. It produces regular reports on website's issues, their levels of priority and solutions to fix them.*

Keyword Overview and Keyword Magic Tool[40] helped Repeat find the keywords matching their actual needs. They started with niche keywords (matching searches with a more specific intent) that were easy to be positioned high in rankings, then started targeting more popular search terms.

ⓘ ***Keyword Overview*** *- keyword research database with general information on a given keyword, including search volume, difficulty, intent and CPC value.*

ⓘ ***Keyword Magic Tool*** *- topic-based keywords suggestions for optimized and structured content organization. Shows possible links between more general topics, subgroups and related searches, including long-tail keywords.*

Finally, Repeat was able to create its website's content in line with the most efficient keywords and users' comfort. Valuable blog posts could also establish Repeat as experts on female well being and environmental consciousness. With the help of Semrush's *SEO Writing Assistant*[41], the company could generate articles that were both interesting for their customers and met SEO requirements. The tool provided content briefs for blog posts writers, checked finished articles and returned suggestions for improving them.

ⓘ ***SEO Writing Assistant*** *- a smart writing editor that helps optimize copywriting for engagement and SEO. Assesses the readability of documents, consistency of the tone of voice and checks for plagiarism. Suggesting SEO improvements based on real-time data.*

3.10.4. Results

The final strategy composed of influencer marketing, paid traffic and organic traffic led Repeat to 3900% traffic growth over 18 months. The organic traffic itself was increased by 45% thanks to just 10 published blog posts. Company's revenue grew by approx. 300% and the domestic market share of Repeat became substantial.

[40] https://www.semrush.com/analytics/keywordoverview/, https://www.semrush.com/analytics/keywordmagic/start)
[41] https://www.semrush.com/swa/

3.10.5. Employee skills needed to adopt the solutions

Repeat team members were lacking useful online marketing knowledge. They started building their strategy in the course of trials and errors. Despite recognizing the importance of organic traffic, they were not able to get valuable insights to perform the necessary improvements of their website.

3.11. Sinnerup

3.11.1. Description of the company

Source: https://raffle.ai/customers/sinnerup

Name	Country	Size
Sinnerup	Denmark	~250 employees

Description: Sinnerup is a Danish retailer specializing in interior design and lifestyle products. The company's offer includes popular brands along with their own in-house designed furniture and home accessories. After over 50 years on the market, Sinnerup now runs 14 brick-and-mortar stores in Denmark and Germany and an e-commerce website.

Goal: Stable control over customer experience during diverse marketing campaigns.

Strategy: Intelligent search functions built into the website.

Technology providers: Raffle

Tools: Raffle AI Search, Instant Answers, Raffle Insights

3.11.2. The need

Sinnerup describes its customers as the "biggest source of knowledge and inspiration" and openly puts their satisfaction at the top of priorities list. While it may not be surprising to hear such bold statements from a company with long traditions, it certainly elevates expectations of shopping experience.

Maintaining the quality of support in online operations turned out to be a big challenge for Sinnerup's team. The company was launching many temporary marketing campaigns which, in order to succeed, needed to be well understood by the audience. At the same time, Sinnerup did not want to create new content for every campaign, as it was considered a time-consuming process. This left many potential customers in search of more information about the details of special offers.

The lack of instantly accessible knowledge resulted in a large rise of inquiries to Sinnerup's customer service. The employees simply did not have enough time to resolve all of the campaign issues quickly, not to mention the rest of the questions they normally received. The support team was overburdened with work and customers - unsatisfied by uncertainty and long waiting time.

In order to address all the inquiries in a more organized and efficient way, Sinnerup turned to automated solutions offered by Raffle[42]:

ⓘ ***Raffle*** *is a provider of AI-based search engine software, aiming to "make searching and finding information easy while maintaining the integrity, accuracy, safety, and relevance of the data". Their offer includes AI search, AI chat assistant and additional analytical and data-handling services.*

The main goal of Sinnerup was to provide their customers with all the information they seeked in a more efficient way that would keep up with a dynamically changing sales process.

3.11.3. AI-based solution

Intelligent search for missing answers

Sinnerup did not have more time to lose and within a day the first solution was introduced. To increase retailer's website responsiveness throughout the subsequent campaigns, Raffle offered their AI-based search tools[43]:

ⓘ ***Raffle AI Search*** *replaces traditional website searches with self-learning technology backed by natural language understanding. Identifying queries' contexts and intentions, the software provides users with relevant answers "regardless of spelling errors or variations".*

[42] https://raffle.ai/
[43] https://raffle.ai/platforms/raffle-ai-search

Whenever a customer wanted to know details about a campaign, the search option within the website could now produce results that were sufficiently informative to meet the need. This particular benefit came from Raffle Search's *Instant Answers* feature[44]:

> ⓘ ***Instant Answers*** *is an automation add-on that enables generation of custom banners with comprehensive answers that match the diversity of clients' inquiries, without the need of constant updating of the website.*

With this tool, campaign questions were addressed instantly, reducing both customer's confusion and support employees' workload. A user was able to use his/her own words, not minding the perfect phrasing or spelling. Because the software identified the queries so accurately, the 24/7 self-service did not require additional calls or messages to the help center. Even if the relevant content was not present on the website, it could still be found through the search window.

Room for improving customer experience

As the Sinnerup's employees were free of excessive pressure regarding infinite campaign questions, they could perform more advanced analytical work. The company wanted not only to simply respond to all the queries but, with time, reduce the very need of asking in the first place. This is where Raffle *Insights* dashboards[45] proved useful:

> ⓘ ***Raffle Insights*** *is an analytical feature providing information on users and their search activities within a website. It helps identify trending topics, content gaps and resolution times in order to determine possible improvements of customer experience.*

With Insights, the company's clients were clustered into groups whose needs and preferences, based on the behavioral patterns, could now be better understood. Once the support team gathered data on frequent questions and resolution effectiveness, they were able to prioritize the generation/modification of content for the website. Instead of repetitive resolving of similar queries, employees now focused on proactive fine-tuning of customer experience.

3.11.4. Results

The implemented solutions enabled Sinnerup Customer Support to no longer "drown in calls". Due to these changes, the company reportedly saves multiple 1000s of dollars a month.

[44] https://raffle.ai/features/instant-answer
[45] https://raffle.ai/insights

3.11. 5. Employee skills needed to adopt the solutions

Raffle claims that their AI Search solutions can be customly created by their clients themselves, with "no coding or AI expertise needed". It is worth noting, however, that Sinnerup's employees had to fill in the Instant Answers banners with "comprehensive" texts, which calls for some writing abilities. It was also not specified to what extent does the Insights function inform a particular decision and how much analytical work has to be later performed by the human employee.

3.12. Sortmund

3.12.1. Description of the company

Sources: Traffic Trends[46] an interview with Sortmund representative

Name	Country	Size
Sortmund	Poland	<50 employees

Description: For the last 20 years Sortmund have been providing specialized equipment to uniformed services. Representatives of military, police, border guard, fire brigades and penitentiaries can purchase clothing and accessories essential for their everyday work. Some of the products, meeting universal standards, are also offered to international clients through numerous marketplaces.

Goal: Creating SEO-optimized website content and successfully targeted marketing campaigns.

Strategy: Automated generation of text and images, marketing and remarketing personalisation.

Technology providers: Open AI, Traffic Trends

46 https://traffictrends.pl/case-study/40-krotny-zwrot-z-inwestycji-w-reklame-w-pol-roku-tak-sortmund-podbja-rynek-z-meta-ads/,

Tools: ChatGPT, DALL-E, Meta Ads

3.12.2. The need

Sortmund's mission is to deliver their products to the professionals in the shortest time and at the best value. The broadness of their offer, however, requires creating and managing a massive catalog of items that would be informative and attractive for the visitors, as well as tailored to the technical requirements of efficient internet communication.

The most tedious work that the company's employees were facing was creating product descriptions. They needed to balance the language of their texts to both include clear benefit language and a sufficient number of SEO keywords. Another problem occurred with the product images. Through generating watermarked pictures, the team wanted to ensure their copyrights. Unfortunately, some of the search engines required the images not to contain any watermarks, leaving Sortmund with thousands of files to edit.

To answer these challenges, the company's management decided to try different functions offered by Open AI[47]:

ⓘ ***OpenAI*** *is "an AI research and deployment company" offering tools based on large language, image and audio models. Some versions of their products are available for free to the broad public while their paid solutions are targeted at both individual customers and enterprises. With the famous Chat GPT at the forefront the company also provides other generative tools for processing text, images and speech, as well as an API platform for developers.*

Apart from the tasks that could be performed with the help of popular AI tools, Sortmund's team was also facing challenges that required overall service from professional providers. Their marketing strategies proved to be unfit for modern e-commerce requirements. In order to reach both existing and potential customers, the company needed well-designed targeting and remarketing methods. Hence their cooperation with *Traffic Trends*[48]:

ⓘ ***Traffic Trends*** *is an AdTech performance marketing platform for e-commerce. They design marketing strategies for various marketplaces and social media platforms, including campaigns in major search engines such as Google or Bing. Acquiring and maintaining a solid customer base is at the core of Traffic Trends' mission.*

The main goal of Sortmund was to optimize their website's visibility and reach individual customers with less time investment.

[47] https://openai.com/
[48] https://traffictrends.pl/

3.12.3. AI-based solution

DIY automation

Highly repetitive product description generation turned out to be manageable through the use of *Open AI's ChatGPT*[49].

> ⓘ ***ChatGPT*** *is an AI language model designed to understand and generate human-like text. It utilizes machine learning techniques to comprehend context and provide appropriate responses, making it a valuable tool for information retrieval, problem-solving, and communication.*

Initially, this solution required some manual corrections. Whenever an employee gave the chat a specific feedback about what should be changed for the sake of context, the remark was stored and taken into consideration in the future. Model's capabilities together with the team's knowledge and experience resulted in content that was appealing for clients and visible for algorithms. All that in much less time than before.

The problem of watermarked pictures was solved with another OpenAI tool - *DALL-E*[50].

> ⓘ ***DALL-E*** *is an AI text-to-image model. It combines the capabilities of GPT for understanding and generating text with advanced image generation techniques to create unique and coherent visuals based on the provided descriptions.*

Recreating large numbers of images manually would be costly and time-consuming, not to mention unappealing. In this case, the repetitiveness of the task did not even require special prompt engineering. In order to remove watermarks, a simple command can be repeated until all the images are processed to a desired form.

Marketing as a service

In the case of Traffic Trends cooperation, Sortmund's marketing was focused on the Meta platform as a main channel of communication. A Meta Ads[51] tool proved useful for this specific strategy.

> ⓘ ***Meta Ads*** *is a marketing system for Facebook and Instagram, used for reaching customers at every step of the conversion funnel. From building brand awareness, increasing website traffic, to generating sales conversions - Meta Ads uses AI-based* ***Advantage+*** *technology to optimize and automate advertising.*

[49] https://openai.com/chatgpt/
[50] https://openai.com/index/dall-e-3/
[51] https://traffictrends.pl/meta-ads/

From the point of view of the seller, marketing content should be as personalized as possible. The classification algorithms, however, perform better when faced with more general criteria. To balance between these two aspects, Traffic Trends began testing different modes of customer segmentation and advertising forms. This resulted in campaigns targeted at a well-defined range of potential new customers.

It is worth noting that these actions were not the first attempt by Sortmund to organize its online marketing. Having previously collected customer information, the company had valuable datasets that became a foundation for upcoming strategies. Fine-tuning of client groups and identifying the better-performing ads, enabled the marketing team to introduce Advantage+ campaigns based on personalisation algorithms.

In parallel to acquiring new clients, Traffic Trends launched remarketing campaigns that made further use of personalisation to maintain website visitors' loyalty and secure conversions.

3.12.4. Results

Better knowledge of their actual and potential customers enabled Sortmund to better allocate their advertising budget and keep it up to date with changes in trends. In the course of six months, the combined campaigns led to an over 4000% return on ad spend (ROAS). This included more than 4300% ROAS of Advantage+ campaign and 15169% ROAS of a simple last-7-days-visitors remarketing campaign.

The effects of introducing ChatGPT and DALL-E were not as easy to measure, since these methods were tested and developed onsite. According to the company's owner, Open AI tools significantly reduced cost and time spent on generating content for Sortmund's online channels.

3.12.5. Employee skills needed to adopt the solutions

The marketing services of Traffic Trends allowed for outsourcing both the technology and its handling, therefore did not require special skills from Sortmund's employees. The AI provider pointed out, however, that the quality of its work depended on the availability and quality of the input data. Therefore some sort of data awareness in the firm seems to be crucial for successful AI implementation. The upside of popular Open AI tools lay in the fact that many Sortmund's employees were already familiar with them due to recreational use. Still, context-specific prompt engineering and the ability to evaluate Chat's output, including potential hallucinations, were considered to be competencies of great importance.

3.13. Velasca

3.13.1. Description of the company

Source: https://www.domo.com/customers/velasca

Name	Country	Size
Velasca	Italy	<250 employees

Description: Velasca is a footwear and clothing company based in Milan. The artisanal brand is developed with an emphasis on a direct supply chain, ensuring quality, fair value of work and close relationships with customers. The products are sold in multiple locations across Europe, as well as through Velasca's online store.

Goal: Collecting and organizing information from different sources to create data-driven strategies for future development.

Strategy: Centralising data, increasing its operational accessibility and automating key tasks.

Technology provider: Domo

Tools: Business intelligence and analytics, Data integration, Automation apps

3.13.2. The need

The mission to deliver products directly from artisans to the client may seem as a clear process that is easily traceable. As Velasca's operations grew, however, with increasing numbers of customers purchasing shoes and clothing from different locations, getting an insight into the efficiency of the workflow proved difficult.

Customer data was indeed collected across numerous online and offline channels, but lacked the proper organization that would provide accessible knowledge for the company's employees. The widespread distribution of products was faced with diverse demand trends that had to be met with optimal inventory management and production scheduling, let alone accurate marketing campaigns.

Making decisions based on the acquired data required time and human resources. Basic customer cohort reports could be done within as much as one week. Still, the results were not satisfying. Employees worked with incomplete data and by the time the analyses were finished,

they could have already been slightly outdated. Lastly, uninformed supply chain management put a threat to the direct-to-customer business model.

Aware of these challenges, Velasca seeked a technological solution that would organize the company's data and make it available on time. This resulted in the cooperation with *Domo Data Experience Platform*[52].

> ⓘ ***Domo** is "a cloud-based platform that provides simplified, near real-time access to data." Delivering data management infrastructure, it enables integration and control over information. Among its tools there are also low-code and pro-code automation apps, as well as business intelligence (BI) and analytics features.*

The main goal of Velasca was to integrate a data hub into its operations for advanced, consistent analytics and informed decision making throughout the organization's units.

3.13.3. AI-based solution

Accessing information

To gain access to all of the company's data, Velasca used the help of Domo's *Data Integration* feature[53].

> ⓘ ***Domo's Data Integration** tools "make disparate data assets accessible and available for business analysis". They enable connecting large volumes of data from multiple sources and processing them within the cloud infrastructure. Native integrators and connectors simplify and speed up accessing the right information at any moment.*

Through integration, Velasca was able to break down its data silos and connect their contents to a single environment. The information from every online and offline channel could now be easily synced and shared between different teams. Transactional data, supply chain details and customer insights were all centralized and ready for further analysis.

Deeper into data

With all the data in the right place, the company was now capable of fully benefiting from the knowledge they provided. For the analyses to be done on time and with proper accuracy, another Domo's solution was introduced[54].

> ⓘ ***Domo's Business Intelligence and Analytics** enable comprehensive data exploration. Backed by AI algorithms, these tools perform advanced analyses to generate reports*

[52] https://www.domo.com/
[53] https://www.domo.com/data-integration
[54] https://www.domo.com/business-intelligence

and predictions. With accessible visualizations, the insights provide a basis for near real-time decision making.

BI and Analytics resulted in more accurate data that was available at all times and almost instantly. With accessible dashboards and visualizations employees were able to better understand the shared data. Gross and net orders were organized with multiple metrics, such as purchase time, location and product details. Inventory and production processes could now be modified in accordance with any changes in demand.

Customer service team gained insights about clients' preferences, needs and habits related to both offline and online purchases. Top-performing products and major business drivers were recognised. Along with monitoring of current marketing campaigns, this helped optimize the company's offer and outreach to provide more and better service.

A bit of automation

The last, yet crucial change to Velasca's operations was introduced through automation included in Domo's App Creation Tools[55].

ⓘ ***Domo's Business Apps*** *"are highly curated data experiences that enable anyone to automate business processes and confidently take action using flexible App Creation Tools." They enable both low-code and pro-code app development using provided frameworks and infrastructure. One of the key features is the integration of automated workflows that perform assigned tasks previously done manually.*

As any other company, Velasca was forced to carry out repetitive tasks that engaged resources and took a significant amount of time. Although manual processing of data required constant support of engineers it still was not free of human errors. Automation took over part of the responsibility for connecting, combining and visualizing data. Due to that, time and workforce was saved for creative and customer care tasks and more refined decision making.

3.13. 4. Results

The implemented solutions led to the measurable outcomes that were accessible thanks to the Domo's technology itself. Average item value (AIV) became 7.8% higher and average order value (AOV) reached 12.3% growth. Through monitoring of customer lifetime value, Velasca could discover that in the course of 1 year clients spent 16.4% more on their orders. With 23% cost reduction and 18% time saved, the company's total revenue increased by 61% in over a year.

[55] https://www.domo.com/business-apps

3.13.5. Employee skills needed to adopt the solutions

Domo's tools not only organized and processed Velasca's data for the company's profit but also enabled its availability for the workers. With personal dashboards and exploration features, employees could understand the information they worked with and improve their data literacy. The need for technical skills, on the other hand, appeared to have been reduced. Low-code automation apps enabled performing tasks with smaller engineering teams and less programming operations.

3.14. Best practices - Innovative Retail Laboratory

Sources: interview, information collected during a dedicated workshop organized for the INAiR consortium by the Innovative Retail Laboratory, website https://www.innovative-retail.de/

A special case in the research of AI-powered retail can be found in Saarbrücken, where the Innovative Retail Laboratory is located. A part of the German Research Center for Artificial Intelligence (DFKI), the IRL is one of a kind research organization, specializing in "application-oriented developments for the retail of the future". As a public-private partnership, they cooperate with government organizations and universities, while maintaining a strong connection to the business. While the IRL conducts the majority of operations in the research centers in Saarbrücken and Berlin the employees also travel through the country, presenting and explaining newly developed solutions.

Since 2007 The Laboratory has been contributing to the implementation of new technologies and methods in the retail industry, with artificial intelligence as an important point of focus. Its interdisciplinary team is composed of experts in engineering, programming and psychology, ensuring that any innovation would meet a complex set of demands of the market, society and government. The IRL is very keen to use AI as a research tool. With methods based on advanced analytics, machine learning, deep learning, computer vision and chatbots, the organization aims to resolve complex problems of the retail industry.

The multidisciplinary team goes through the entire process of developing a new custom technology. They conduct technology scouting in search of topics trending across retail businesses. First ideas can be materialized in the form of prototypes or MVPs, which are then tested and confronted with the potential users. The mix of theoretical and practical knowledge

resulting from the work of the IRL employees is not only used internally but shared further, during the workshops and training sessions conducted by experts.

While the scope of the Innovative Research Laboratory is broad, any part of the described AI development can become a point of focus. An especially interesting element of the Lab's offer are its Research as a Service (RaaS) practices. Companies that lack knowledge or resources to test new ideas can reach out for the Laboratory's help. If they ask a specific question, IRL is there to find an answer.

The work of particular importance for INAIR is the Mittelstand-Digital Zentrum Handel - a section of the German government's initiative of digitalising small and medium-sized companies, in this case focusing on the retail sector. The Innovative Retail Laboratory is responsible for the AI-related parts of the research, including workshops, presentations and an educational podcast. With financial support from Mittelstand-Digital, the IRL team also conducts implementation projects for retail SMEs.

The Innovative Retail Lab focuses on resolving social and environmental challenges in retail. They develop systems that encourage consumers to shop with their own packaging and monitor their home inventory with smart storage shelves. Other experiments aim to redefine retail stores as "social meeting points," making them more inclusive for elderly people. Many innovations are designed to familiarize consumers with AI technologies through fun and engaging experiences, such as VR and AR environments or gamified shopping experiences.

With practical projects like finger-point-triggered product recognition and intelligent fruit crates, the Innovative Retail Lab aims to stay at the forefront of digital innovations in the retail sector. However, the organization notes that many companies first need simpler solutions. Reluctance towards technological change often means businesses operate without structured enterprise resource planning (ERP) or data awareness. Numerous improvements are needed before artificial intelligence can become a primary focus.

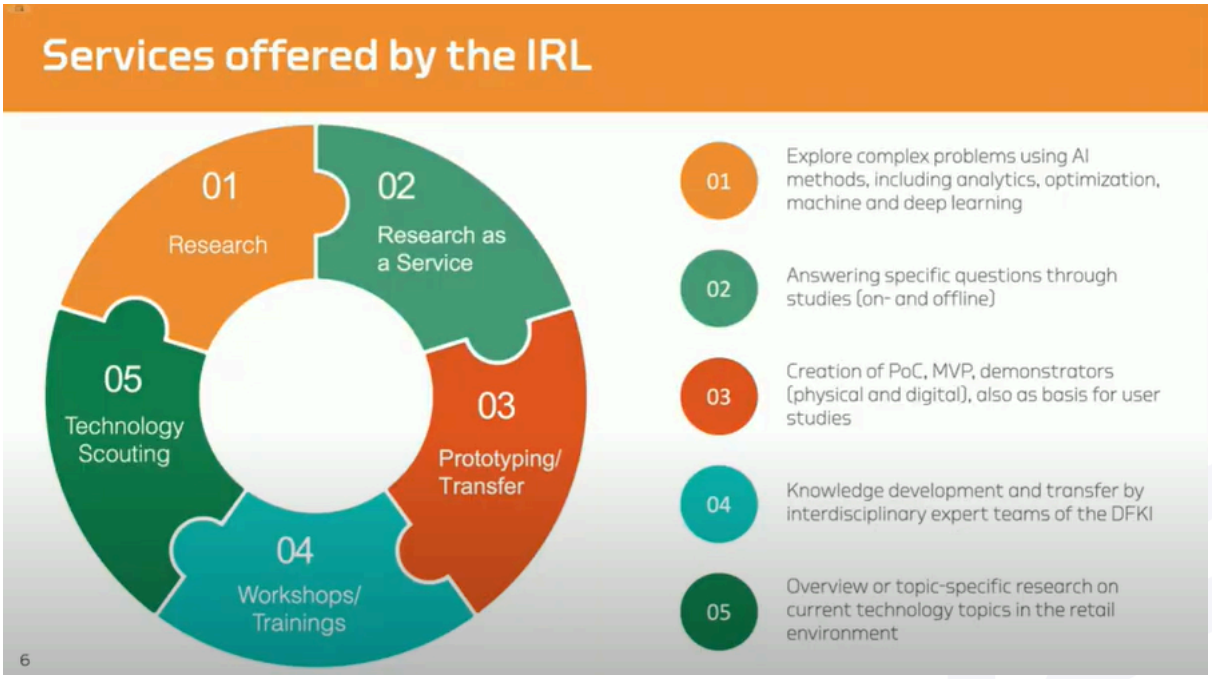
The following topics are the primary focus of the IRL:

- Analysis of consumer behavior
- Automated inventory maintenance
- Data protection and privacy
- Influence of the Internet of Things on society

- Innovative prediction systems
- Innovative marketing for user-oriented services and dialogue marketing
- Intelligent assistance systems
- Machine Learning and sensor fusion
- Navigation and kiosk systems in the supermarket
- Personalized and mobile purchasing support
- Robotics and logistics support
- Smart labels (e.g. RFID and NFC) in retail
- Control of customer flows
- Technologies to enhance the customer experience in department stores
- Fusion of digital and analog worlds

Source: Innovative Retail Laboratory presentation.

Figure 37 Overview of the Innovative Retail Lab's activities



Source: Innovative Retail Laboratory presentation.

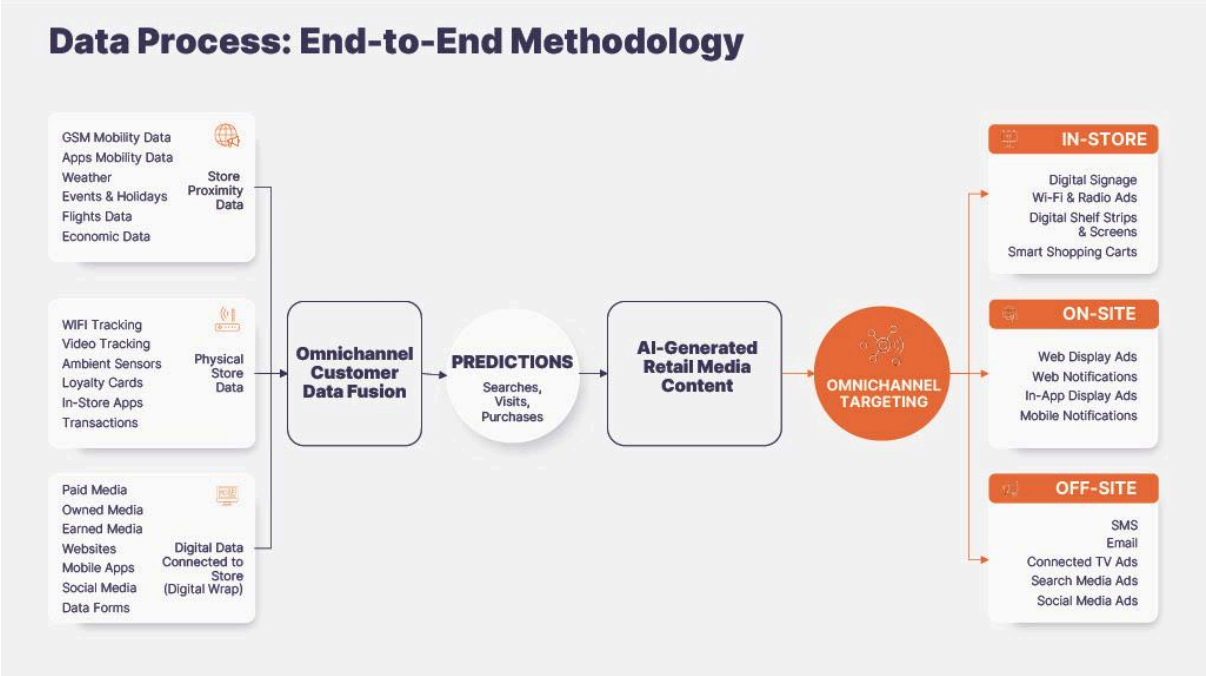
3.15. Best practices - Footprints AI & Danubius

Sources: https://www.mist.com/wp-content/uploads/Footprints-AI-Intro.pdf, https://www.romanianbusinessjournal.ro/footprints-ai-romanias-retail-media-market-to-exceed-10-million-euros-in-2024/, https://danubius.org/en/danubius-si-footprints-ai-lanseaza-reteaua-de-retail-media-cu-cea-mai-mare-acoperire-geografica-din-romania/

Another interesting project comes from Romania and is not limited to one organization, but is the result of a fruitful collaboration between two local technology companies. One of them develops advanced software, while the other is focused on supplying retailers with hardware. Together, they managed to include Romanian SMEs in the new environment of B2C business, benefiting from innovations in artificial intelligence.

Footprints AI is an AI-based omnichannel retail media platform specializing in dynamic targeting based on consumer behavior. Through data-driven automation, predictive behavioral models and hyperlocal actionable insights, the company enables analysis of anonymous traffic, leveraging the potential of data from digital and physical points of contact alike. It enables bricks-and-mortar retailers to optimize their marketing strategies in a way that was previously only possible in e-commerce.

Figure 38 Footprints AI's customer data generation pattern



Source: https://www.mist.com/wp-content/uploads/Footprints-AI-Intro.pdf.

Danubius presents itself as "one of the most important integrators of tax and payment solutions in Romania". During its 30 years in the market, the company has been offering electronic cash registers that introduced the most recent innovations in fiscal payments (card transactions, bluetooth, OS integrations, portable printers, BlueCash). It does not come as a surprise that at some point, it would cross its path with the development of AI.

The solution brought about by Footprints proved successful for the platform's international partners. The clients, however, were mostly large retailers with adequate resources. Meanwhile, the broad offer of Danubius allowed the ECR provider to reach different kinds of businesses, which resulted in a sizable network of merchants, including the smaller ones. The cash registers turned out to be the key to introducing AI technology to Romanian SMEs.

The effect of the collaboration was a new type of smart cash register. Available as a free upgrade to all the clients possessing the newest model of Danubius' product, this equipment is able to gather transactional data and connect it to Footprints' system. The AI algorithms enable profiling of the customers based on their activities and generate predictions on future behavior and preferences. The resulting marketing strategies can be deployed within the retail media network, launched together by Footprints and Danubius as an alternative to popular advertising platforms (Google, Meta) and traditional media (radio, TV). Importantly, all the customer data is said to be correctly anonymised, in line with the GDPR policies.

As one can see from the scheme above, cash registers are only one of many potential sources of customer data, suggesting that this solution does not yet realize the full potential of Footprints AI's system. It is, nevertheless, an important step towards democratization of the artificial intelligence technologies, allowing SMEs with physical stores to enter the competition fueled by the digital transformation of retail. Danubius CEO stated that the retailers participating in the first stage of product development can expect to "benefit from an additional income of 25%, subject to certain conditions".

3.16. Best practices - Dare Media

Sources: https://www.daremedia.pl/, interview with Dare Media's CEO

Polish e-marketing company is an example of a different approach towards AI adoption which may be interesting for retail businesses just setting off on their adventure with artificial intelligence technologies. In short, Dare Media specializes in "growth hacking strategies" through data analysis and automation, based on extensive use of popular software. Tools provided by Google Analytics, OpenAI, Semrush or Salesforce are just a few of the vast range of

solutions that the firm has to offer. Its areas of interest include customer support, communication channels, SEO, marketing campaigns and data-driven optimization.

It may seem counterintuitive to add a middleman on top of all the financial constraints that stand in the way of MSMEs' digital transformation. Dare Media's strength, however, lies in its expertise - the knowledge of where to start and how to do it. The company's service begins with an audit and a set of recommendations on possible improvements. To minimize the risk of wasted resources, many collaborations operate on a success-fee model, where the technology provider earns a share of the profits that result from improvements. Initial testing and scalability also help smaller businesses that are not yet convinced towards AI solutions.

As a marketing-focused company, Dare Media uses a range of tools for content generation. Specifically, transforming one kind of content into another is a process that can be easily accelerated and simplified through automation. Dare Media's CEO mentions ChatGPT (https://openai.com/chatgpt/), Claude (https://claude.ai/) and Gemini (https://gemini.google.com/) as very handy when it comes to redistributing media. These tools enable generating transcripts of audio files, social media posts and blog articles.

Other solutions employed by Dare Media are audiovisual generation software for pre-production (storyboards, animatics), editing (highlights, effects) and even creating whole films or songs from scratch. In these cases, the firm recommends tools such as Luma (https://lumalabs.ai/dream-machine), Midjourney (https://www.midjourney.com/home), Runway (https://runwayml.com/), Storyboarder (https://storyboarder.ai/), Suno AI (https://suno.com/) and Topaz (https://www.topazlabs.com/).

In some instances Dare Media uses its subscriptions of the abovementioned services to generate a broad, comprehensive offer for its own clients. Whole systems of automated CRM, SEO, sales or paid advertisement may be chosen, or, as is often the case with MSMEs, smaller improvements remain a lower-budget option. Dare Media claims to be keeping track of the latest innovations and updating their toolsets accordingly with new but verified software available on the market.

When it comes to data analysis, however, there is more input from the company itself. Based on ChatGPT technology, Dare Media team creates their own scripts that enable collecting and processing customer data from different channels. Reviews spread all over the social media, forums and e-stores can be easily organized and put together with market analysis, fueling

informed decision making as well as sales or marketing strategies.

According to Dare Media's CEO, even the more technologically advanced firms may need "guidance on integrating AI and digital tools into their operations". Together with automation fears and concerns about data security, these skill gaps should be addressed through "training and reassurance". Getting a professional overview and testing of possible AI implementation may be a good first step for MSMEs just entering the new era of retail. After that, it is for them to decide whether to keep outsourcing the whole service or continue the upskilling process for developing in-house solutions.

3.17. Towards classification of models of AI adoption and integration in retail companies

Table 10 Main technologies and application areas by use case

Company name	AI technology applied	AI applications in the value chain	Benefits of AI application
ALOHAS	• Chatbot • Augmented intelligence	• Customer engagement • Operations optimisation	• Good service (greater availability and shorter response time due to chatbot assistance) • Automation of customer service (answering frequent inquiries)
Feed.	• Chatbot • Insight engine • Speech recognition • Augmented intelligence	• Customer engagement • Inventory management • Knowledge and insight management • Operations optimisation	• Good service (personalisation, omnichannel connection) • Automation of customer service (order updates, resolving simple issues) • Optimisation (workflow monitoring, chain supply monitoring with real-time reports)
Grünewald	• ML • Deep learning • RPA	• Inventory management • Knowledge and insight management • Operations optimisation	• Prediction (forecasting demand and sales trends) • Automation (generating orders matching demand)

Kerrigans	• Chatbot • Augmented intelligence • RPA	• Customer engagement • Knowledge and insight management	• Automation (recommendations, changes in stock and prices) • Good service (personalisation, chatbot assistance)
Kuchyne Valent	• ML • RPA • Augmented intelligence • Insight engine • NLP	• Customer engagement • Knowledge and insight management • Operations optimisation	• Prediction (SEO-oriented analysis, market analysis) • Automation (copywriting) • Optimization (images)
L Cosmetics	• RPA • Insight engine	• Inventory management • Knowledge and insight management • Operations optimisation	• Prediction based on insight engines (inventory levels) • Automation of supply chain processes (order generation and scheduling)
Pet Media Group	• ML • Computer vision • NLP • Augmented intelligence • RPA	• Operations optimisation	• Automation (content moderation, automated visual tagging and classification of content)
Procosmet	• Chatbot • Insight engine • Augmented intelligence	• Customer engagement • Operations optimisation • Knowledge and insight management	• Automation (omnichannel communication, data collection) • Good service (availability due to chatbot assistance, personalization) • Optimization (workflow, order management)
Purelei	• Insight engine • Augmented intelligence • Chatbot	• Customer engagement • Operations optimisation • Knowledge and insight management	• Automation (frequent inquiries resolution) • Good service (availability due to chatbot assistance, personalization)
Repeat	• Insight engine • NLP • Augmented intelligence	• Customer engagement • Knowledge and insight management • Operations optimisation	• Prediction (SEO-oriented analysis, market analysis, predictive analytics of KPIs for search results and advertisements) • Automation (copywriting)
Sinnerup	• insight engine,	• Customer engagement	• Automation (automated website

	augmented intelligence, NLP	• Knowledge and insight management • Operations optimisation	assistance, frequent inquiries resolution) • Optimization (copywriting prioritization) • Good service (availability)
Sortmund	• Chatbot • RPA • Insight engine	• Customer engagement • Knowledge and insight management • Operations optimisation	• Automation (automated recommendations, generation of texts and images, remarketing), • Optimisation (customer segmentation) • Good service (chatbot assistance, personalization)
Velasca	• RPA • Insight engine • Augmented intelligence	• Customer engagement • Knowledge and insight management • Operations optimisation • Inventory management	• Optimization (streamlining processes, organizing data) • Automation (repetitive tasks) • Prediction (forecasting demand and sales trends, insight engines of predicted demand) • Tracking customer behaviors online and offline)

Source: own elaboration based on classification by Oosthuizen et. al. (2020).

The table above results from a combination of explicit mentions and researcher's assessments of specific AI technologies. Note that, as explained in chapter 1.2.3, some technologies presuppose the use of more general ones. For example, while only some of the stories included terms "Machine Learning" or "deep learning", it is most likely that some kind of ML algorithm was present in each of the cases.

On the basis of the above analysis, we have developed a preliminary classification of AI models of AI adoption and integration in retail companies.

Table 11 Classification of models of AI adoption and integration in retail companies

Model of AI Adoption & Integration	Description	Applications/tools
Applying (AI Embedded in Apps)	The company employs ready-made applications with embedded AI from suppliers, allowing for rapid technology implementation without requiring deep technical knowledge. This approach is particularly suitable for smaller companies or those new to AI, offering minimal integration effort and fast deployment but limited customization flexibility.	• Chatbots • Automatic content generation • Personalized recommendations in online stores
Embedding (AI APIs in a Custom App Frame)	The company integrates AI into its applications using APIs, allowing for greater control and customization to meet specific company needs. This method is beneficial for companies with moderate technical knowledge, as it offers enhanced flexibility in application customization while requiring basic technical expertise.	• Personalized chatbots • Automating customer service • Advanced data analysis
Extending (AI Models via Data Retrieval)	The company enhances its AI models through data retrieval, necessitating advanced data management skills. This approach allows for greater personalization and customization, enabling the use of available data to develop more sophisticated applications like predictive sales analysis or personalized recommendations.	• Analysis and processing of large customer data sets • Demand forecasting • Inventory optimization
Enhancing (AI Models via Fine-Tuning)	The company customizes AI models by fine-tuning them with its own data. This process offers a high level of flexibility and requires advanced technical knowledge and resources. Fine-tuning allows for significant customization tailored to the company's specific needs, facilitating the creation of highly optimized and efficient systems.	• Creating advanced predictive models • Content and marketing offer personalization • Logistics operations optimization
Building (Custom Models From Scratch)	The company builds AI models from scratch, which offers high flexibility and significant potential for innovation. However, this approach demands advanced technical knowledge, considerable resources, and time. Constructing models from the ground up allows companies to fully explore and use the capabilities of generative AI, but it requires a substantial investment in both expertise and resources.	• Unique AI solutions tailored to the specific needs of the company • Advanced analytical systems • Large-scale process automation

Source: own elaboration

The collected use cases reveal several groups of essential skills for AI adoption in retail companies:

- **technical skills:** tool navigation; data literacy (collection, processing, interpretation); prompt engineering (generation, interpretation)
- **soft skills**: communication, collaboration
- **cognitive skills**: critical thinking (output data evaluation), problem solving
- **management skills**: leadership; change management (reorganizing tasks, convincing employees); understanding business opportunities

4. AI Skills: Definitions and Classifications

In this section, we will address the issue of AI skills, which are essential to prepare MSMEs for the coming technological change, while at the same time enabling them to limit its negative effects. In this section, we will present the ways in which AI skills have been defined in the available literature to date, as well as the current ways of classifying AI skills. According to the 2023 WEF's Future of Jobs report, only training in analytical thinking and creative thinking is ranked higher than education for AI skills (Aertsen, 2023: 10). A lack of relevant skills is said to be one of the two major barriers to AI adoption, with the second being cost. This issue may relate to the skill gap of existing staff or difficulties in hiring new, skilled employees (Lassébie, 2023).

Key takeaways

- Comprehensive research on AI skills in MSMEs, especially in the retail sector with a focus on sustainability and green skills, is lacking.
- Most AI research in retail has been led by STEM professionals focusing on technical aspects such as decision support systems, natural language processing, and the Internet of Things.
- There are emerging efforts to define AI skills, emphasizing literacy, social, and technical competencies.
- AI applications in retail cover a wide range of functions, including business decision support, inventory and supply chain automation, customer relationship enhancement, behavior monitoring in physical stores, and recruitment process automation.
- Several challenges hinder AI adoption in retail, such as potential job losses, skill shortages, trust issues, technical difficulties, and the need for sustainable practices and industry standards.
- **There is a notable absence of systematic definitions that link AI skills to digital transformation in the retail sector.**
- The need for empirical research remains significant, as this area is under-researched. **Future studies should aim to clearly associate AI skills with sustainability challenges**.
- The current proposals for AI skills classification include the OECD Employment Outlook report, which outlines skills for developing, maintaining, and interacting with AI systems.

- Addressing these research gaps could enhance the understanding of how AI skills, digital transformation, and sustainability intersect within the retail industry.
- A specific research agenda is needed that blends qualitative and quantitative methods and considers the perspectives of multiple stakeholders.

4.1. Importance of AI Skills

The importance of skills related to AI technologies can be assessed from several perspectives. As Manca points out, artificial intelligence "does not operate in a vacuum," emphasizing the influence of human-machine interactions on the overall outcome of implemented technologies. In short, employees need to possess skills that allow them to provide adequate input, draw informed conclusions, and critically assess all steps of the process (Manca, 2023: 19-20). Acquiring AI skills prepares employees for the impact of artificial intelligence on their company. Both the actual threats of skills mismatch and a person's fears of possible job loss can be alleviated through AI-oriented upskilling and reskilling (Cramarenco et al., 2023: 746; Morandini et al., 2023: 53). AI-related skills were also found to be "associated with positive and statistically significant wage returns" (Manca, 2023: 36).

However, some evidence suggests that AI implementation is likely to have a limited impact on the skills required from employees to perform their tasks. Milanez argues that while technologies change dynamically, skill requirements tend to evolve in a more gradual manner (Milanez, 2023: 60-69). When AI tools are provided by an external company, they may be developed and advertised as intuitive and easy to operate, requiring minimal employee training for implementation (Milanez, 2023: 70, 95). The lack of significant change in skill needs may be due to the limited reliance on AI technologies. If AI systems only perform simpler tasks, leaving more complex ones to human employees, it is not surprising that many companies emphasize the importance of existing skills (Lassébie, 2023).

4.2. AI Skills Defined

As of now, **AI skills have not been analyzed by scholars in a sufficiently detailed and multidimensional manner** (Cramarenco et al., 2023: 747). Hence, several ambiguities surround the term "AI skills." Nevertheless, the literature review was successful in **mapping the initial proposals for classifying AI skills**. For example, the OECD Skills Outlook 2023 describes AI skills as "the skills that are needed to develop, maintain and adapt AI systems and not the broader set of skills that are needed to work with and alongside AI" (OECD, 2023), which from the very start suggests that some dimension is missing. The Artificial Intelligence Skills Alliance (ARISA) project also claims to focus on "specialized skills needed for the development and maintenance

of AI initiatives and applications," while acknowledging that everyone should possess basic knowledge of how AI functions and its impact on people's everyday lives (Aertsen, 2023: 11). Von Richthofen et al. suggest that skills resulting from AI adoption "are not only relevant to employees who work directly with AI" (von Richthofen et al., 2022: 9-10).

A basic skill set for the "new era of intelligence" is often referred to as "AI literacy" (Ng et al., 2021: 507). AI literacy is "the ability to understand, use, monitor, and critically reflect on AI applications without necessarily being able to develop AI models." As opposed to job-specific skills, AI literacy is expected to be a cognitive norm for the general population (Laupichler et al., 2022: 1). While the specific definitions vary, the term is expected to describe not only the proper handling of AI tools but also a broader understanding of the technology itself. Questions of how AI functions, what it is used for, and how to apply it in different contexts are among the skills that an AI literate person should possess (Ng et al., 2021: 505).

The terminology seems to have much to do with the methods used to extract data on AI skills. Many researchers search for AI-related skills through job postings analysis (Acemoglu et al., 2022; Aertsen, 2023; Alekseeva et al., 2019; Manca, 2023: 202; Maslej et al., 2024; Samek et al., 2021; Squicciarini and Nachtigall, 2021). Based on the data provided by Lightcast (formerly Burning Glass Technologies), they employ a list of skills keywords "based on the presence of words and phrases commonly associated with the knowledge of AI" (Alekseeva et al., 2019: 8). Another identification of AI skills came from an AI-driven analysis of job advertisements. Using NLP and TF-IDF tools, researchers of the ARISA project obtained an ordered list of skills, the demand for which was determined by the frequency of a given term (Aertsen, 2023: 14).

Because of this methodology, **the term "AI skills" may seem limited to more technical skills explicitly related to artificial intelligence technologies**. The work of Lane et al. is also in line with this approach. Although the authors emphasize the impact of AI on a broad range of skills, including "human skills" (creative and social intelligence, reasoning, creative thinking), the prefix "AI" is specifically applied to "specialized AI skills," which seems to stand for very narrow, mostly technical expertise (Lane et al., 2023: 13, 66).

To go beyond technical skills, Margaryan defines skills as "the ability to apply knowledge to work tasks," a set that includes core skills, transversal skills, and dispositions. He also suggests emphasizing "the uniquely human, interactional, creative and emotional capabilities that will be relevant in AI-mediated workplaces" (Margaryan, 2023: 2). Other researchers make similar efforts not to overlook the importance of the "non-AI skills" for the successful implementation of AI, as they list types of competencies considered to be "complementary" (Cramarenco et al., 2023: 733; Lassébie, 2023; OECD, 2023).

What becomes evident from the job postings analysis is that, from the perspective of employers, skills related to working with AI technologies tend to be looked at in bundles. These include both AI and non-AI skills, but their combinations vary. Not only are skill mixes different across occupations, industries, and stages of AI adoption, but they may also change rapidly over time, keeping up with AI innovations (Samek et al., 2021: 16, 23, 72; Squicciarini and Nachtigall, 2021: 49; von Richthofen et al., 2022: 12-13). In one of the papers, the average composition of an

"AI vacancy" was only 10% AI skills, 20% socio-emotional and foundational skills, and 70% technical skills. Over time, AI employers required more individual skills from each skill group, once again suggesting the need for a broad skill mix (Borgonovi et al., 2023: 33). A person with expertise in a given industry context and some degree of AI expertise can become a π-shaped professional (Aertsen, 2023: 41). Possessing multidisciplinary knowledge and skills enables identification and resolution of complex challenges at the intersection of different domains.

One other method of skill analysis can be found in Stanford's Artificial Intelligence Index Report 2024 (Maslej et al., 2024). One of the chapters focused on the self-reported data from LinkedIn profiles. Skills reported by the platform's users were listed in two categories: "AI Literacy" and "AI Engineering" (Maslej et al., 2024: 480). This breakdown of AI skills reflects well the broad picture of the terminology described above. On the one hand, every member of contemporary society is expected to be equipped with a set of competencies constituting their AI literacy. Shifting focus to the work environment, AI skills are highly specific abilities closely related to particular AI technologies and attributed to a limited group of professionals. In the end, however, the future of work powered by artificial intelligence will require complex and sizable combinations of skills, adjusted individually to various roles and tasks.

4.3. AI Skills Classifications

The commonly used Lightcast classification allows researchers to categorize AI skills into clusters. The most recent version of this classification, present in the 2024 AI Index Report (Maslej et al., 2024: 478), proposes eight clusters:

1. **Artificial Intelligence**
2. **Autonomous Driving**
3. **Generative Artificial Intelligence**
4. **Natural Language Processing (NLP)**
5. **Neural Networks**
6. **Machine Learning**
7. **Robotics**
8. **Visual Image Recognition**

Interestingly, the latest data from Lightcast indicates a recent decrease in demand for the majority of AI skills (Maslej et al., 2024: 226). Meanwhile, a new set of skills related to generative artificial intelligence has been on the rise. The ARISA project developed another cluster, "Data," which included skills in data processing and analysis using AI (Aertsen, 2023: 16). However, after performing a job postings analysis, a new set of five categories emerged (Aertsen, 2023: 7):

1. **AI general skills**: programming languages (Python, Java, JavaScript, C++), traditional ICT skills (SQL, big data), and soft skills (e.g., teamwork).

2. **Big data and data analytics**: skills in data science, machine learning, data management, data security, business intelligence, systems and architecture, process automation, technology & business topics, renewable technology.

3. **Machine learning and deep learning**: data literacy and understanding of AI.

4. **Cybersecurity and data security**: broad understanding of security within AI systems.

5. **(Large) Language models**.

As one can notice, **there is a significant difference between predefined AI skills and those resulting from more detailed analysis.** The mere occurrence (or lack thereof) in job postings, however, does not always determine the importance of a given skill. Ethics and responsible AI, although mentioned in numerous skill classifications, are not as often mentioned in advertisements (OECD, 2023).

Other major categories of skills mentioned in the literature are transversal skills, soft skills, socio-emotional skills, foundational skills, and cognitive skills. A good example of transversal skills, backed by the terminology employed by **ESCO** classification (European Skills, Competences, Qualifications and Occupations), comes from the work of Morandini et al. While in many cases not new, these skills are said to have been truly appreciated with the introduction of AI systems. ESCO researchers created a transversal skills and competences (TSCs) model, which can be understood from the point of view of AI implementation (Morandini et al., 2023: 46-50):

1. **Core skills**: written and oral language fluency (e.g., for understanding tools' interface and documentation), working with numerical data, and use of digital tools.

2. **Thinking skills**: analytical, critical, and creative thinking, used for processing and assessing information, drawing conclusions, and generating ideas or solutions.

3. **Self-management skills**: managing strengths and limitations, having a reflexive and proactive approach towards self-development, and managing time and tasks more productively.

4. **Social and communication skills**: maintaining interactions that are productive, empathetic, and empower leadership, important for sharing information, building trust, and overcoming challenges.

5. **Physical and manual skills**: using physical equipment with dexterity and agility, which improves performance, provides safety, and helps employees adjust to new tools faster.

Specific technical AI skills are considered more context-dependent, while a more universal value is assigned to soft skills, transversal skills, and skills related to functioning in organizations (Aertsen, 2023: 40). The more detailed differentiation of skills is usually done with regard to different job positions. Common classification distinguishes managers or decision-makers and employees working with AI tools-AI professionals.

AI professionals need a combination of specific technical skills and a common set of soft and business-related skills (Aertsen, 2023: 34-35):

1. **Technical:** data science, data analysis, data engineering, machine learning.
2. **Soft:** effective communication, presenting products, conflict management.
3. **Business-related:** understanding business processes, customer relations.

Decision-makers within organizations should be equipped with basic AI knowledge on terminology, practice, ethics, and law (Aertsen, 2023: 9). Socio-emotional skills for managers include (apart from a basic set) presentation, planning, budgeting, and business development (Samek et al., 2021: 7). Other skills for decision-makers include (Aertsen, 2023: 24, 40):

1. **Understanding business opportunities of AI implementation** in a particular organization to raise competitive advantage.
2. **High-quality data procurement and management**.
3. **Securing employees possessing valuable AI expertise**.
4. **AI advisory skills:** risk management, AI compliance, strategy formulation, change management.

In the OECD Employment Outlook 2023, the focus is shifted from specific job positions to roles related to different aspects of AI implementation. Lassébie considers: **a.** *skills needed to develop and maintain AI systems* and **b.** *skills to adopt, use and interact with AI applications* (Lassébie, 2023):

Table 12 Skill needs in the Age of AI

	Type of skill	Examples
Skills to develop and maintain AI systems	**Specialized AI skills**	General knowledge of AI (such as Machine Learning) Specific knowledge of AI models ("decision trees", "deep learning", "neural network", "random forest", etc.), AI tools ("tensorflow", "pytorch", etc) and AI software ("java", "gradle", "galaxy cluster", etc).
	Data science skills	Data analysis Software Programming languages, in particular Python Big data Data visualization Cloud computing
	Other cognitive skills	Creative problem solving
	Transversal skills	Social skills Management skills
Skills to adopt, use and interact with AI applications	**Elementary AI knowledge**	Principles of machine learning
	Digital skills	Ability to use a computer or a smartphone
	Other cognitive skills	Analytical skills Problem-solving Critical thinking Judgment
	Transversal skills	Creativity Communication Teamwork Multitasking

Source: Lassébie, 2023.

To effectively develop and maintain AI systems, individuals must cultivate a range of specialized AI skills that include general knowledge of AI, including the principles of machine learning, and specific expertise in AI models such as decision trees, deep learning, neural networks, and random forests. Proficiency in AI tools such as TensorFlow and PyTorch is essential, as is familiarity with AI software such as Java, Gradle and Galaxy Cluster. Data science skills are critical, including knowledge of data analytics, software development, programming languages (especially Python), big data management, data visualization, and cloud computing. In addition, cognitive skills such as creative problem solving are important, as are transversal skills such as social and management skills, which are essential for navigating the interdisciplinary and collaborative nature of AI development and deployment across sectors.

Competence in adopting, using and interacting with AI applications requires a basic knowledge of elementary AI principles such as machine learning. It also requires digital literacy, which is essential for proficient use of computers and smartphones. Cognitive skills play a crucial role and include analytical, problem-solving and critical thinking skills. In addition, transversal skills, such as creativity in innovation, effective communication, teamwork for collaborative projects and multi-tasking skills, are essential for effectively engaging with and using AI technologies in different domains and applications.

As for the other specific skills considered generally important, researchers mention prompt engineering (understood as generating, evaluating, and interpreting prompts), assuming responsibility for making decisions, the ability to fail, and performing tasks with a high degree of uncertainty (OECD, 2023). In the context of dynamic social and economic processes, Cramarenco underlines the relevance of "AI sound development" skills, which are characterized by an agile working environment and resilience behaviors (Cramarenco et al., 2023, p. 745). Even if a company has collected large amounts of data, there is still a need for processing, integration, and analysis. Lassébie and Quintini describe effective communication between teams as "one of the most important challenges in the adoption of AI technologies" (Lassébie and Quintini, 2022: 46).

4.4. AI Skills in Retail: Systematic Literature Review Approach

4.4.1. Data collection

In the data collection phase, we used Scopus – a leading citation database renowned for its comprehensive repository of high-quality, peer-reviewed papers (Zhu & Liu, 2020).

The keywords combinations we used were:

TITLE-ABS-KEY (**X** AND **Y**) AND PUBYEAR > 2017 AND PUBYEAR < 2025

Where: **X**=['sales', 'retail', 'e-commerce'], **Y**=['AI', 'artificial intelligence']. These keywords were scrutinized within titles, abstracts, author keywords, and 'topics' as delineated by the platform.

In our data retrieval process, we used the Scopus API to systematically extract the relevant publications. We collected a diverse range of publications from the database, including conference proceedings, book chapters, and other materials. To ensure the reliability of our analysis, we refined our focus exclusively to peer-reviewed articles, specifically limiting our scope to the categories of articles and reviews.

This search yielded a total of 1300 publications. In the analysis we used full texts of 645 articles for which we had permissions to retrieve pdf files. We parsed the PDF documents using Python

PyPDF2 library to extract text. Given the diverse formatting and structures of academic papers, this step is crucial to ensure that the text is accurately extracted for further processing.

In the analysis, we used Retrieval-Augmented Generation (RAG) to simulate the work traditionally performed by human annotators who would manually tag AI concepts within articles (Lewis et al., 2020). This manual tagging process, especially for a dataset extending over a few thousand pages, is not only resource-intensive but also susceptible to errors stemming from human oversight, cognitive biases, and heuristic shortcuts. In contrast, we argue that RAG offers a robust and consistent approach.

The biggest advantage of RAG is that it minimizes the possibility of hallucinations. While the AI possesses extensive knowledge from its training, our methodology strategically refrain from using this knowledge. The model's generative functions are not employed to introduce or infer information from its training but rather to interpret and analyze the text it's presented with. In our pipeline when the system identifies potential sections of the text that might discuss AI concepts it leverages its natural language understanding capabilities to analyze the given text. The goal is to ascertain whether the authors are indeed mentioning specific AI concepts and if these concepts (skills and technologies) are discussed as relevant for the retail and e-commerce sector. By 'relevant for AI,' we refer to a broad spectrum of connections. This includes technologies and skills that facilitate the adoption of AI, help manage its implementation, and address its consequences for human work.

One of the significant advantages of employing RAG in our analysis is the reproducibility of the results. By using seed parameters available in the OpenAI models, specifically the gpt-4o model, we ensured that our findings are replicable, providing a degree of consistency that manual tagging struggles to achieve. Although the models cannot be set to be entirely deterministic due to their inherent stochastic nature, the use of seed parameters ensures that the results are highly consistent across multiple runs (Anadkat, 2023).

The methodology we employed shares some ground with Named Entity Recognition (NER), which is a process in NLP that involves identifying and categorizing key information (entities) in text (Li et al. 2020). Entities could be names of people, companies, locations, etc. Our work parallels this by identifying 'concepts' within text. Illustrating the progression in NLP, studies have shown that even older GPT-3 models could match the performance of fully supervised NER baselines (Wang et al. 2023). Zhou et al. (2023) demonstrated that the LLAMA model, a large language model (LLM), significantly outperformed supervised NER models, as evidenced by a substantial margin in the F1 score - a measure of a test's accuracy. This comparison spanned 43 datasets encompassing nine varied domains. In a similar vein, Monajatipoor (2024) demonstrated that in the biomedical field, GPT-4 outperforms traditional NER methods.

In fields like biology, medicine, law, programming or finance standardized benchmarks exist to measure the efficacy of LLMs as NER tools (Chang et al. 2024). However, for our purposes, such benchmarks are unavailable. To ensure the robustness and reliability of our findings, we undertook a test in which we randomly selected a sample of papers to manually detect any

instances of hallucinations where the model might generate non-mentioned concepts or omit relevant ones. The robustness check did not reveal any such instance.

4.4.2. Results

The current discourse on AI and skills has at least two significant limitations. Firstly, the term 'skill' is often used too loosely. For example, it is sometimes used as a catch-all term for entire occupations or fields such as 'data science' or 'programming', which encompass a broad range of skills, knowledge, and qualifications (Stephany, 2021). Additionally, the discussion tends to focus primarily on the technical skills necessary for developing and implementing AI solutions, such as machine learning, natural language processing (NLP), or data visualization techniques (Margaryan, 2023).

To address these issues, we employed LLM to classify AI concepts into two categories: skills/competencies and knowledge following the approach used by ESCO. We used ESCO's definitions along with examples to ease the classification process.

Using our pipeline we have initially identified 8067 unique concepts (mentioned 18499 times in total). We cleaned the results by taking the following steps: merging obviously synonymous concepts (e.g., "mobile applications" and "mobile apps"), removing overly general terms (e.g., "collaboration"), and excluding non-English terms. As a result, we ended up with 5,741 concepts, with 4,661 referring to knowledge and 1,080 to skills.

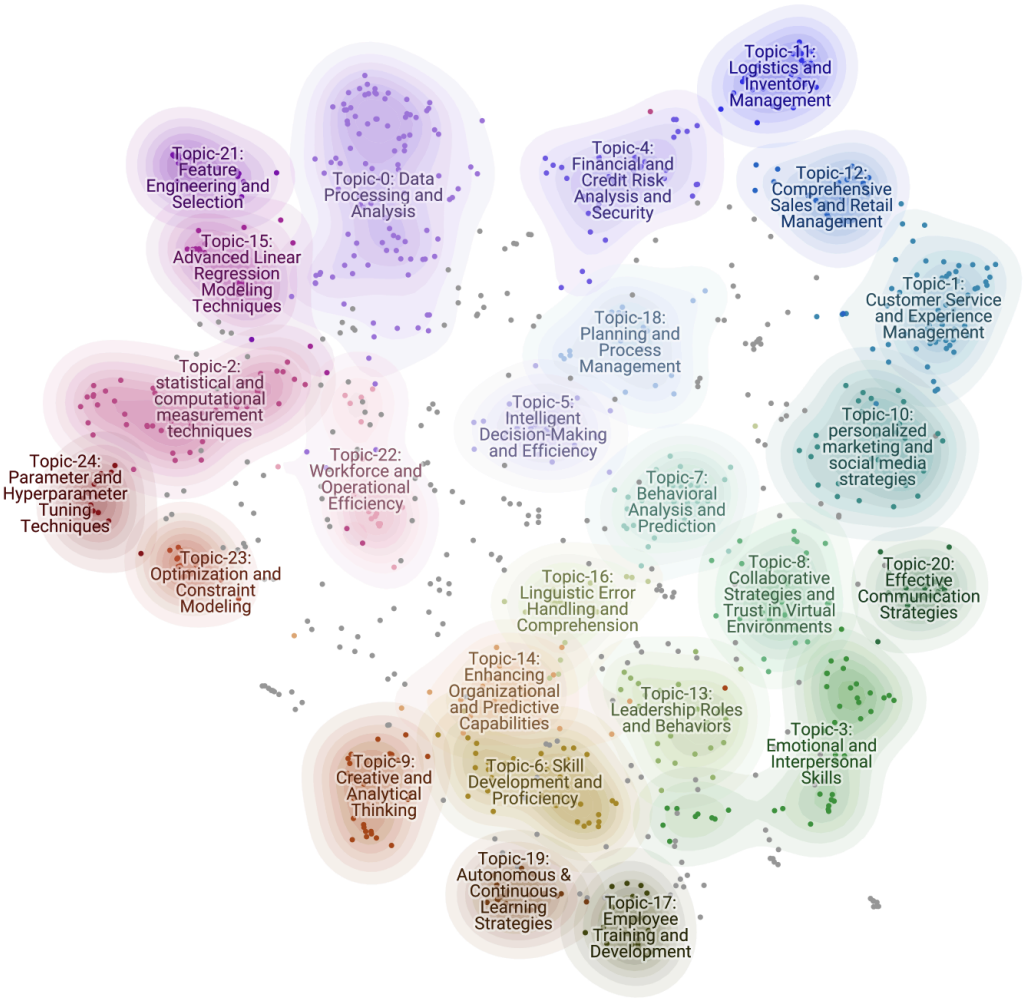
In the following section, for each AI concept type (skill, knowledge), we present the top 30 most frequently mentioned skill keywords identified in the literature, as well as a cluster map created using a similar methodology to that used in Section 5 of the report, where we created maps for skills and technologies required in job ads. Here the names of the clusters are not the most common keywords but aggregated labels designed to complement the top keywords lists.

Table 13 Top 30 most frequently mentioned skills keywords relevant for AI in literature on AI in retail sector

1. Decision Making	16. Data-Driven Decision-Making
2. Problem-Solving Skills	17. Teamwork
3. Critical Thinking	18. Resource Management
4. Communication Skills	19. Management Skills
5. Analytical Skills	20. Strategic Thinking
6. Problem Solving	21. Customer Management
7. Adaptability	22. Feedback Analysis
8. Creativity	23. Emotional Analysis
9. Emotional Intelligence	24. Data Interpretation
10. Risk Management	25. Cognitive Engagement
11. Customer Engagement	26. Resilience
12. Active Learning	27. Knowledge Retention
13. Research Skills	28. Interdisciplinary Collaboration
14. Leadership Skills	29. Knowledge Sharing
15. Negotiation Skills	30. Operational Flexibility

Source: own elaboration

Figure 39 Key skills clusters identified in scientific literature relevant to AI



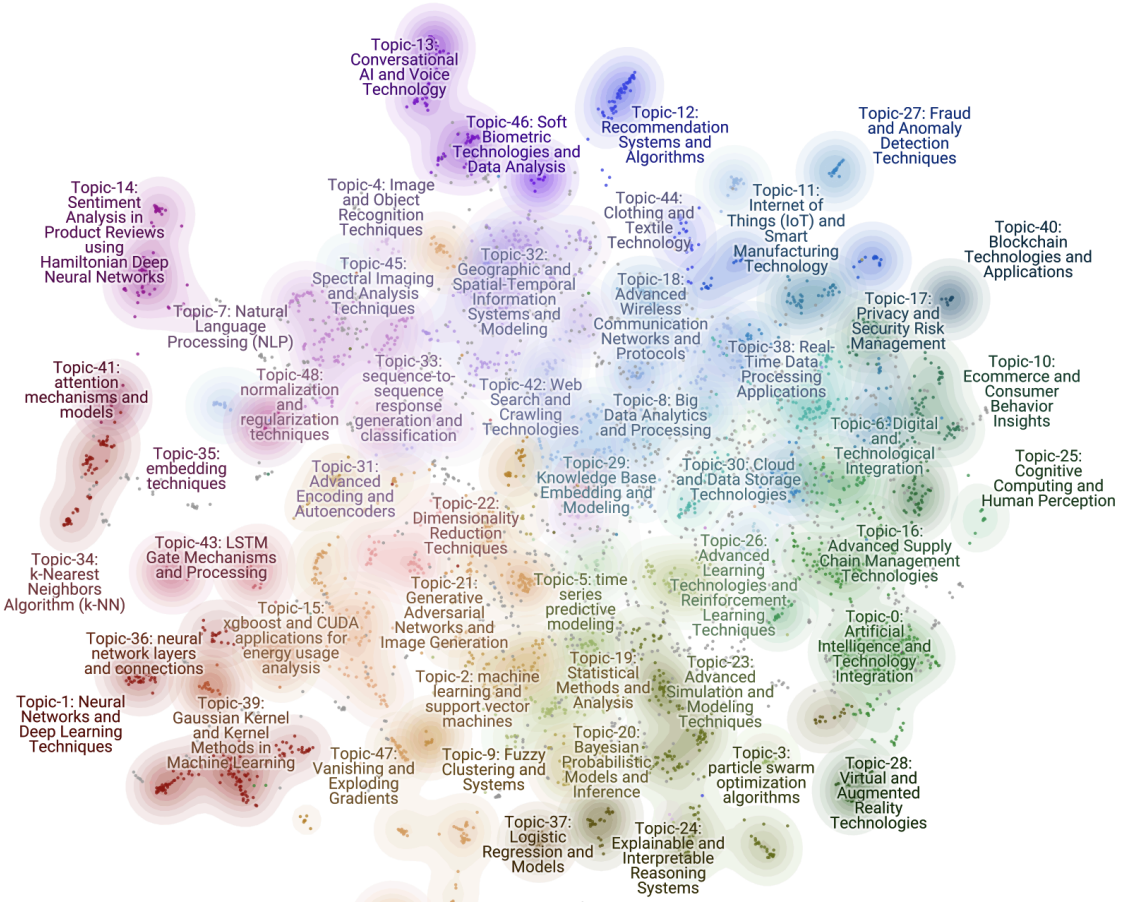
Source: own elaboration

Table 14 Top 30 most frequently mentioned knowledge concepts keywords relevant for AI in literature on AI in retail sector

1. Machine Learning	16. Random Forest
2. Deep Learning	17. Chatbots
3. Natural Language Processing	18. Decision Tree
4. Neural Networks	19. Speech Recognition
5. Data Mining	20. Python
6. Sentiment Analysis	21. Convolutional Neural Networks
7. Computer Vision	22. Collaborative Filtering
8. Big Data	23. Data Science
9. Feature Extraction	24. Blockchain
10. Supervised Learning	25. Text Mining
11. Image Processing	26. Big Data Analytics
12. Predictive Modeling	27. Ensemble Learning
13. Reinforcement Learning	28. Long Short-Term Memory (Lstm)
14. Support Vector Machine	29. Transfer Learning
15. Decision Trees	30. Recommendation Systems

Source: own elaboration

Figure 40 Key knowledge clusters identified in scientific literature relevant to AI



Source: own elaboration

4.4.3. Usage and future work

In the project repository, we include two datasets: one listing unique concepts and a master file referencing all articles mentioning each given concept. The former allows for browsing skills and knowledge concepts, while the latter serves as a reference to works addressing each concept and enables quantitative analysis, such as identifying the most frequently mentioned concepts.

Future work might involve further subcategorization of the terms into narrower categories, such as soft skills versus hard skills, using a similar methodology to what we have presented in this analysis. These datasets are intended to aid in qualitative analysis by organizing extensive literature on the subject. Analysts can select the concepts of interest and receive a list of articles explicitly highlighting their importance for AI in the retail sector.

5.AI SKILLS NEEDS: PERSPECTIVE OF EMPLOYERS

In this section we present what kind of skills employers in the retail sector are looking for. To answer this question we analyzed major job advertisement platforms in the examined countries (Cyprus, Germany, Italy, Poland, and Romania), from which we retrieved job offers using either web scraping tools we developed or official APIs.

Key takeaways

- **Only 0.5% of job ads specifically list AI skills as a requirement.**
- **Most job advertisements primarily require basic digital skills.**
- Job ads across the studied countries share several key similarities, such as a universal emphasis on proficiency in office software (e.g., Microsoft Office) and ERP systems (e.g., SAP), strong demand for CRM management skills, and the importance of digital marketing (e.g., Google Ads) and e-commerce platform expertise. Basic computer skills and general digital literacy are also essential.
- However, notable differences exist: Cyprus values agile methodologies and design tools like Figma and Adobe Design; Germany focuses on cloud technologies (AWS, Docker), advanced IT infrastructure, and creative skills (Adobe Photoshop, Illustrator); Italy prioritizes data business intelligence, social media management, and hardware installation and support; Poland highlights advanced Excel skills and specific SAP modules; and Romania includes emerging technologies such as VR glasses and electronic processing software.
- Additionally, Italy and Romania emphasize customer interaction and retail front-end competencies, whereas Cyprus and Germany concentrate more on technical and backend skills.

5.1. Data collection

Data was collected three times during the period from March to May 2024, resulting in a total of 44,494 job offers. Details about the selected portals, collection methods and the number of retrieved offers are presented in Table 15.

Table 15 Web-scraping of retail and e-commerce job adverts

Country	Portal	No. of offers collected	Offers per M inhabitants	Categories	Monthly portal visits per capita	Retrieval technique
Cyprus	cypruswork.com	1,080	1200	sales e-commerce	0.10	Custom Selenium webscraper
Germany	xing.com	5,289	63	retail e-commerce	0.20	Custom Selenium webscraper
Italy	adzuna.it	14,000	237	sales e-commerce	0.03	Official API
Poland	pracuj.pl	22,366	589	sales e-commerce	0.30	Custom BS4 webscraper
Romania	ejobs.ro	1,759	93	retail e-commerce	0.10	Custom Selenium webscraper

Source: own elaboration with data on Monthly portal visits per capita based on similarweb.com (monthly visits 2023) and Eurostat (population 2023).

The number of job offers varies, influenced not only by the market size and its current dynamics but also by the data retention policies of the portals. Some portals allow for the retrieval of all relevant offers, while others impose certain restrictions. To partially mitigate this issue, we collected data three times. However, for more representative results, continuous scraping of these portals over a longer period would be necessary. This exercise is intended as an initial overview.

5.2. Text mining analysis

We analyzed the job offers using a text mining method called topic modeling. Specifically, we used the BERTopic algorithm (Grootendorst 2022), which clusters similar texts and identifies latent topics by leveraging transformer models and c-TF-IDF (class-based Term Frequency-Inverse Document Frequency). The aim was to uncover latent topics related to digital skills and technologies in demand within the retail sector of the countries in question.

Given that job offers are semi-structured data—the information we sought (technologies and skills) could appear in various sections, differing between portals—we developed a pipeline to standardize them. First, we identified all offers not presented in English and translated them

using ChatGPT 3.5 via the OpenAI API. Next, we used the ChatGPT-4 model API to extract the skills and technologies mentioned in the offers. This step aimed to clear the data of irrelevant information, enhancing the clarity of the topic modeling results.

To ensure the reliability of our approach and mitigate potential model hallucinations, we included explicit instructions in the prompt to return no output if no digital skills or technologies were mentioned in the offer. As a robustness check, we randomly selected a subset of offers from each country and compared the skills and technologies identified by the algorithm with the original text. We found no false positives (skills and technologies not present in the offers) nor false negatives (missed skills and technologies) ensuring reliable results. This reliability is attributed to the fact that we did not rely on the model's pre-existing knowledge from training but rather provided it with the actual job offers, leveraging its strength in natural language processing for accurate semantic information retrieval.

To facilitate the inspection of our analysis, we used UMAP (Uniform Manifold Approximation and Projection) to visualize the clusters of job offers in a 2D space. This method helps in reducing the high-dimensional data into a two-dimensional representation, making it easier to interpret.

In the context of topic modeling, topics are groups of words that frequently appear together, representing underlying themes within the data. Keywords are the most significant words that define these topics.

In the visualization:

- Each dot represents a single job offer (for readability purposes we present a sample of the entire 44k corpus of offers).
- Different colors are used to denote different topics.
- The proximity of dots to each other indicates semantic similarity, meaning job offers that are close together share similar digital skills and technology requirements.

Additionally, the labels for each cluster come from the first three words representing the most prominent keywords for that topic. This labeling method provides a quick and intuitive understanding of the main themes within each cluster.

By using UMAP and labeling clusters with representative keywords, we can easily identify and inspect the clusters of offers, providing a clearer understanding of the distribution and relationship between different topics in the job offers.

For each country, we present two types of figures. The first one is the UMAP visualization as described above. The second type consists of bar charts showing the prevalence of keywords relevant to specific topics. These bar charts provide a detailed view of the most common digital skills and technologies mentioned in the job offers, allowing for a deeper understanding of the demand in each country.

5.3. Main insights

The analysis revealed that only around 0.5% of job offers explicitly relate to AI, with no significant differences between countries. Due to the low percentage of AI-specific job offers, a broader focus was adopted. The new approach involves analyzing broader digital skills and technologies in demand across the retail sectors to assess digital maturity and AI-readiness of analyzed markets.

Job advertisements predominantly require basic digital skills, such as proficiency in office software and general computer literacy. These foundational digital competencies are essential across all countries. Requirements like "general computer skills and MS Office proficiency" frequently appear as the sole digital competencies, even for mid-level positions such as Customer Services Specialist for E-commerce.

Additionally, **typical requirements also include CRM, ERP, and digital marketing tools**, although these are usually not necessary but considered an "advantage".

Table 16 Notable differences

Cyprus	Emphasizes agile methodologies and design tools (e.g., Figma, Adobe Design)
Germany	Highlights cloud technologies (e.g., AWS, Docker)
Italy	Extra focus on data business intelligence and social media management
Poland	Prioritizes advanced Excel skills and national ERP solutions
Romania	Refers to emerging technologies (e.g., VR glasses)

Source: own elaboration

5.3.1. Cyprus

We find requirements for a variety of digital skills in Cyprus. Employers are looking for candidates with expertise in database manipulation, agile methodologies, and various programming languages. Specifically, database manipulation is highlighted under Topic-0, agile methodologies under Topic-6, and programming languages under Topics-10 and 12.

There is a significant emphasis on tools for marketing digital ads and customer relationship management (CRM). This focus highlights the need for skills that enhance customer engagement and sales, with marketing digital ads covered under Topic-4 and CRM under Topic-2.

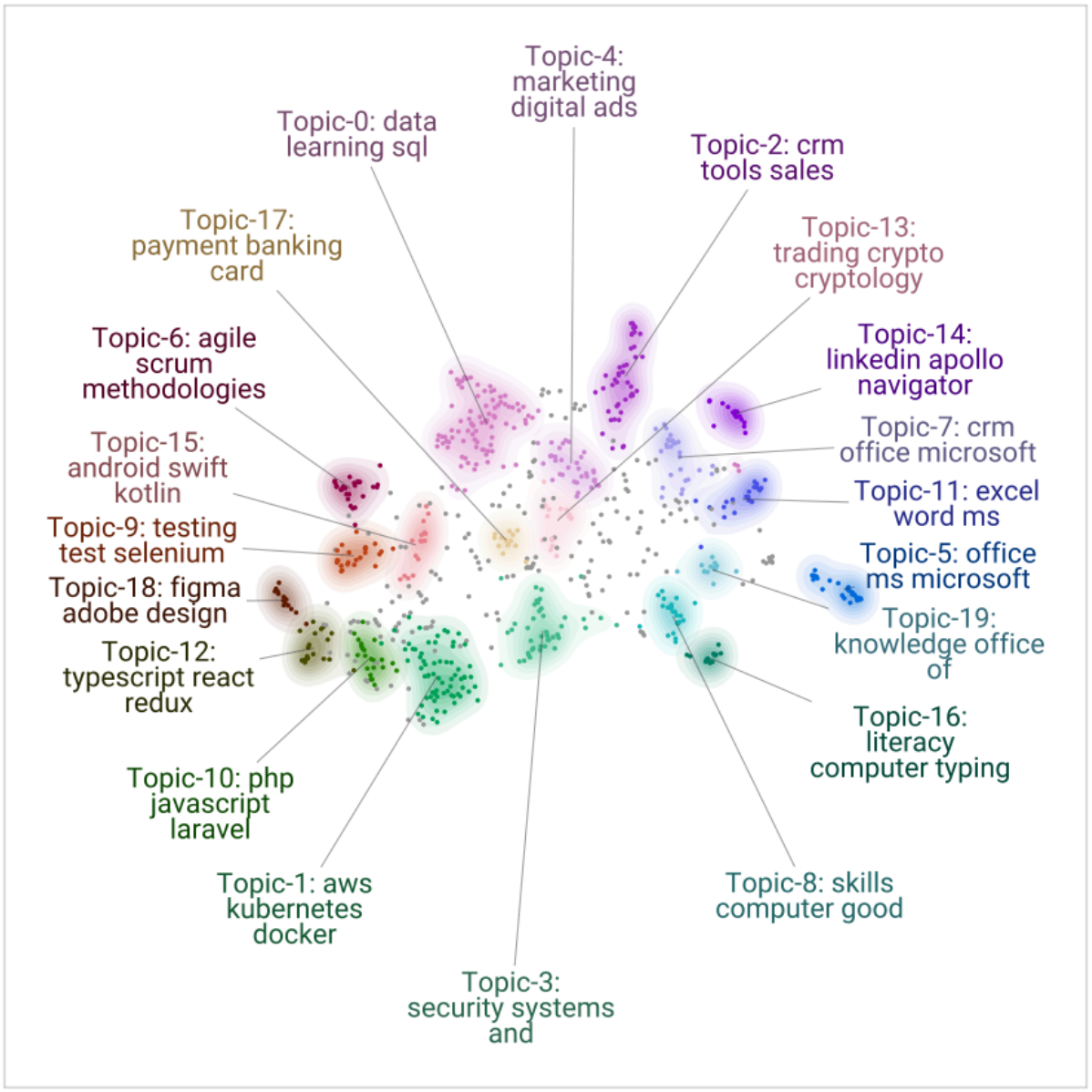
Knowledge in IT infrastructure and cybersecurity is also in demand. The need for competencies in these areas is reflected in Topics-1 and 3, indicating that businesses are seeking workers with skills helping to protect and maintain their IT systems.

Proficiency in office software is another key requirement. Many job ads revolve around skills in Microsoft Office, Excel, and Word, as noted in Topics-5, 7, and 11. Basic computer skills are also essential, with Topics-8 and 16 indicating the importance of general computer literacy.

There is a demand for specialized technical skills, particularly in payment systems, trading, cryptology, and certain programming languages like Swift, Kotlin, and PHP. These specialized skills are addressed in Topics-17, 13, 10, and 15.

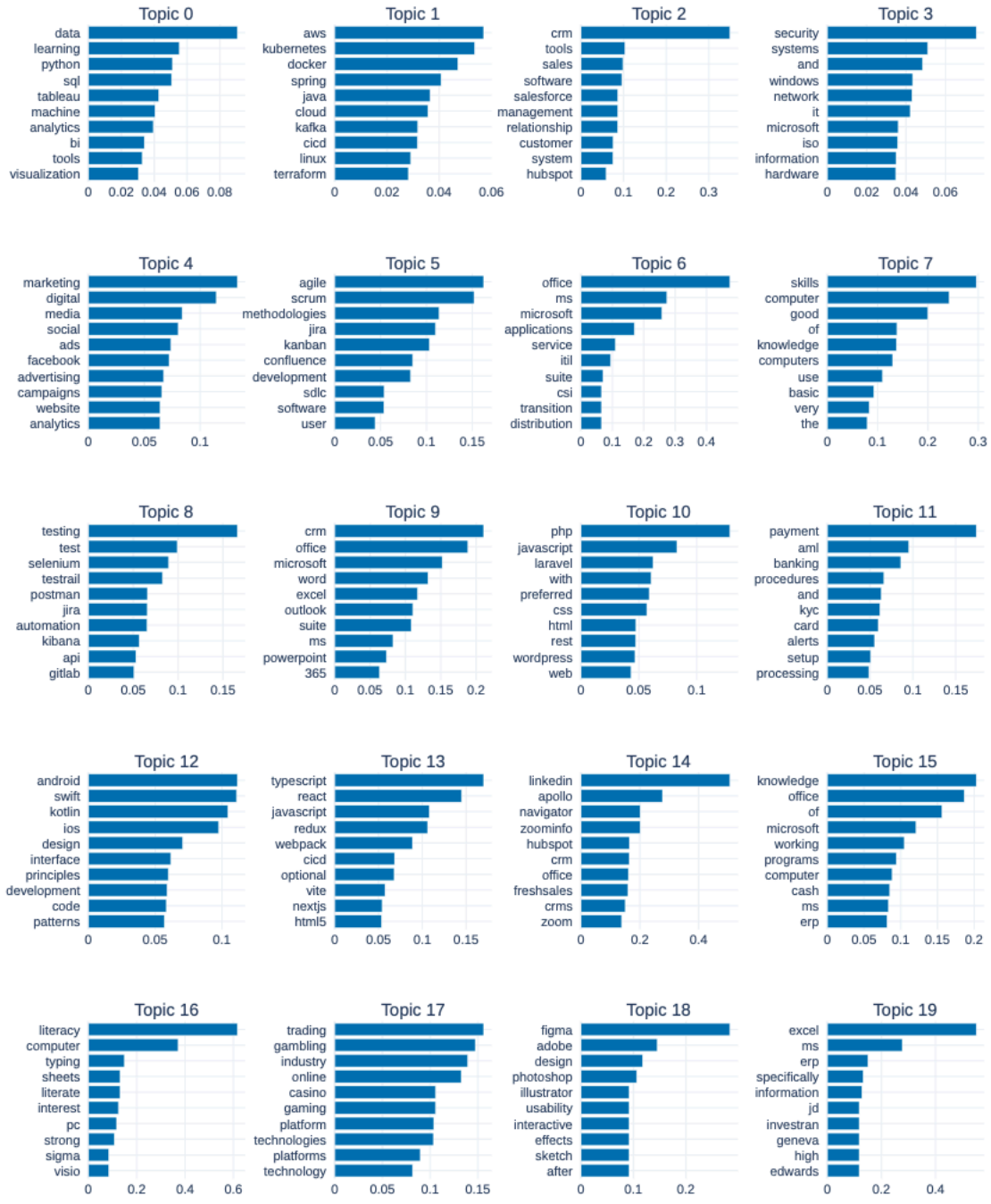
Finally, familiarity with agile methodologies and design tools is crucial for modern project management and design practices. These requirements are covered under Topics-6 and 18, respectively.

Figure 41 Technologies and digital skills required in job ads in Cyprus



Source: own elaboration

Figure 42 Keywords representing identified topics in job ads in Cyprus



Source: own elaboration

5.3.2. Germany

Job advertisements in Germany particularly highlight skills related to cloud technologies (Topic-8), data analysis (Topic-9), and e-commerce platforms (Topic-1).

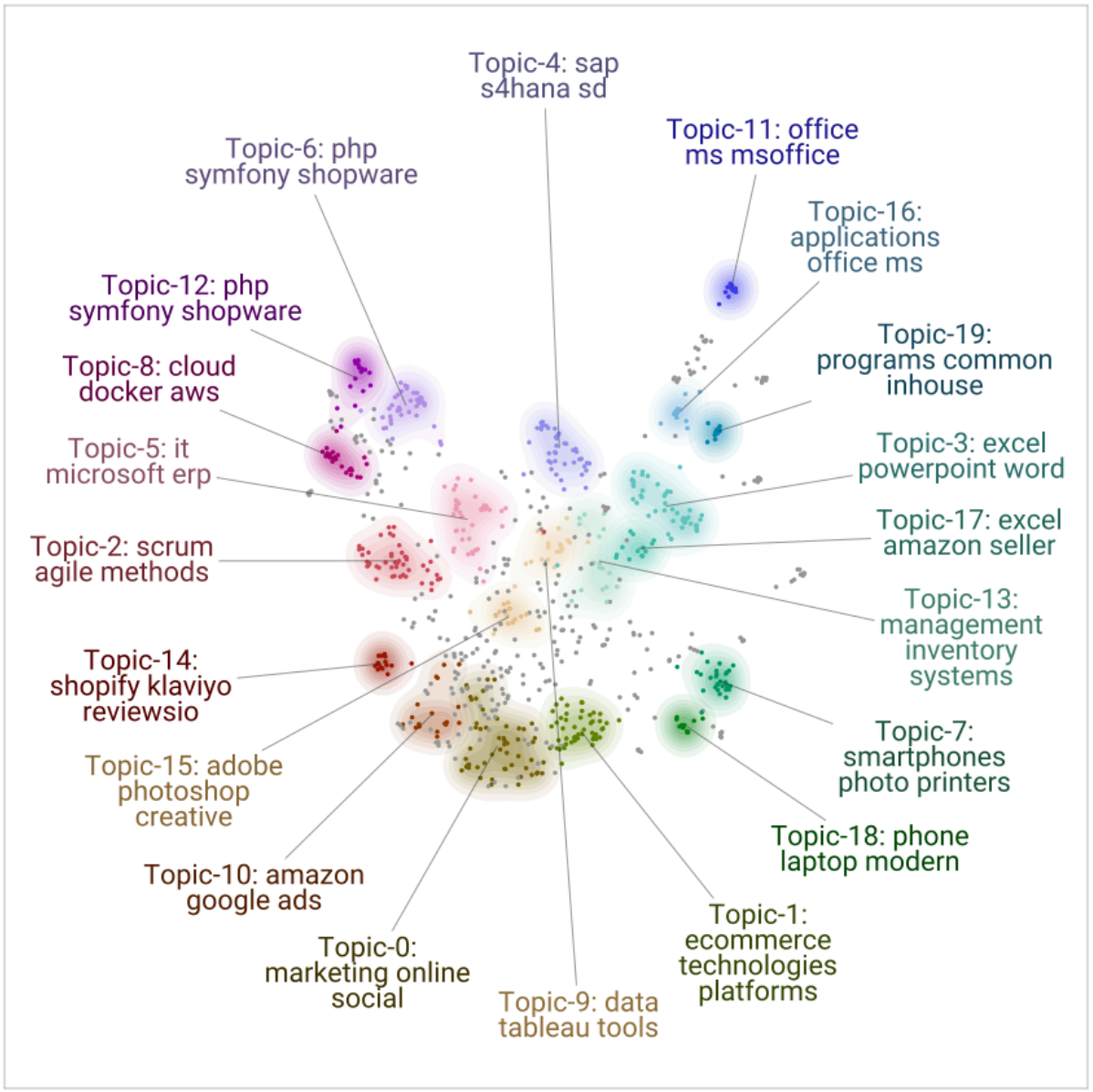
There is a significant emphasis on ERP systems (Topic-5) and proficiency in office software like MS Office (Topics-11 and 16). This suggests the importance of these tools in various job roles.

There is also a high demand for skills in online marketing (Topics-0 and 10) and tools like SAP (Topic-4) and Shopify (Topic-14).

The topic related to agile methodologies (Topic-2) suggests a need for familiarity with modern development and project management practices.

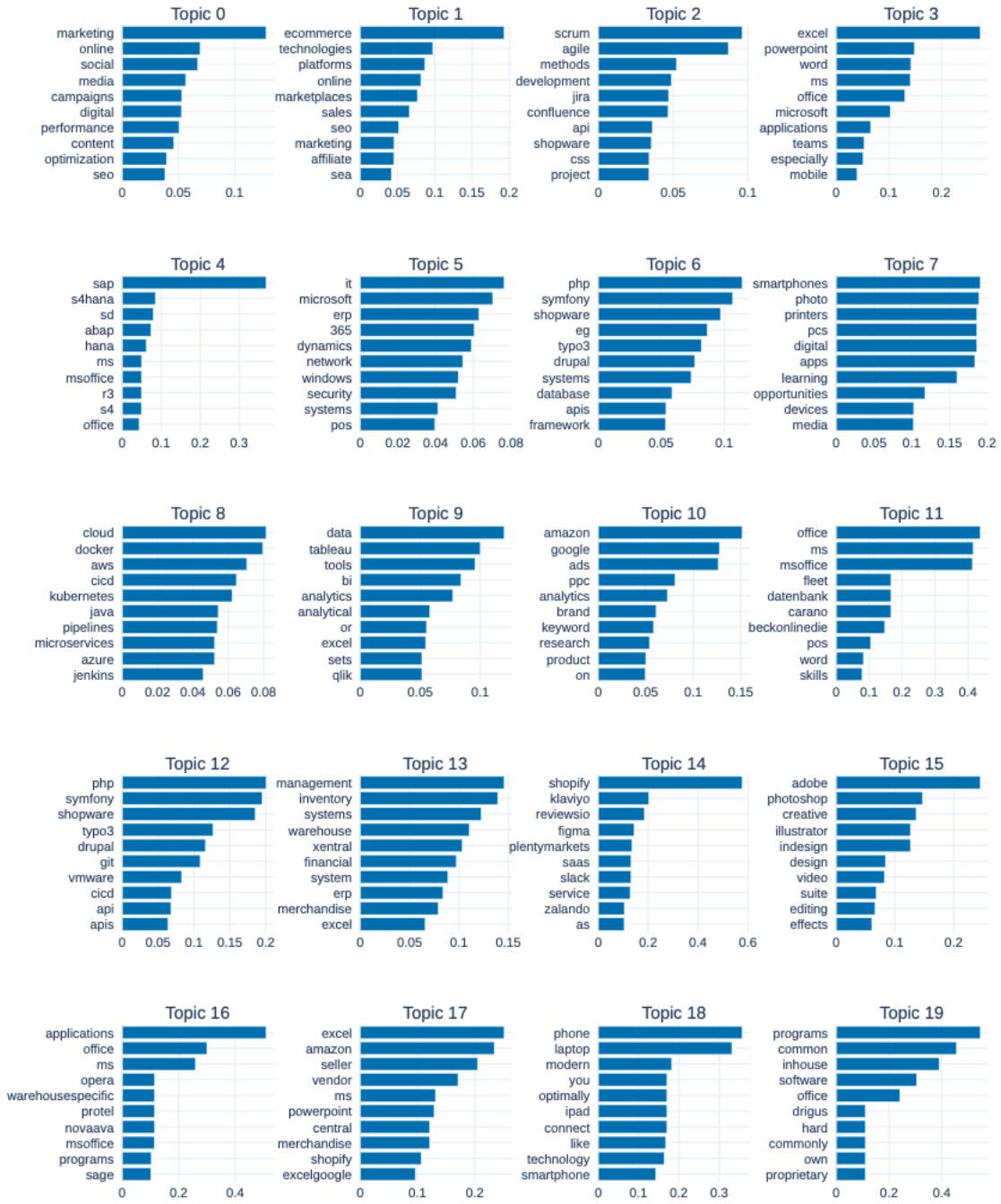
Furthermore, there is a notable demand for specialized skills in areas such as Adobe Creative Suite (Topic-15) and inventory management systems (Topic-13).

Figure 43 Technologies and digital skills required in job ads in Germany



Source: own elaboration

Figure 44 Keywords representing identified topics in job ads in Germany



Source: own elaboration

5.3.3. Italy

Job advertisements in Italy demand a variety of technical skills, particularly in frontend and mobile development. This includes proficiency in JavaScript, HTML, CSS (Topic-0), and Android development (Topic-4).

There is significant emphasis on data-related skills and business intelligence (Topic-1), suggesting a need for data-driven decision-making capabilities.

There is a high demand for proficiency in office software (Topics-8, 7) and general computer skills (Topics-6, 13), indicating the importance of basic digital literacy.

CRM monitoring and support (Topic-2) and management of email platforms (Topic-5) are also significant, pointing to the importance of maintaining customer relations and communication.

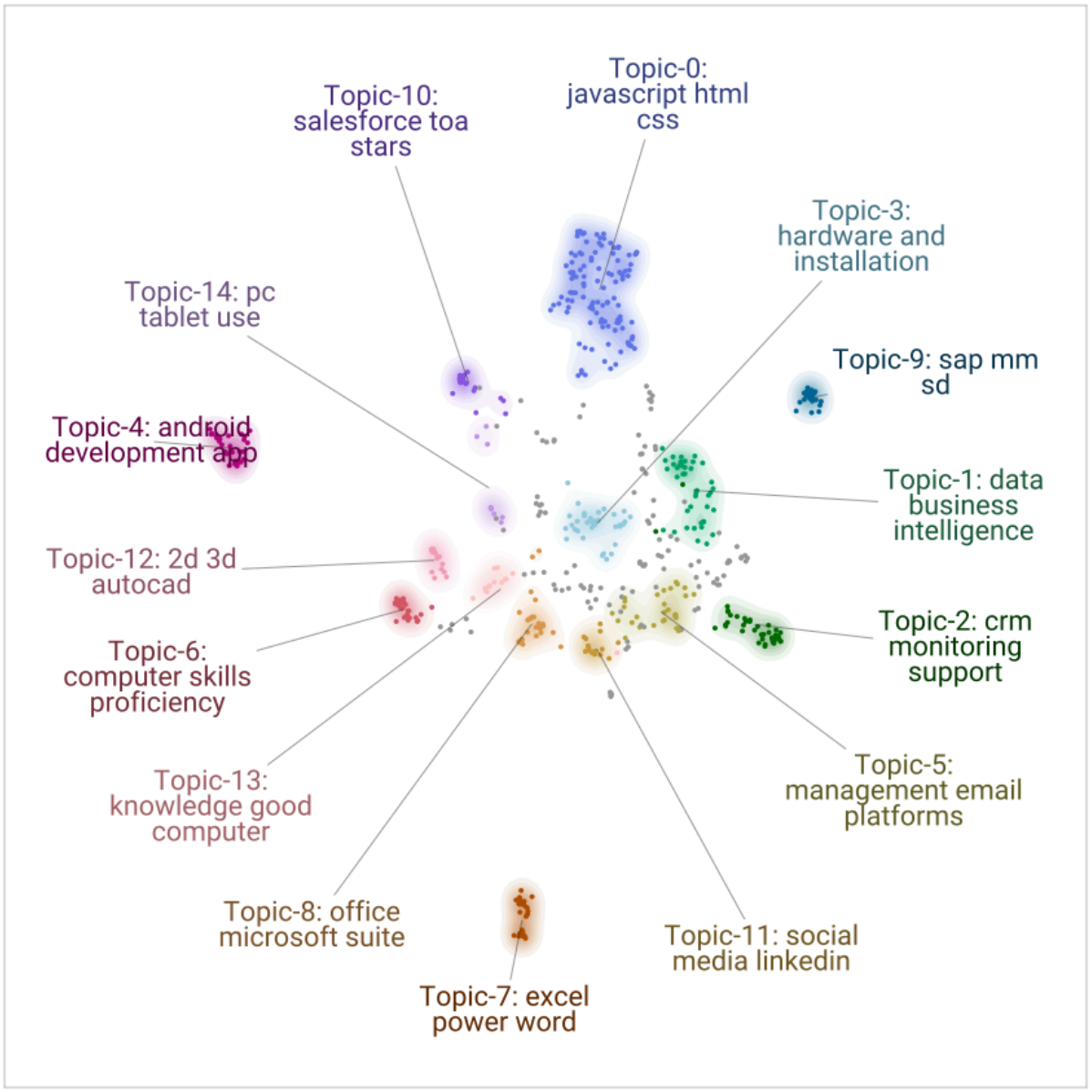
Skills in hardware installation (Topic-3) are required, reflecting roles that need technical support capabilities.

Specialized knowledge in enterprise resource planning tools is highlighted by topics like Topic-9.

There is a demand for skills in managing social media platforms like LinkedIn (Topic-11), indicating the role of social media in business strategies. The inclusion of Salesforce skills (Topic-10) suggests a need for proficiency in popular CRM platforms.

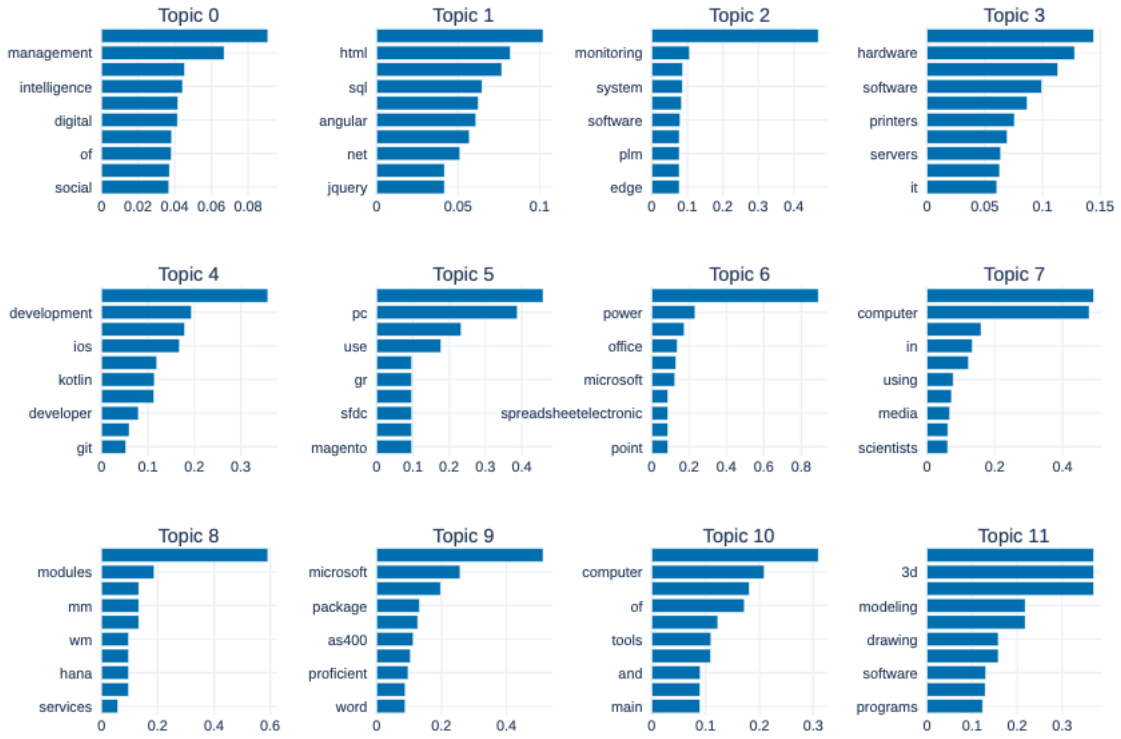
Lastly, there is a demand for design-related skills such as 2D and 3D AutoCAD (Topic-12), indicating specialized technical roles.

Figure 45 Technologies and digital skills required in job ads in Italy



Source: own elaboration

Figure 46 Keywords representing identified topics in job ads in Italy



Source: own elaboration

5.3.5. Poland

Job advertisements in Poland place a strong emphasis on proficiency in MS Office (Topics-3, 8, 2, 38) and ERP systems (Topics-24, 30, 40). This indicates a need for robust office and enterprise software skills.

Skills related to e-commerce platforms and online sales (Topics-34, 36), including online payment gateways, are highlighted, underscoring the importance of digital sales and transaction processing.

There is a high demand for CRM systems (Topics-4, 23) and sales management (Topics-15, 49), suggesting a focus on effective customer relationship management and sales strategies.

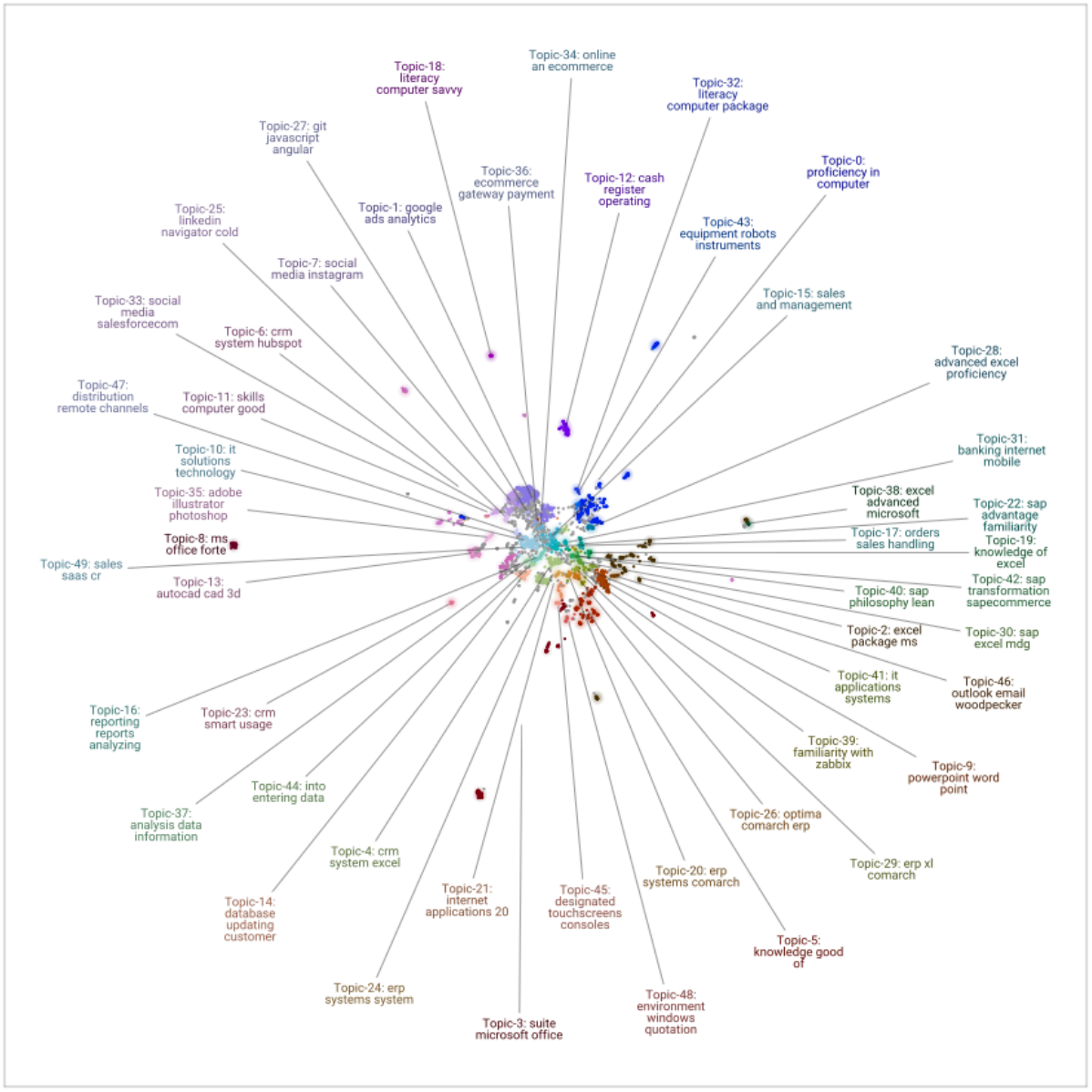
Job ads highlight a variety of technical skills, including IT solutions and technology (Topic-10), programming (Topic-27), and database management (Topic-14).

There is significant emphasis on digital marketing skills like Google Ads (Topic-1), social media management (Topics-7, 33), and creative tools like Adobe Illustrator and Photoshop (Topic-35). This highlights the importance of online marketing strategies.

Skills in data analysis and reporting (Topics-16, 37), including entering and analyzing data, emphasize the role of data-driven decision-making in business operations.

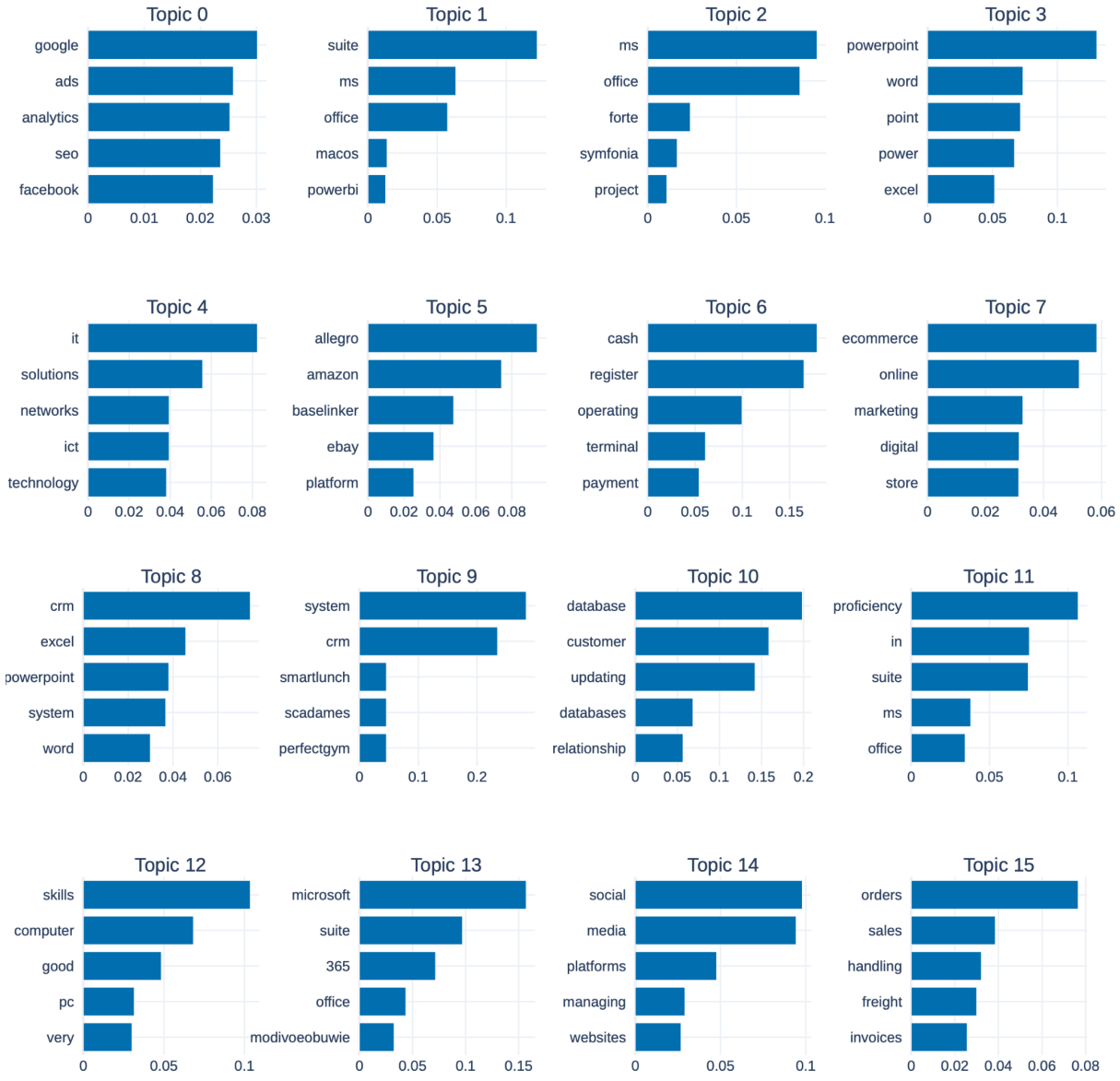
General computer skills (Topic-11) and literacy (Topics-18, 32), including basic computer use and proficiency in software packages, reflect the need for foundational digital competencies.

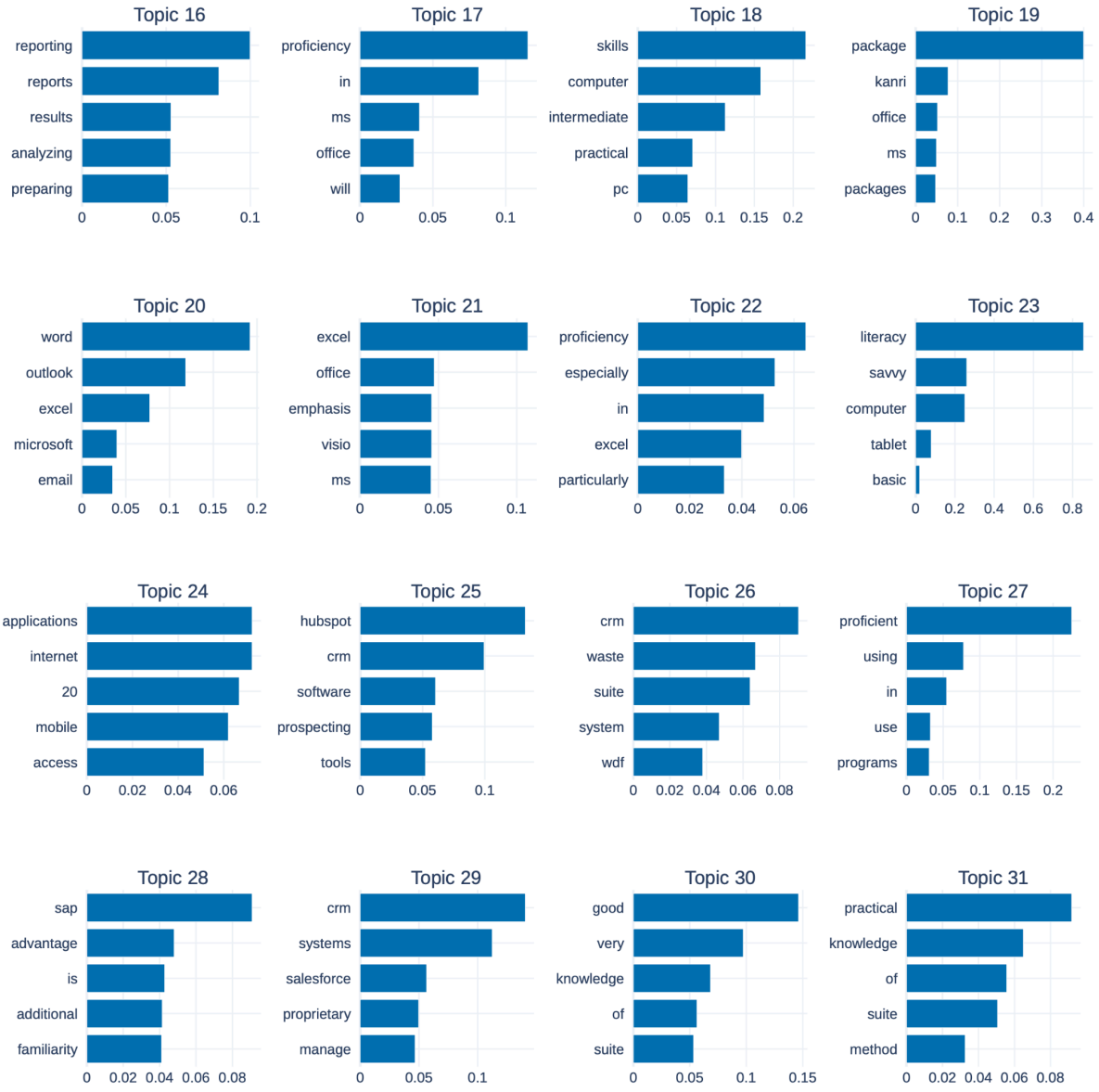
Figure 47 Technologies and digital skills required in job ads in Poland



Source: own elaboration

Figure 48 Keywords representing identified topics in job ads in Poland




Topic 16
reporting
reports
results
analyzing
preparing
0 0.05 0.1
Topic 17
proficiency
in
ms
office
will
0 0.05 0.1
Topic 18
skills
computer
intermediate
practical
pc
0 0.05 0.1 0.15 0.2
Topic 19
package
kanri
office
ms
packages
0 0.1 0.2 0.3 0.4
Topic 20
word
outlook
excel
microsoft
email
0 0.05 0.1 0.15 0.2
Topic 21
excel
office
emphasis
visio
ms
0 0.05 0.1
Topic 22
proficiency
especially
in
excel
particularly
0 0.02 0.04 0.06
Topic 23
literacy
savvy
computer
tablet
basic
0 0.2 0.4 0.6 0.8
Topic 24
applications
internet
20
mobile
access
0 0.02 0.04 0.06
Topic 25
hubspot
crm
software
prospecting
tools
0 0.05 0.1
Topic 26
crm
waste
suite
system
wdf
0 0.02 0.04 0.06 0.08
Topic 27
proficient
using
in
use
programs
0 0.05 0.1 0.15 0.2
Topic 28
sap
advantage
is
additional
familiarity
0 0.02 0.04 0.06 0.08
Topic 29
crm
systems
salesforce
proprietary
manage
0 0.05 0.1
Topic 30
good
very
knowledge
of
suite
0 0.05 0.1 0.15
Topic 31
practical
knowledge
of
suite
method
0 0.02 0.04 0.06 0.08

Source: own elaboration

5.3.6. Romania

There is a focus on emerging technologies and devices, such as VR glasses and modern tablets and phones (Topics-3, 13), indicating a need for familiarity with the latest technological advancements.

General computer skills (Topics-1, 2, 4, 7) are essential, reflecting the need for foundational digital competencies and operating knowledge.

There is a demand for technical skills in areas such as CRM software (Topic-8), PHP and MySQL (Topic-11), and IT configuration and networking (Topic-22).

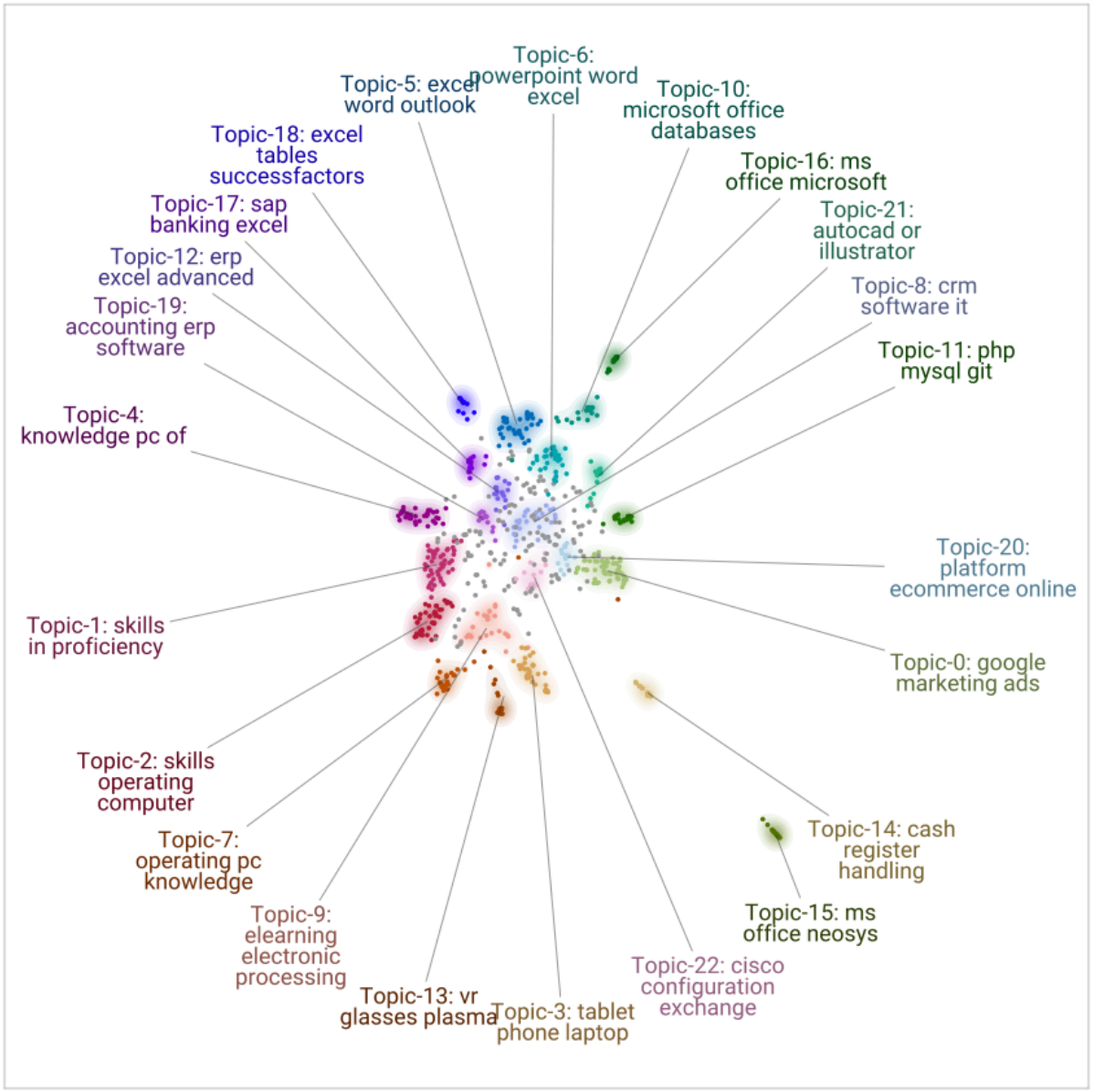
Skills related to e-commerce platforms (Topic-20) and online marketing, including Google Ads (Topic-0), highlight the importance of digital sales and marketing strategies.

Advanced skills in Excel (Topics-5, 18) and knowledge of data tables and ERP software (Topic-19) are crucial, highlighting the need for advanced data management capabilities.

There is an emphasis on skills related to customer interaction, such as cash register handling (Topic-14), suggesting the importance of front-end retail competencies.

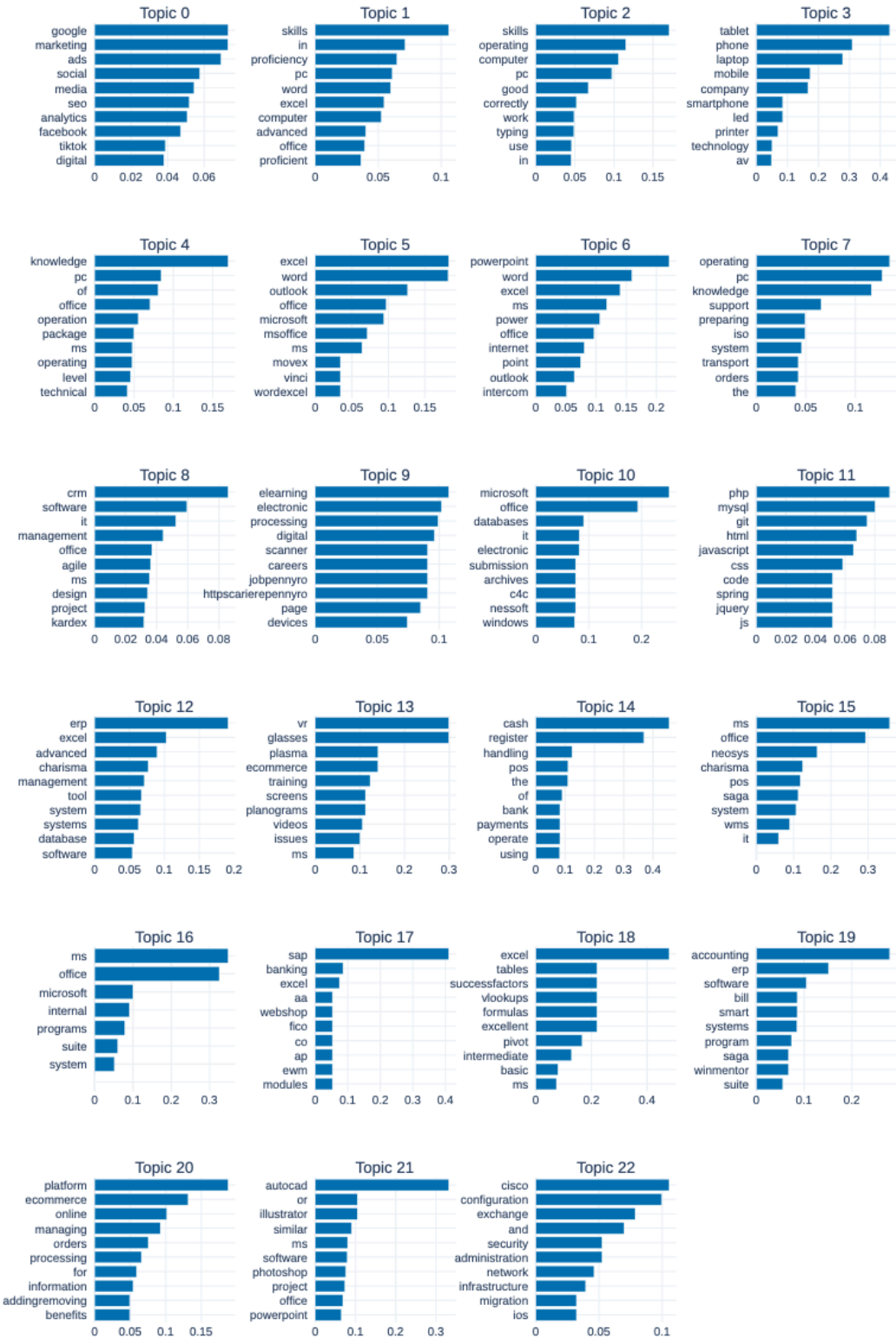
Finally, similarly to other countries there is a strong emphasis on proficiency in Microsoft Office (Topics-5, 6, 10, 16) and ERP systems (Topics-12, 17, 19), indicating the importance of office software and enterprise resource planning tools in job roles.

Figure 49 Technologies and digital skills required in job ads in Romania



Source: own elaboration

Figure 50 Keywords representing identified topics in job ads in Romania



Source: own elaboration

6. AI SKILLS NEEDS AND GAPS: PERSPECTIVE OF THE RETAIL SECTOR STAKEHOLDERS

Referring to the challenges facing the retail sector and the expected value of artificial intelligence in addressing these challenges, participants in co-creation workshops from selected EU countries identified core skills and competencies that MSMEs should possess for digital transformation and AI integration. They also pinpointed the specific skills needed for managers and employees. This section summarizes the skill sets co-created by the participants during the workshops.

Key takeaways

- Understanding the context of MSMEs, specifically their target audiences and customer segments, is fundamental for implementing AI in retail.
- **MSMEs need to understand data and data-driven processes to effectively implement AI technologies.**
- This understanding should foster a culture of openness to new knowledge, learning, and development within the company.
- Managers need skills for strategizing various AI technologies, understanding their opportunities and risks, and controlling data generation and infrastructure.
- Practical skills for employees include understanding AI technology and its application, grasping the implications of AI use, and possessing basic computer skills with an openness to continuously acquire new competencies.

6.1. AI Skills in Retail Companies

This section of the report presents findings from a thematic analysis conducted on transcripts from a series of co-creation workshops. Workshops were held between 4th April and 25th May, comprising a total of nine sessions that gathered a collective of 58 experts. The workshops included three remote sessions conducted in Italy, and two sessions each in Germany, Poland, and Romania. Participants in these workshops included owners and managers of MSMEs, digital specialists from retail companies and e-commerce technology providers, as well as representatives from universities, research agencies, and other organizations dedicated to promoting digital transformation among European MSMEs in the retail sector. The co-creation

workshops were complemented by additional material in the form of 13 in-depth individual qualitative interviews conducted with experts in retailing and the implementation of new technologies in the market, including artificial intelligence, from Germany, Poland, Romania, and Czechia.

Participants in the workshop identified a number of fundamental skills that MSMEs in the retail sector should have if they are to implement AI-based or AI-enabled solutions. In the analysis, we present these as an **understanding of the business context**, an **understanding of the processes involved in data production and AI technologies**, and a core set of skills that make up **a culture of openness** to acquiring new knowledge and learning about new technological solutions.

Workshop participants noted that a fundamental skill for implementing AI in retail is **understanding the context** in which MSMEs operate, in particular understanding their target audiences and the customer segments with which they are trying to build relationships:

> *Yes, I can tell you that the companies and the retail brand are trying to put the attention on the customer and not on the product. It's very strange what the feeling is about the customer and about the manager. It is so different because we work by focusing on the customer and because, knowing the consumer and his habits, we can personalize the communication, the offer and increase the relationship. (...) And now with the big data and with the loyalty card, you must, you must improve this approach, okay? And I also think the AI, excuse me. AI must improve that relationship. And you can also use AI to predict the trend of consumers and the other things that can improve the relationship. Because for example, Generation Z is more... We must make a difference between the physical store and the digital store. The digital store is more preferred by Generation Z, but the physical store is preferred by the other generation and the older customer. I think we must have a different approach between the different generations.* (Workshop_Italy_2)

A participant in the Italian workshop presents what the ability to understand context should entail. Above all, it is important to understand the customer, their behaviors, and habits in order to personalize communication with them - a key determinant of effective business performance in both analogue and digital times. What AI brings is the potential to improve these relationships based on the analysis of available data sets and the prediction of trends and segmentation of customer groups. However, as the above quote from the workshop suggests, AI is just a new tool for understanding the context in which a business operates. What is important is the synergy of the new digital tools based on AI with the company's operations, as illustrated by the example of digital and bricks-and-mortar stores and the consumer behavior of the so-called Generation Z. Understanding the context allows us to use the technology itself skillfully to build relationships with customers.

Another skill that MSMEs should have when implementing AI technologies is an **understanding of data**, or more precisely, the processes of the company that are based on data, on which both the use of specific technologies and the strategy for achieving the set goals should be based. This issue was raised by a workshop participant from Poland in the passage quoted earlier in the automation section:

> *(...) because in order to create a model that can perform better, you need the quality of data. So when you are working on a supply chain, you must be aware that you don't have silos, a lack of information in some processes, because what you put inside the input, the quality of the input is related to the quality of output. So if you want to automate, and you want a lot of information and knowledge that comes from all your infrastructure, digital infrastructure, you need a good integration of all your software and integration with the software of the third part.* (Workshop_Italy_2)

A participant in the Italian workshop emphasized the critical importance of data quality. He noted that data quality is defined by the infrastructure and flow of data within the organization, ensuring that there are no data silos. Data silos, where information is isolated and not accessible across different departments, can significantly hinder the efficiency and effectiveness of data use. It's therefore essential to have a seamless flow of data throughout the organization. The participant went on to explain that understanding what constitutes quality data means recognizing the relationship between the organization's infrastructure and the software it uses.

Quality data doesn't exist in a vacuum; it is the result of well-integrated systems that facilitate the smooth exchange and processing of information. For data to be truly valuable, there must be a good integration of all the elements involved, from data collection and storage to analysis and reporting. This integration ensures that data is not only accessible and reliable but also actionable, enabling the organization to make informed decisions based on accurate and comprehensive information. In addition, the participant emphasized that achieving high data quality requires continuous monitoring and maintenance of the data infrastructure. By maintaining high standards of data quality, organizations can use their data more effectively to gain insights that drive innovation, improve customer satisfaction, and ultimately drive business performance.

The issue of data understanding within MSMEs leads to a core skill set that can be characterized as a **culture of openness** within the company to new knowledge learning and development. This issue was highlighted by a workshop participant from Germany:

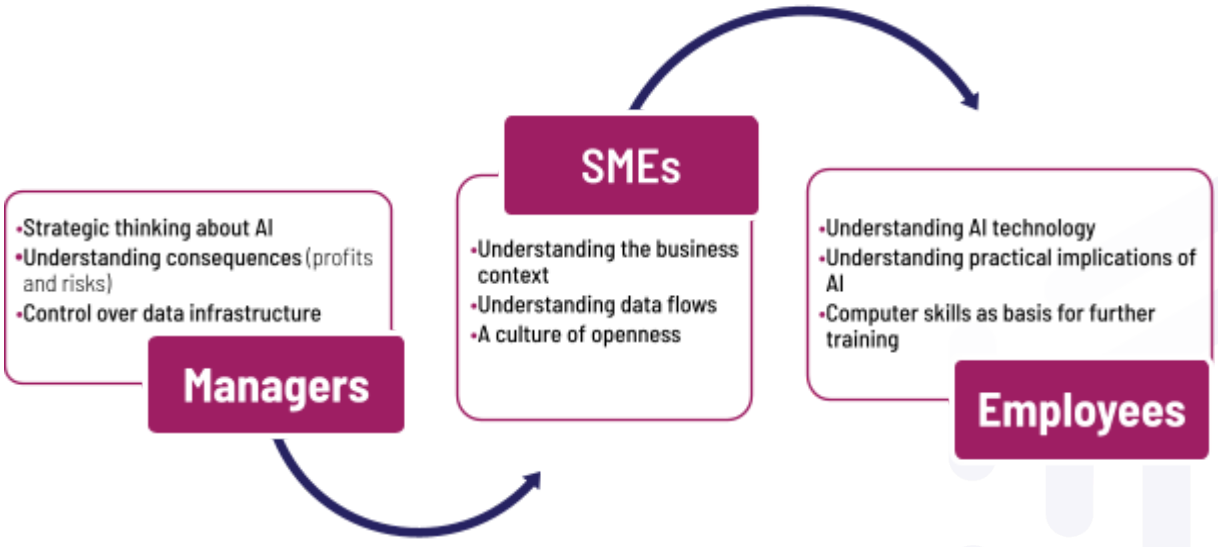
> *I think there needs to be a bit of technical openness. But also, a greater degree of openness in terms of, I would almost say, pride. A lot of the functionality that is core to a role can sometimes be performed by artificial intelligence. And* ***there has to be a willingness to embrace that and eventually define a new role for yourself in order to still be there****. So, I think there's a big fear of losing your job if you use these tools because one of your skills is basically being challenged or maybe even replaced. And there has to be that openness to be*

vulnerable about that, to say, OK, I'm using this thing that makes part of my work obsolete, but it gives me the potential and the freedom to expand into a completely unknown realm of how I use my time. It requires a certain openness to constant change that I don't think comes naturally to most people. (Workshop_Germany_2)

The workshop participant points out that there should be a culture of openness within the company, especially with regard to technical issues and the implementation of new technologies. The participant points out that while there is a general fear of automation, a culture of openness, of learning new knowledge, of being able to acquire new skills in place of what has been automated, makes companies, including managers and employees, resistant to change and to technological developments, which at this point are identified with the development of artificial intelligence. A culture of openness within the company allows the company to open up to previously unknown areas and to develop skills in synergy with technological developments.

In the most general sense, a culture of openness as a set of skills related to the acquisition of new competences is crucial for MSMEs to adapt to the challenges of the transformation of the retail market and to benefit from the functions offered by the implemented AI technology. With an understanding of the business context and an understanding of processes based on qualitative data, this provides a core set of skills to be resilient to change.

Figure 51 Overview of AI Skills



Source: own elaboration

6.2. AI Skills for Managers

While companies as a whole need a range of skills related to the careful use of AI technologies in context, the reflexivity of the company's data generation process, and a general culture of openness to change and the acquisition of new skills, workshop participants also highlighted specific skills that managers should possess. The skills required of managers are related to **strategy** for the different AI technologies being applied in the organization, **understanding the consequences** of their application in terms of opportunities and risks, and the ability to **exert control over the data generation process and the data infrastructure** within the organization.

An artificial intelligence expert and management consultant from Germany summed up the key qualities that managers should possess in terms of strategic thinking and action as follows:

> *Let's say they hear buzzwords in the media such as AI right now. But they don't fully know what it's capable of, what its shortcomings are, so it's very important for them to realize that yes, it's a buzzword, but it doesn't mean it will magically solve all the problems you have in the world. You have to make sure that they know because obviously the rest of the employees often follow the managers. You have to make sure that these people know exactly what they are getting themselves into. And how this can be done which is why I would focus more on the management.* (Int_Exp_Germany-1)

It is important for managers to have the knowledge to understand what AI is and what its potential is in the specific context of a particular company. At the same time, this understanding on the part of managers is important for the implementation of technological change in a company, because along with the manager's certainty, it is the company's employees who become confident in the direction of change and technological transformation.

Above all, MSME retail managers need to demonstrate **strategic skills**, which include an understanding of the context in which their businesses operate, as well as skills in mobilizing staff and available resources for the implementation of new technologies, including artificial intelligence:

> *I think the ability to find those areas that are most applicable to these organizations of ours. Because that is the key, right? If we want to use AI to improve certain processes, then we must diagnose which processes are the most suitable, where the impact will be the best. What we have also highlighted here, I would say the second element is change management, because it is important to convince the team of our ideas. It is well known that managers acquire this knowledge through such training. And now it is important to share this knowledge with the team in an appropriate way and to convince as many people as possible of the concept. It is a well-known fact that this increases the likelihood of success. Involved people are a guarantee of that. We also evaluate the effectiveness of the tools so that we can correct them. So, you know, we make some decisions, we make an action plan. It is important to evaluate this at*

every stage to correct any deviations or dangerous situations that could jeopardize the whole process. (Workshop_Poland_1)

As a workshop participant from Poland points out, managers need to be able to think strategically along three specific dimensions. First, they need to be able to diagnose the need within the company and therefore the exact place where AI technology can be useful. Second, along with the diagnosis, managers need to demonstrate their ability to convince employees of their strategy for implementing new technologies. Third, managers need to be able to manage change in a practical way, ensuring that the strategy is implemented.

Strategic skills are directly linked to another set of skills that workshop participants believe a good manager should possess, namely **the ability to understand the consequences** as a particular set of gains and losses associated with the implementation of AI technologies:

> ***P1:*** *But we have already started thinking about it, so what do we need to do to implement it? Managers need to be able to develop an implementation plan. They need to understand how to assess the risks. They also need to be able to appoint an implementation team. Because there are resources and there are costs, right? What will be the monthly costs in general, for example to maintain the AI infrastructure?*

> ***P2:*** *I can honestly say that entrepreneurs here are not at all aware that there are costs involved, yes? Because there is a perception that this is a one-off cost of implementation. And it's not the maintenance of some IT infrastructure, but at least the use of some, I don't know, engines in the SaaS model and so on and so forth. Depending on the variant, depending on the options that are chosen, they will also generate correspondingly high monthly costs.* (Workshop_Poland_1)

Participants in the Polish workshop discussed in depth the essential skills that managers need, particularly in the context of implementing Artificial Intelligence strategies. They emphasized that the successful deployment of any AI strategy must be accompanied by a comprehensive implementation plan. This plan serves as a roadmap, detailing the steps necessary to effectively integrate AI into the organization's operations. A critical component of this implementation plan is the ability to accurately calculate the costs associated with maintaining the infrastructure required for AI. Managers must have a thorough understanding of the financial implications, which include initial setup costs, ongoing maintenance costs and potential system upgrades.

In addition to financial planning, managers must also be able to identify and mitigate the risks associated with AI implementation. These risks can range from technical challenges, such as system integration issues, to broader organizational risks, such as employee resistance to change or disruption to existing workflows. Managers need to develop contingency plans to proactively address these risks and ensure a smoother transition to AI-enabled operations. Conversely, it is equally important for managers to understand and communicate the positive outcomes expected from AI adoption. This includes demonstrating their ability to foresee the

benefits that AI can bring to the business in terms of predictive functions, automation, optimization, and enhanced customer care.

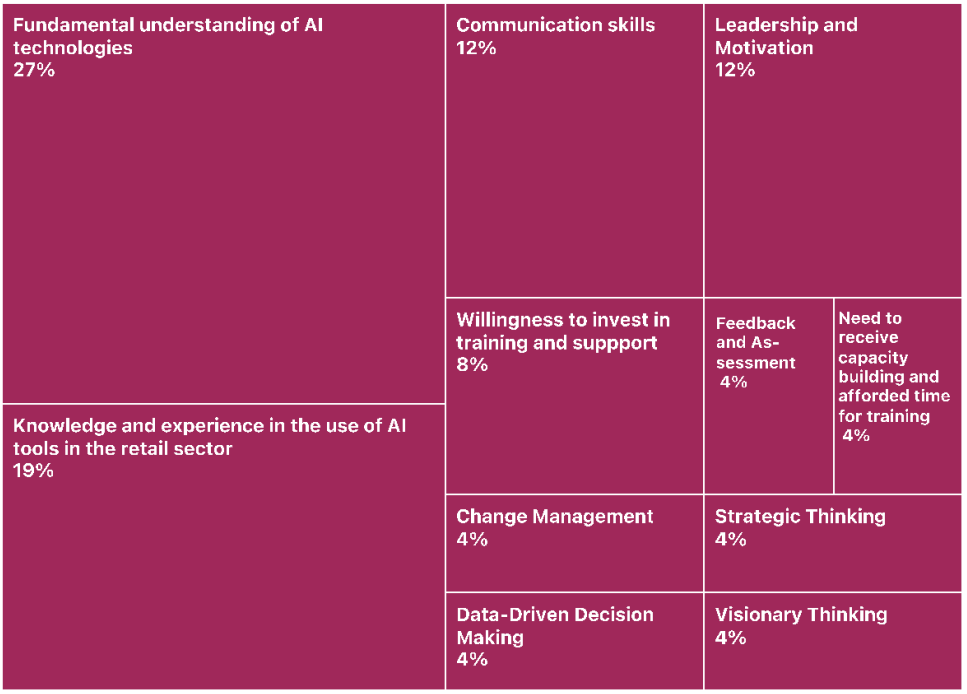
A direct translation of strategic skills, both in terms of creating and implementing an action plan and understanding the various consequences, is t**he ability to take control of the company's data generation process**. This theme was discussed during one of the Italian co-creation workshops:

> ***R2:*** *In general, it's not about programming skills. It's understanding and being aware of how machine learning works. So, you can design a process, you can design the quality of output that you want, just being aware of what you can do, from your data to the output that you want. (...) So a manager needs to at least be aware of what are the building blocks that make up an AI model, and with the combination of that AI model, what you can have.*
>
> ***Okay. And I've got model building and evaluation here. So, it's not just about how to build the models, but also how to evaluate them, right?***
>
> ***R2****: Yeah. How you design the infrastructure of your data. So, from one side, you have to be aware of the problem statement that you want to solve, the data architecture that is part of your knowledge, the knowledge within your company, and thanks to the model of AI, what are the outputs that you can build.* (Workshop_Italy_2)

The implementation of AI technology in an organization needs to be under the control of managers who have a basic knowledge of how a particular technology, a particular AI model, is constructed, but most importantly it needs to be combined with knowledge of the organization's data infrastructure. Managers should be able to control the design of the data infrastructure so that they are able to understand the implications of using a particular AI model. In this sense, understanding the data infrastructure is, in a sense, an extension of the manager's reflexivity in understanding their own company and the consequences of applying new technologies in their own company.

Furthermore, in Cyprus survey research, one in three respondents believes that managers and executives in retail MSMEs should possess a fundamental understanding of AI technologies. They should also know and have experience in using AI tools in the retail sector to effectively support their employees in acquiring AI competencies (Figure 52). Respondents indicated that online training for retail employment should include examples of AI applications in the sector as well as real-life examples. Employees should be trained in areas such as data analysis, cybersecurity, and effective prompt writing.

Figure 52 What skills do managers and executives in retail MSMEs need to effectively support their employees in acquiring AI competences? (% of responses)



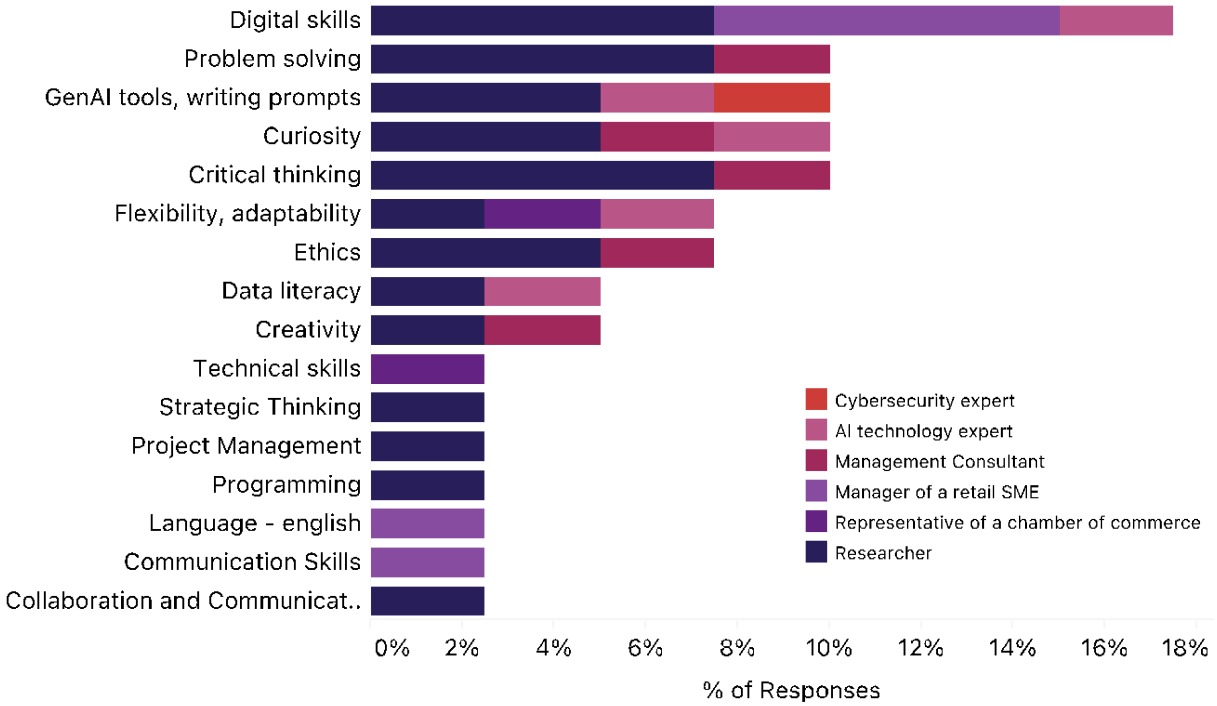
Source: own elaboration

Broadly speaking, managers need to demonstrate several critical AI skills. These include the strategic application of new technologies, the ability to calculate profit and loss, and a deep understanding of the company's data generation process and the underlying infrastructure. By mastering these areas, managers can effectively harness the power of AI to drive innovation and achieve organizational goals.

6.3. AI Skills for Workers

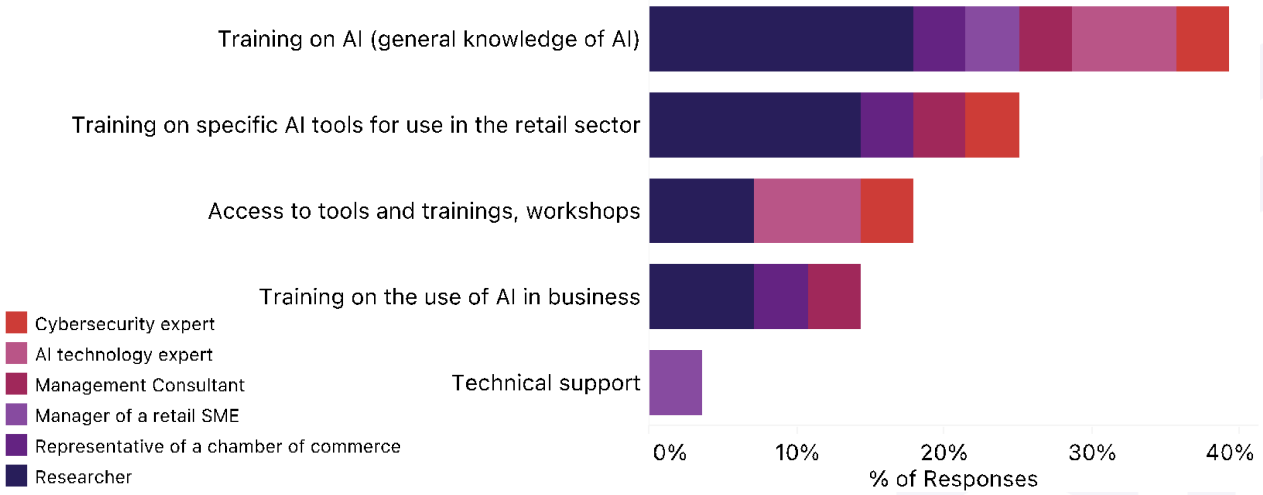
Digital skills are of the utmost importance in the daily work of MSMEs. Skills related to Generative AI, such as prompt engineering, are gaining significance. Respondents from the survey research in Cyprus emphasize the need for adaptability to changing work conditions and the willingness to develop skills. A large portion of researchers highlight the importance of skills related to working with data, such as problem-solving, data literacy, and critical thinking (Figure 53). Most respondents indicate that employees should strengthen their general knowledge of AI. One in three believes that it is crucial to train employees on tools specific for use in the retail sector (Figure 54).

Figure 53 What skills do MSME employees need to use AI technologies in their everyday work? (% of responses)



Source: own elaboration

Figure 54 What kind of support and in which areas do employees need to acquire new skills enabling the use of AI technologies? (% of responses)



Source: own elaboration

Participants in the co-creation workshop from selected EU countries also addressed the issue of characterizing the skills that retail staff should have in the implementation and use of AI-based technologies. Significantly, practical skills related to the application of new technologies were emphasized, which in turn consist **of an understanding of the AI technology** itself and its direct application, an **understanding of the implications of the practical use of AI** and, most importantly in this context, **the possession of basic computer skills combined with an openness** to continuously acquire new competences.

Firstly, employees in small and medium-sized enterprises should have skills that amount to an **understanding of AI technologies**, as participants in a workshop in Italy pointed out:

> *Yes, it can be learning a specific tool or maybe simulating what you can do with... How you can announce your sales and your sales skills thanks to this tool or some, for example, new tool that you can develop with AI. The important thing now is that you can relate it to your role within a company. You could understand what are the tools that can enhance your skills. So, if you are a salesperson, for example, a lot of business analytics within the sales, the type of product that customer is buying, the price of optimization that can be a dashboard, can be analytical tools that can be easily provided, what is the value of this technology. And the same for HR. Imagine you have 200 curricula to analyze. I think a tool that can help you in the selection with a skills assessment tool, or for example with a kind of analysis of all the documents that some employees could apply, can be very useful to solve some time-bound activities.* (Workshop_Italy_2)

Understanding AI technologies is not only about the practical skills of using them, but also about the ability to relate the new technology to the workplace and the tasks assigned to it within the organization. Two examples are presented here, that of a salesperson and that of a human resources manager, and the different ways in which AI can be used in each case. For example, a participant in the Italian workshop suggests that a practical understanding of the technology itself must be linked to the context in which not only the company as a whole but also the specific department of a given company operates. Importantly, employees should learn this on a specific tool that can enhance their skills in their job.

A practical understanding of AI as a core skill for an employee is linked to an **understanding of the practical and immediate implications of using AI** in retail, as discussed by participants in the Italian workshop:

> ***R1:*** *But I think they should know not only the positive effects, but also the negative effects. Because AI, data security or something like that, it's a pro and a con. You must see if it's helpful or not. Because if you use AI and the person who must do it is not familiar with AI, it's going to be more work in the beginning because they don't understand the process. So, you have to train your people to work with your AI.*

> ***R2:*** *Yeah, they should have some difficulties that they want to overcome. I think maybe we have some problems and then we can use AI to solve them. We should realize that AI can solve problems better than we can on our own.*
>
> ***R1:*** *And they should also know what their challenges are. They should know their business in a way that they know where the difficulties are.* (Workshop_Germany_1)

Employees in small and medium-sized enterprises using or implementing AI-based solutions need to fully understand the practical implications of this process. This includes both positive aspects, such as improving or increasing the effectiveness of the tools they use, and negative aspects, particularly in relation to maintaining robust data security. The ability to understand these practical implications requires strong critical thinking skills and a willingness to overcome challenges or improve performance. In this context, employees need to adopt a strategic mindset. This doesn't mean thinking only about the broader business perspective, but rather focusing on their specific job roles or the departments they represent. They need to be able to analyze and identify challenges within their area of work that can be addressed through the thoughtful application of AI technologies. Employees also need to be vigilant about the risks associated with AI, particularly when it comes to data security. They need to be aware of potential vulnerabilities and understand best practices for protecting sensitive information. This dual awareness - of both the opportunities and the risks - enables them to make informed decisions that benefit their specific roles and the organization as a whole.

Overall, employees in MSMEs need to combine strategic thinking with practical application skills to use AI technologies effectively. In doing so, they can not only improve their own performance, but also contribute to the overall success and competitiveness of their organization. Workers also need to develop a nuanced understanding of how AI can streamline processes, improve efficiency, and help achieve departmental goals. This requires them to be proactive in learning about AI's capabilities and limitations, staying abreast of the latest advances, and continually seeking ways to effectively integrate AI tools into their daily tasks.

The main value of an employee's AI skills comes from having **basic computer skills, but also being open to acquiring new knowledge**. In particular, workshop participants emphasized the basic ability to work with basic digital technologies, pointing out that AI enables the creation of specific software without advanced programming skills. This was put in the most nuanced way by a participant in an Italian workshop:

> *I think for users, for example, if you have Microsoft Copilot, users have had to upskill to be more productive. If you are a company, you want to be competitive and you need to create solutions, for example, how to improve your ecommerce performance. If you create a solution that your customers can use based on AI or a chatbot or whatever, then you need to be able to create it. You can also hire consultants to do that for you, but I think the solutions will be much more, even less programming, but more low code. What is happening today, for example, in automation is that there are solutions that are low code or no code. Where you can do an orchestration of a process, or you can even do RPA robotics. For a process without having a*

> *big understanding of the programming language, right? So, I think it's more important to digitally upskill your people in general and have the critical resources that can give you a competitive advantage to design and build your own solutions, as a customer, as a client.* (Workshop_Italy_1)

A workshop participant illustrated the value of AI technology by presenting an example of Microsoft's Copilot tool, which streamlines basic computing activities. This example highlights that employees do not need advanced programming skills to benefit from AI tools in their everyday tasks. The primary advantage lies in having employees with basic computing skills who can leverage AI technology, such as Copilot, which has a low entry threshold. One participant emphasized that the main value for companies is that they no longer need to outsource tasks to specialists or consultants. Employees with foundational computing skills can enhance their productivity and efficiency by using AI tools, which simplifies operations and reduces reliance on external expertise. This capability can lead to significant cost savings and operational improvements for companies.

However, other workshop participants noted that it is crucial for employees to be open to acquiring new AI skills. The rapid evolution of AI technology means that ongoing learning and adaptation are necessary for employees to fully use these tools. A willingness to explore and embrace new AI applications, combined with a solid grounding in basic computing skills, provides a significant advantage for companies implementing AI-based solutions. The combination of openness to learning and basic computer skills is a key strength for companies. Employees who are willing to continuously develop their AI competencies can drive innovation and efficiency within the organization.

Participants in the co-creation workshop emphasized the importance of employees understanding the practical applications of technology within their specific job roles and its potential positive and negative consequences for the company's activities. The workshop also underscored the critical need for basic digital skills among the workforce and highlighted the importance of fostering openness in skill development.

7. Challenges to AI Adoption in Retail

This section explores barriers to AI implementation in retail, focusing on MSME challenges. These include job displacement concerns, AI expertise scarcity, trust issues, technical barriers, sustainability concerns, and lacking industry standards. Workshop findings highlight MSME struggles with supply chain efficiency, inventory management, digital transformation, adapting to AI, and addressing customer communication challenges. Participants noted competitive pressures from US and Chinese digital giants and MSMEs difficulties in retaining a skilled AI-capable workforce.

Key takeaways

- Prior research has identified several obstacles to AI integration in MSMEs in the retail sector, including concerns about potential job displacement, lack of AI expertise, and absence of trust within the company and with customers. Additionally, there are technical challenges, lack of sustainability, and insufficient industry standards.
- Participants of co-creation workshops highlighted challenges such as maintaining supply chains, managing product inventory, navigating digital transformation, adapting to AI-driven technological shifts, and addressing communication challenges in customer relationships across marketing and customer service.
- A major challenge emphasized by workshop participants is the considerable competitive pressure exerted by digital giants from the United States and China, which are profoundly influencing the structure of the retail sector.
- Another important challenge is the **difficulty experienced by the small and medium retail companies in retaining and developing a skilled workforce.**

7.1. Challenges identified in the academic literature

The reviewed literature identifies **several challenges that must be addressed in the adoption of AI in retail**. These include job displacement, a lack of requisite skills, a lack of trust, technical issues, and sustainability and industry standards. To address these issues, a specific research agenda is required that employs a combination of qualitative and quantitative methods and considers the perspectives of multiple stakeholders.

The implementation of artificial intelligence in retail and the development of AI skills represent new opportunities for small and medium-sized enterprises. However, they also bring potential risks and challenges that need to be addressed. In this section, we will summarize the literature on the fundamental dilemmas of implementing AI in retail, while also considering issues related to AI skills. AI is already ubiquitous, often embedded invisibly in our everyday tools and as part of complex technological systems (Coeckelbergh, 2020: 3). In retail, AI advances can perform activities that involve cognition. This capability is helping companies to dramatically change scale, mission and learning paradigms, demonstrating AI's significant ability to create business value. The strategic use of AI is therefore identified with harnessing this capability (Kitsios and Kamariotou, 2021: 7). However, a lack of understanding can lead to unintended consequences, such as customer disappointment when human-like agents fail to meet user expectations (Schanke et al., 2021: 7).

In this section, we look at some specific aspects of AI implementation, highlighting the **barriers and drivers to AI adoption**. We will then characterize the **challenges and dilemmas** associated with the implementation of AI in retail. Finally, we will raise some fundamental questions about **how the research and development sector can respond to these challenges**, especially in terms of AI skills.

As Malenkov et al. (2021) emphasize, one of the foremost challenges today is grasping the core nature and influence of AI on business and society. The idea of AI in business is frequently viewed superficially as a series of automated standard tasks, yet it signifies a significant transformation in management, industry, and services; however, the economic aspects of this shift are crucial and often overlooked, as many developers of robotics, neural networks, and AI fail to perform comprehensive economic assessments of their projects' impacts (Malenkov et al., 2021: 15).

In line with Cubric (2020), we can describe the following **general barriers and drivers for the adoption of AI** in MSMEs in the retail sector:

- **The main drivers for AI adoption are economic**, such as reducing costs and time, improving performance and customer satisfaction, making more accurate predictions, and improving decision making (Cubric, 2020: 11).

- Barriers to AI adoption include **both economic and technical challenges**, such as the high cost of implementation and maintenance, the need for support infrastructure, lack of usable data, non-reusability of models, and limited applicability to specific problems (Cubric, 2020: 11).

- **Social barriers** include increased reliance on non-humans, job security concerns, lack of knowledge and understanding of potential benefits, security issues, lack of trust, and difficulty in obtaining multiple stakeholder perspectives. These social barriers are often perceived as deficiencies (knowledge, trust) that, if carefully managed, can be overcome and lead to acceptance of the technology by those who will use it or be replaced by it (Cubric, 2020: 11).

The mapped literature also identifies a number of specific challenges associated with the application of AI in the small and medium-sized retail sector. The challenges of adopting AI in this area are of a technical, economic and social nature. The challenges have been clustered within Table 17.

Table 17 AI Challenges in Retail

Challenge	Description	Literature
Employment displacement	• Skills displacing technological change (SDT) shows that automation can both destroy jobs and create new tasks and roles that enhance existing jobs. • SDT workers tend to be better educated and work in larger organizations in complex, non-routine roles involving teamwork and on-the-job learning. • They face greater job complexity and variety, but also experience greater job insecurity. • Digital skills have a significant moderating effect on the risk of displacement.	Chen et al., 2022; McGuinness et al., 2023
Lack of skills	• Lack of trust within the business and in relation to digital transformation is derived from a lack of skills in using AI tools. • There is expected to be significant variation in AI skills across different regions.	Chaudhuri et al., 2022; Jian et al., 2023
Lack of trust	• Lack of AI implementation skills increases distrust within the company. • The use of AI also affects trust between the company and the customer - disclosure in terms of automated customer service is essential.	Chaudhuri et al., 2022; Schanke et al., 2021
Technical problems	• Inaccuracy of inferences. • Inaccuracy of predictions.	Giroux et al., 2022
Sustainability and industry standards	• Machine learning AI requires a lot of data, and data processing and storage use energy, which has environmental and climate implications. • Sustainable use of AI in retail requires industry standards and policy recommendations. • AI can be used to mitigate certain consumer behaviors that are harmful to the environment, such as the mass purchase of cheap products from afar.	Coeckelbergh, 2021; Nishant et al., 2020; Pan and Nishant, 2023; Rohde et al., 2024

Source: own elaboration

Among the specific challenges identified, the most important is the risk of job displacement for certain types of workers. Research suggests that AI-driven digital transformation may reshape employment dynamics by automating existing jobs while creating new ones. In particular, workers in larger companies who are trained in specific roles appear to be more vulnerable to job loss. A key factor in mitigating job displacement is the development of digital skills, especially AI skills. Firstly, the lack of these skills hampers the effectiveness of employees

within their organizations and undermines trust. Moreover, this issue can affect companies differently in different regions. Secondly, inadequate application of AI can undermine trust between companies and customers, especially if the use of AI lacks transparency in customer interactions and throughout the sales process.

In addition, technological challenges related to AI itself are highlighted. Existing literature highlights issues such as inaccuracies in inferences and predictions generated by AI applications. The environmental impact of AI, particularly the carbon footprint of machine learning and large-scale data analysis, is also a major concern. Furthermore, the lack of standardized policies for the retail sector, as noted in the current literature, highlights the need for preventative measures to manage the impact of AI. Some researchers also suggest that AI has the potential to mitigate negative aspects of retail, such as curbing certain consumer behaviors.

While AI offers transformative potential, addressing its challenges – from job displacement and skills development to technological limitations and environmental impacts – requires proactive strategies and policy frameworks to ensure its responsible and beneficial integration in sectors such as retail. In order to respond effectively to the challenges outlined above, initial proposals are beginning to emerge from the existing literature.

As it was described by Ramos (2022: 11), **UNESCO's AI Recommendation calls on all stakeholders to take decisive action to harness the opportunities of AI while addressing its challenges**, with the aim of promoting inclusive societies and economies, particularly in the area of employment. Recognizing the gap between regulatory frameworks and technological progress, the Recommendation underlines the importance of ethical standards throughout the life cycle of AI and in the regulation of digital markets. It rejects the notion of AI neutrality and highlights how human choices and biases can influence AI systems, potentially leading to discrimination and negative impacts. The Recommendation advocates for updated laws and institutions capable of managing the impact of AI, including addressing job displacement by automation, ensuring fair market competition, safeguarding consumer rights, and protecting developing countries vulnerable to labor market shifts and market abuses.

Recent literature has begun to outline the role of the R&D sector through initial proposals for a **research agenda on AI skills** in the workplace. Margaryan (2023) presents a comprehensive approach to this issue, identifying four key dimensions of the research agenda:

- **Work practices and skill requirements across the AI production chain should encompass stages** such as big data generation (e.g., data labelers/verifiers), AI design and development (e.g., machine learning engineers, data scientists), and AI use (e.g., workers using AI tools, managers overseeing AI implementation) (Margaryan, 2023: 2).

- The integration of insights from computer science/engineering, social sciences and humanities in AI research should **advocate multidisciplinary approaches to understanding the skill requirements of AI-driven roles**. Theoretical frameworks should aim to synthesize concepts from these diverse fields (Margaryan, 2023: 3).

- **Quantitative and qualitative research methods should be integrated to effectively assess skill transformations in AI-mediated environments**. Recommendations should include cross-sectional, longitudinal, and causal study designs, as well as direct and indirect measurement techniques for comprehensive analysis of AI-related skills (Margaryan, 2023: 3).

- **A participatory co-design framework should be established to incorporate the perspectives of different stakeholders in AI and skills research**. This collaborative approach should involve researchers, technology developers, users and policy makers working together to explore and address the implications of AI adoption in the workplace (Margaryan, 2023: 4).

Research should prioritize the involvement of a wide range of stakeholders involved in the implementation and development of AI technologies, using mixed methods as a research approach. A research perspective structured in this way can incorporate the different perspectives of individual stakeholders responding to the demand for AI skills. AI skills should encompass both technical proficiency in using available tools and evaluating them, alongside the social competence required for managing interactions with stakeholders within companies and customers. Importantly, AI implementation must also consider potential environmental risks and harms.

7.2. Challenges identified by retail sector stakeholders

Participants in the co-creation workshop identified a number of key challenges for MSMEs operating in retail markets. Key challenges included issues such as **maintaining supply chains** and product inventory, **digitally transforming businesses,** and adapting organizations to the technological changes associated with AI, and effectively managing **communication issues in customer relationships**, both in marketing and customer service. Importantly, among the challenges, workshop participants also highlighted **uneven competition with digital giants** from the US and China that are changing the face of the retail market, as well as **the ability to retain and develop their own workforce**. This section presents and discusses the above issues, drawing on contributions from participants in co-creation workshops held in selected European Union countries.

The first of the key challenges for small and medium-sized companies in the retail market is the issue of the **supply chain**. In particular, in terms of their intelligent maintenance and the use of available material resources for the benefit of potential customers and the environment, as reported by a co-creation workshop participant from Italy:

> *Another thing that comes to mind, which I have noticed working specifically in supply chain and inventory, is a different mindset and approach to assortment management. I speak obviously for the autonomous stores we have opened, in Retail and Large-scale Retail Trade. It's a different approach to managing both sales and*

storage, inventory, etc. The problem in the supply chain for neighborhood stores is that to have the necessary stock to satisfy different targets, you need physical space to store the goods, which also ties into sustainability. For example, in Trento and Bolzano provinces, I can't get goods to a supermarket in the mountains, and, if I had to make it autonomous, I also have the logistics problem (e.g., how the goods arrive). [...] It's a bit like concentric circles from company values to effective and real logistics management down to the mindset of the store and staff, which needs to be changed if started differently. In other points of sale, we have noticed that if the staff is present and, for example, we have seven young people in the studio, they are much more ready. We had to train the entire internal staff differently. (Workshop_Italy_3)

During the workshop, one participant discussed the challenges faced by his autonomous local shops, particularly emphasizing the complexity of managing the supply chain effectively. He noted that one of the primary challenges is ensuring a proper supply chain that meets two critical criteria: accurately identifying and responding to the needs of local consumers and maintaining sustainability in terms of storage capacity for products. This challenge involves a delicate balance of multiple factors, including the physical storage capacity for products, efficient logistical management, and the development of appropriate staff skills. These skills are essential for adapting to the evolving needs of consumers and effectively managing autonomous shops. A relatively under-discussed issue is the alignment of retail terms and conditions with climate or sustainability policy objectives. Thus, the issue of the supply chain is multifaceted, requiring a comprehensive approach that integrates material resources, logistical strategies, and human expertise to ensure the success of autonomous local shops.

Workshop participants noted that the challenge of supply chain management, and the skills required by the workforce in this area, is closely linked to another important issue: **the digital transformation of micro, small and medium-sized enterprises (MSMEs)** operating in the retail market. They pointed out that effective supply chain management requires not only an understanding of traditional logistics and warehousing issues, but also the integration of advanced digital technologies. As indicated by one of the German experts in retail industry:

It's more like, at least for German, the companies are not ready yet for such a thing because they are missing the basics behind. So, for example, they don't have an ERP system running, which is something you probably basically need if you want to do anything further with more intelligent things and so on. So, I think for most of the companies now, it's more like a mindset thing. So, most of them are not yet ready. So, we see now a lot that are going first steps in this direction. (Int_Exp_Germany-12)

Digital transformation is both a technical challenge and a challenge in terms of organizational culture and openness to change. Integrating the ability to use new technologies with an open organizational culture is critical for MSMEs to remain competitive and responsive to market demands. Participants of co-creation workshops emphasized the need to equip the workforce with new skills to work with digital tools and platforms that streamline supply chain operations,

increase efficiency, and improve customer satisfaction. In addition, digital transformation involves adopting innovative solutions such as artificial intelligence and data analytics to predict consumer behavior, optimize inventory management and ensure seamless operations. Consequently, addressing the supply chain challenge is deeply intertwined with the broader goal of digital transformation and requires a holistic approach that encompasses technology adoption, workforce training, and strategic planning for retail MSMEs.

However, as workshop participants from Poland point out, small and medium-sized enterprises find it difficult to be autonomous in their digital transformation, relying for example on marketplaces that are not an integral part of their company's digital infrastructure:

> *Small businesses, on the other hand, usually have the disadvantage of not selling through their own website, but through some kind of marketplace, which means they have to store this data somewhere. And to start with, they have to create a subsite for themselves. There are not many companies that have such an instantly recognizable brand (...) but most of the time they all start by connecting to some existing marketplace and selling on Amazon or in Poland on Allegro and they have to manage this data somewhere (...) at some point there is probably a saturation threshold, and they get so annoyed that they have to pay some draconian money. I mean, it's often a two-way street, that the website, their online store is created somewhere and if you buy from Allegro, you can often buy through Allegro or directly through the website. If we have some digital skills and we know how to search for it, then it exists and then people go into SEO because there are a lot of companies in the market at the moment that deal with SEO and making sure that the search results are relevant. So this is also an area that is developing.* (Workshop_Poland_2)

The digital transformation of micro, small and medium-sized enterprises (MSMEs) in retail presents significant challenges. On one hand, there is a growing need for smart solutions and supply chain management that integrate AI capabilities and data analytics. However, the reality for most MSMEs often involves relying on the sales and analytics infrastructure provided by major market players, such as global giant Amazon or regional platform Allegro. MSMEs typically lack recognizable brands that can independently attract customers to their websites, forcing them to depend on these popular marketplaces. In Poland, for example, Allegro serves as a crucial marketplace for MSMEs. Using such distribution infrastructure means that companies do not have exclusive control over their data flows and must navigate advanced analytical requirements. A workshop participant from Poland highlighted that one solution to this problem involves developing brand positioning strategies and optimizing search engine visibility. This approach represents a fundamental form of digital adaptation, enabling MSMEs to build their own autonomy. By focusing on effective SEO practices and creating robust online presences, MSMEs can improve their brand marketing efforts and gain greater control over data flows. This dual approach not only enhances their market visibility but also empowers them to manage their data more effectively, thus fostering a more sustainable digital transformation.

While maintaining relative autonomy in terms of data flow and the ability to analyze it is crucial from an MSME perspective, the challenge remains **to communicate appropriately with customers** and to develop a strategy to consistently build brand visibility in order to build relationships with potential customers on this basis. Communicating your brand is one of the main challenges for small and medium sized businesses, not only in terms of positioning your online sales space, but also in terms of building an image that responds to local needs. This issue was highlighted by a workshop participant from Romania:

> *Customers will also prefer international companies, will prefer McDonald's or let's not say McDonald's, let's say Starbucks even though they have a local coffee shop, maybe next to them. But, we have to understand that a customer, which is a globalization product, will prefer to feel in a global market, but they want to also have a taste of their local side. They won't forget that they are in a local environment. Even though they have Starbucks and McDonald's and various global companies. This is an issue that I've seen quite a lot in very small companies, but I've also seen companies that are able to compete with big names in their industries because they learned how to position themselves, like you and my colleague said earlier, not by offering a cheaper alternative, but by offering an added value to their product or service so that the customer is willing to pay more, but, he's willing to help a local company or the customer will be willing to receive more personalized support in using their product or the service. And so, there are so many ways that the company can differentiate itself from the cheaper competition.* (Workshop_Romania_1)

According to a participant in the Romanian workshop, small and medium-sized enterprises are not necessarily destined to fail when competing with global brands. One significant advantage MSMEs hold is their superior understanding of local needs and the values of their potential customers. The real challenge lies in effectively communicating this understanding and establishing a strong market presence. This involves both SEO positioning, which ensures their visibility in online searches, and broader market positioning, which differentiates them from global 'low-cost' brands. To compete successfully, MSMEs must develop strategies that highlight their unique value propositions and the quality of their products. This includes emphasizing their local expertise and the personalized touch they can offer, which larger global brands often lack. By focusing on these areas, MSMEs can carve out a niche for themselves in the market, appealing to customers who value quality and local knowledge over low-cost alternatives. Effective communication and strategic positioning are therefore crucial for MSMEs to leverage their strengths and thrive in a competitive landscape dominated by global players.

Significantly, not all participants were unequivocally optimistic about the ability of small and medium-sized enterprises to compete with global giants in the retail sector, whether it be the marketplaces of digital giants or global brands such as Starbucks. Among the key challenges, workshop participants pointed to **the market advantage or dominance of global companies**

over local companies, most of which are small and medium-sized enterprises. One of the workshop participants from Italy put it in the strongest terms:

> *I would also add another issue which regards the relationship between the small shops and iTech platforms like Temu, Amazon, Alibaba, which are destroying the retail character. And they are also creating different monopolies in the economy. I think this is a, uh, another problem that we should face. I don't have the experience personally, but this works pretty much in every sector: big companies, they always create challenges to the smaller ones.* (Workshop_Italy_1)

The workshop participant highlighted a critical issue concerning the relationship between small shops and technological giants and digital platforms. These platforms are viewed as harmful to the retail nature of small businesses, fostering monopolies within the economy. While the participant acknowledges their lack of personal experience in this matter, he observes that large companies consistently create significant challenges for smaller ones across various sectors. This underscores a broader concern represented by all co-creation workshop participants about the adverse impact of large technology platforms on the viability and sustainability of small retail businesses, emphasizing the need for strategies to mitigate these challenges.

One of the key areas of continued challenge in the retail sector **is recruiting and training the right workforce** in small and medium sized retailers. As one expert on the Polish e-commerce sector put it:

> *Honestly, it's still a lack of competence. Such competencies in the areas of both understanding the technology that supports business and how business can use technology. Despite the considerable development of what we call e-retail in Poland, i.e. theoretically knowing how to sell online and retailers being able to do so, they still have major staffing problems. Because today in our country, for example, there are no bachelor's or master's studies aimed at training future staff of the e-commerce market, for example.* (Int_Exp_Poland-5)

The e-commerce market, and the retail market in general, still lacks competence and people with the right technological skills, even in a context as advanced in terms of digital transformation as Poland. There are entire faculties of e-commerce studies in Poland and, according to the expert, there is still a shortage of qualified employees on the market. Recruiting competent people is therefore a key challenge. The second important issue is to maintain and develop the skills of internal employees. This issue was highlighted by a participant in a workshop held in Romania:

> *Training costs are related to the employee shortage because if you don't have employees that stay a long time in your company, they have the time to learn your products and also to improve the customer service. That means you'll constantly have*

employees that are fresh, let's say. A couple of months in the background and you need to train them to learn the product, to learn the company, the message, everything that's related to it for customer service and this training have a higher cost. (Workshop_Romania_1)

Of paramount importance, according to workshop participants, is meeting the challenge of getting the right balance in the workforce, which means first and foremost retaining employees and developing their skills in line with the adopted business strategy. If there is high staff turnover, companies are condemned to constantly bringing in a new pool of employees, which reduces their ability to develop long-term strategies to properly manage their supply chains in relation to identified consumer needs, to execute their digital strategy and adapt to new technologies and digital environments, and to position their brand appropriately and compete with the digital giants on an uneven retail playing field.

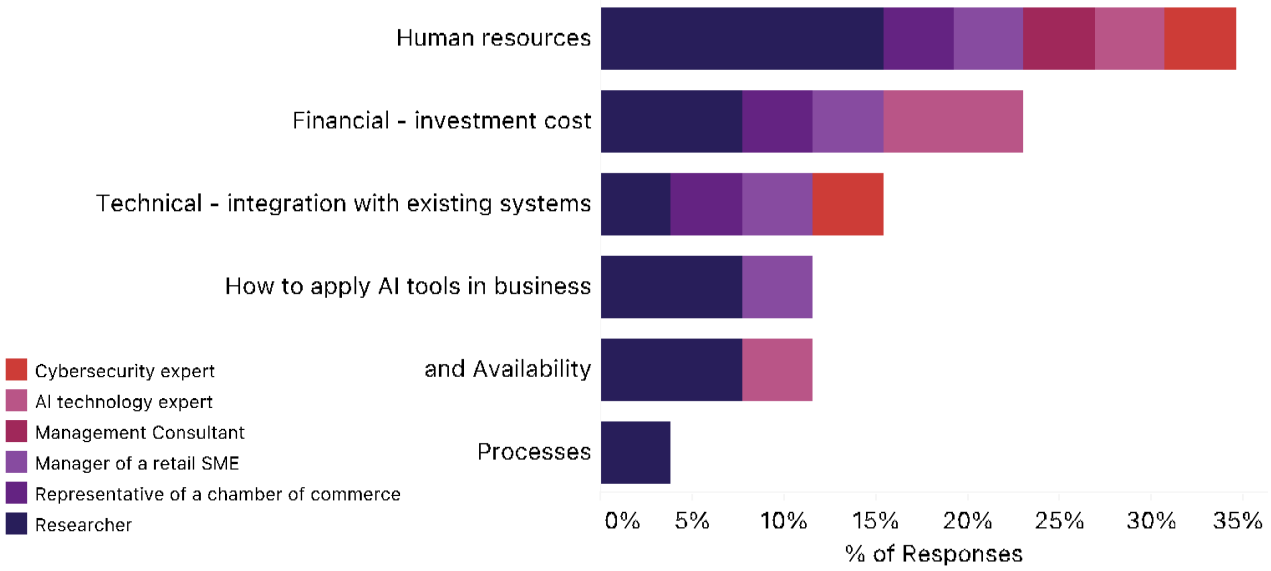
Table 18 Relevant aspects of modern retailing, together with the main challenges in each area

Retail Aspects	Main Challenges
Supply Chains	Logistics management, maintenance of the supply chain and storage of products in relation to changing consumer needs.
Digital Transformation	Maintain autonomy and digital skills development within the organization by controlling the data infrastructure and flow.
Customer Communication	Building customer relationships and care during the sales cycle, as well as positioning yourself as a local brand.
Market Competition	An imbalance in competition with global brands and digital giants with larger data sets and better analytics technologies.
Workforce	Retention and training of permanent staff.

Source: own elaboration

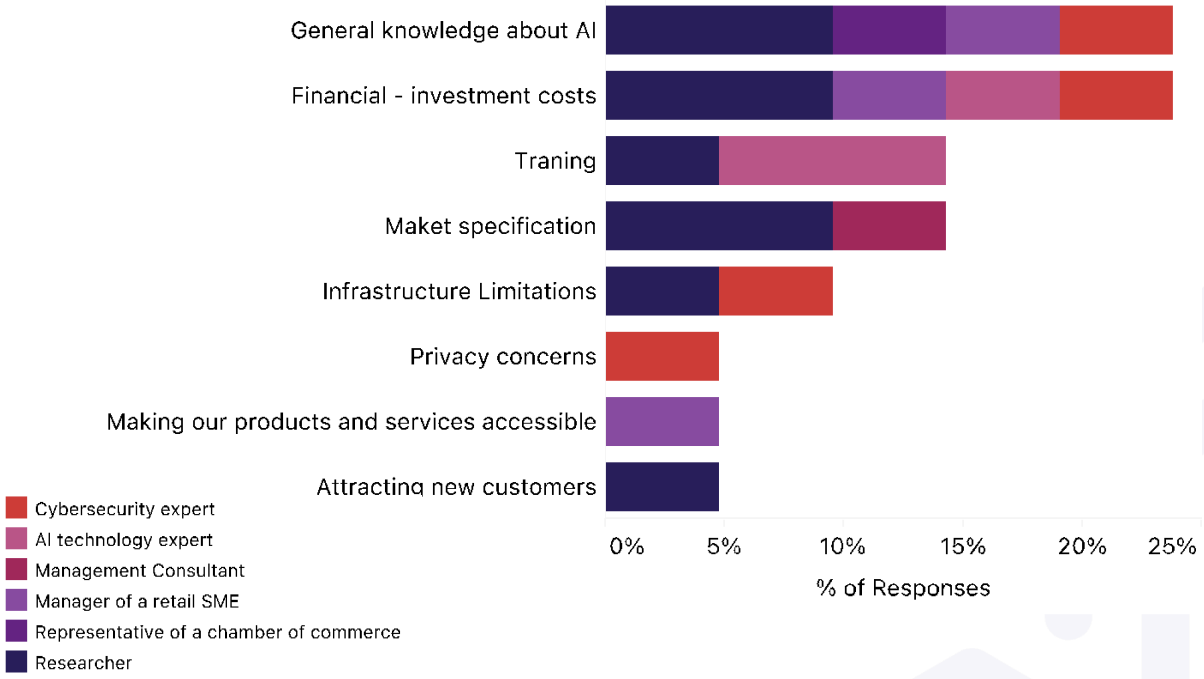
Moreover, in a survey conducted in Cyprus, every third respondent reported that the biggest challenges related to implementing AI in retail SMEs concern human resources (Figure 55), including insufficient skills and knowledge of AI technology among employees. Another significant barrier is cost. One in four respondents fears insufficient financial resources for implementing new technologies. In SMEs, the main challenge, apart from costs, appears to be the overall knowledge related to AI (Figure 56).

Figure 55 What are the main challenges associated with implementing these technologies in retail SMEs in your country? (% of responses)



Source: own elaboration

Figure 56 What challenges are specific to SMEs in your country? (% of responses)



Source: own elaboration

In the retail sector, small and medium-sized enterprises face many challenges. These include managing logistics, optimizing supply chains and warehouse operations, adapting to digital transformation, and defining their brand identity in the face of fierce global competition. A critical issue they face is ensuring that they have a skilled workforce that can effectively address these challenges, which is essential for the execution of successful business strategies. In addition, this report highlights the importance of embracing advanced technologies such as artificial intelligence (AI).

8. Recommendations and guidelines for designing an AI Core curriculum for MSMEs in Retail

The research was primarily conducted to develop recommendations and guidelines for designing an AI Core Curriculum and open education resources. The implementation of generative AI in micro, small, and medium-sized enterprises (MSMEs) in the retail sector requires a varied approach to training, tailored to the specifics of the company as well as tasks of employees. The inAiR open education resources should aim to develop both transversal and technical skills essential for the effective implementation of AI technologies.

8.1. Practical guidelines for course design

The following practical guidelines were collaboratively developed during the co-creation workshops and collected through interviews and questionnaires with the sector stakeholders.

- Workshop participants stressed the importance of **separate training tracks for managers and staff**.
    - For managers of small and medium-sized companies, AI training should focus on **developing skills in strategic thinking and planning the application of AI** within their operational environments.
        - The aim of the training should be to **understand the business opportunities of using AI in retail**, particularly in the individual areas identified in the report: automating and optimizing the supply chain, improving employee efficiency, and providing good customer service.
        - Training should focus primarily on **developing competencies in data management and understanding data infrastructures** that use data AI models within the company and to acquire new **knowledge of the risks associated with the use of AI**, particularly about the security of corporate data.
    - For employees of these companies, AI training should emphasize **acquiring hands-on experience with specific types of technology**.
        - Training should take a practical form, during which participants will gain h**ands-on experience with specific AI tools.**

    - AI training courses must focus on motivating employees to **apply these types of tools to the tasks assigned to their specific job**.
    - In this type of training, it is extremely important to use specific case studies that can illustrate the implications of the practical application of AI.

- Training courses should strike a balance by avoiding both sensationalist 'AI hype' discourse that exaggerates the revolutionary aspects of artificial intelligence and overly technical jargon that could discourage some participants from engaging with the subject.
- Training must **use practical examples or use cases** that are understandable to managers and employees in the retail sector and avoid abstract terms or hypothetical exemplary situations.
- AI training should be based on **free or "pocket-friendly" (relatively cheap and readily available) tools and software** to introduce managers and employees to the lowest-cost artificial intelligence implementations.
- Training should focus on the effects and consequences of AI technologies to facilitate an understanding of how the technology can be practically applied in specific situations.
- Training should be delivered remotely and adopt a flexible online training structure.

8.1. Development of transversal competencies

Transversal competencies, synonymous with transferable or soft skills, are applicable across various fields and professions. Soft skills such as communication, collaboration and adaptability are essential resources in any organization. In the context of digital transformation within companies, especially through the implementation of AI technologies, it is crucial that transversal competencies foster a **digital mindset**.

Digital mindset is "a set of approaches we use to make sense of, and make use of, data and technology. This set of attitudes and behaviors enable people and organizations to see new possibilities and chart a path for the future" (Leonardi, Neeley 2022: 19). Three essential aspects of the digital mindset are: Collaboration (understanding the potential of collaboration with the new technologies, AI included), Computation (basic knowledge of technologies and data literacy) and Change (openness to organizational and individual change).

Table 19 Digital mindset as transversal skill

Manifestation of the digital mindset	Aspect of the digital mindset	Application in the context of a company
Openness to innovation and organizational change	Change	Willingness to explore new technologies and tools, and a readiness to experiment and take risks to enhance processes and outcomes within the company. Orientation to knowledge sharing to build a company-wide data literacy and technological
Flexibility and adaptability	Change	Ability to quickly adapt to changes in technology and work environment combined with a proactive approach to learning and developing new digital skills.
Data orientation and data literacy	Computation/ Collaboration	Understanding the value of data as a strategic resource based on the ability to collect, analyze and use data for decision making
Understanding of technology	Computation/ Collaboration	At least basic knowledge of modern digital technologies such as AI, Big Data, IoT, and cloud computing. Basic understanding of AI, its fundamental principles, and potential applications in various business contexts. Ability to identify and assess which technologies can be useful in different business contexts, in the given retail company. Attitude of openness in collaboration with new technologies. Initiative in identifying problems and seeking solutions using AI.
Digital Ethics and responsibility	Collaboration	Awareness and application of ethical principles in the use of digital technologies. Responsibility for protecting personal data and privacy.

Source: own elaboration

Our research indicates that it is crucial to develop managers' transversal competencies, such as team management, change management, communication, conflict resolution, innovation implementation, and fostering a culture open to change. Training for managers should focus on effectively communicating technological changes within the organization and techniques for motivating and engaging employees during the AI implementation process. They should also be skilled in managing conflicts and issues arising from the introduction of new technologies.

Additionally, managers should be equipped with knowledge on planning, monitoring, and evaluating AI-related projects, as well as identifying and mitigating risks associated with the adoption of new technologies. In other words, training should provide them with specific change management skills that enable them to coordinate the adoption and integration of AI into their companies' core business processes.

Table 20 Change management skills in the context of AI functions in retail companies

AI Functions in retail as identified in literature review (see Section 1.3)	Change management skills necessary in digitally transforming companies
Predictive	Basic knowledge of modern digital technologies and their applications in predictive analytics Ability to communicate the results of predictive analyses to the team and other stakeholders.
Optimization	Ability to analyze patterns and identify the most effective ways to manage inventory. Skills to implement and manage changes in warehouse and logistics processes. Capability to work collaboratively with different departments within the company to optimize processes. Understanding and promoting principles of sustainability and responsible resource management. Recognizing the importance of collecting and analyzing data to optimize product storage
Automation	Knowledge of AI tools used in CRM and task automation. Understanding the needs and expectations of customers and employees to better tailor AI tools. Willingness to experiment and take risks to improve customer relations and employee efficiency. Open approach to experimenting with data to personalize customer interactions and optimize internal processes. Skill in clearly and effectively communicating changes and new AI-related processes to the team and customers.
Good service provision	Understanding the importance of high-quality customer service and the ability to use AI to enhance it. Openness to introducing solutions for efficient time and task management with AI tools.

Source: own elaboration

8.2. Development of technical skills

One of the important insights gained from the analysis of use cases and collected through engagement with the sector stakeholders is that many companies use ready-made AI solutions provided by external vendors. In this situation, **advanced technical skills are less critical than**

openness to learning new systems and a willingness to explore new solutions. There is a need to develop training in transversal skills and to build an environment for the exchange of knowledge and information about systems offered by system providers. Also, some experts we consulted suggested that building a rapport to training offered by technology providers can significantly support the process of skills upgrading.

Insights from sector stakeholders have identified specific sets of technical and business skills that are particularly important for managers in the initial stage of digital transformation. Ultimately, these skills will be essential for every employee in MSMEs within the retail sector.

Fig. 57 Technical/business skills essential for effective adoption & integration of AI in retail companies

Basic Knowledge of AI	**General Data Literacy and Analytics**	Understanding **Applications** of AI in the Retail Sector	**Technical Support and Cybersecurity Basics**
• Understanding the functioning of rule-based and self-learning algorithms. • Creating and using prompts for various AI usage scenarios.	• Ability to work with data, analyze it, and use the results for business decision-making. • Understanding the data infrastructures that use AI models within the company. • Quick and confident decision-making based on AI analyses. • Ability to quickly adapt to changing data and market conditions • Skill in visualizing data and AI-generated results for better understanding and communication within the organization.	• Familiarity with AI tools and platforms that can be utilized within the company. • Knowledge of AI applications in various business areas such as marketing, sales, and customer service. • Awareness of AI use cases in the retail sector, illustrating real benefits and usage scenarios.	• Technical skills needed to support and troubleshoot AI implementation. • Basics of cybersecurity and fraud detection using AI tools.

Source: own elaboration

Technical skills needed for development in a company depend on the model of digital innovation implementation within the company. Companies implement innovations to varying degrees and in different models, which translates into their needs for employee competencies, and consequently, their training needs. On the basis of the collected insights we suggest that in the area of technical skills development AI Core Curriculum should take into account the diverse models of AI integration in companies.

Table 21 Adjustment of the training level of technical skills to the model of AI integration within company

Model of AI integration	Description	Applications/ Tools	Employee Skills Needed for AI Integration within the Company	Training level (for relation, see Appendix 4)
Applying (AI Embedded in Apps)	The company employs ready-made applications with embedded AI from suppliers, allowing for rapid technology implementation without requiring deep technical knowledge. This approach is particularly suitable for smaller companies or those new to AI, offering minimal integration effort and fast deployment but limited customization flexibility.	• Chatbots • Automatic content generation • Personalized recommendations in online stores	• Basic application operation. • Understanding of basic AI functions • Ability to interpret results generated by applications	Foundation
Embedding (AI APIs in a Custom App Frame)	The company integrates AI into its applications using APIs, allowing for greater control and customization to meet specific company needs. This method is beneficial for companies with moderate technical knowledge, as it offers enhanced flexibility in application customization while requiring basic technical expertise.	• Personalized chatbots • Automating customer service • Advanced data analysis	• Basic API programming skills • Knowledge of system integration • Ability to manage data and interpret results	Intermediate
Enhancing (AI Models via Data Retrieval)	The company enhances its AI models through data retrieval, necessitating advanced data management skills. This approach allows for greater personalization and customization, enabling the use of available data to develop more sophisticated applications like predictive sales analysis or personalized recommendations.	• Analysis and processing of large customer data sets • Demand forecasting • Inventory optimization	• Data management skills • Advanced data analysis skills • Understanding of business processes and their optimization	Intermediate
Extending (AI Models via Fine-Tuning)	The company customizes AI models by fine-tuning them with its own data. This process offers a high level of flexibility and requires advanced technical knowledge and resources. Fine-tuning allows for significant customization tailored to the company's specific needs, facilitating the creation of highly optimized and efficient systems.	• Creating advanced predictive models • Content and marketing offer personalization • Logistics operations optimization	• Advanced programming and data analysis skills • Ability to fine-tune AI models • Knowledge of the company's data specifics	Advanced
Building (Custom Models From Scratch)	The company builds AI models from scratch, which offers high flexibility and significant potential for innovation. However, this approach	• Unique AI solutions tailored to the specific needs of the	• Expert technical knowledge in AI and ML • Ability to design and	Advanced

Model of AI integration	Description	Applications/ Tools	Employee Skills Needed for AI Integration within the Company	Training level (for relation, see Appendix 4)
	demands advanced technical knowledge, considerable resources, and time. Constructing models from the ground up allows companies to fully explore and use the capabilities of generative AI, but it requires a substantial investment in both expertise and resources.	company • Advanced analytical systems • Large-scale process automation	build AI models. • Deep understanding of data and business processes.	

Source: own elaboration

A well-designed curriculum of online courses can enable MSMEs in the retail sector to develop the necessary skills and competencies among their managers and employees. This, in turn, will facilitate the successful integration and use of AI technologies, enhancing their operational efficiency and competitive edge in international markets.

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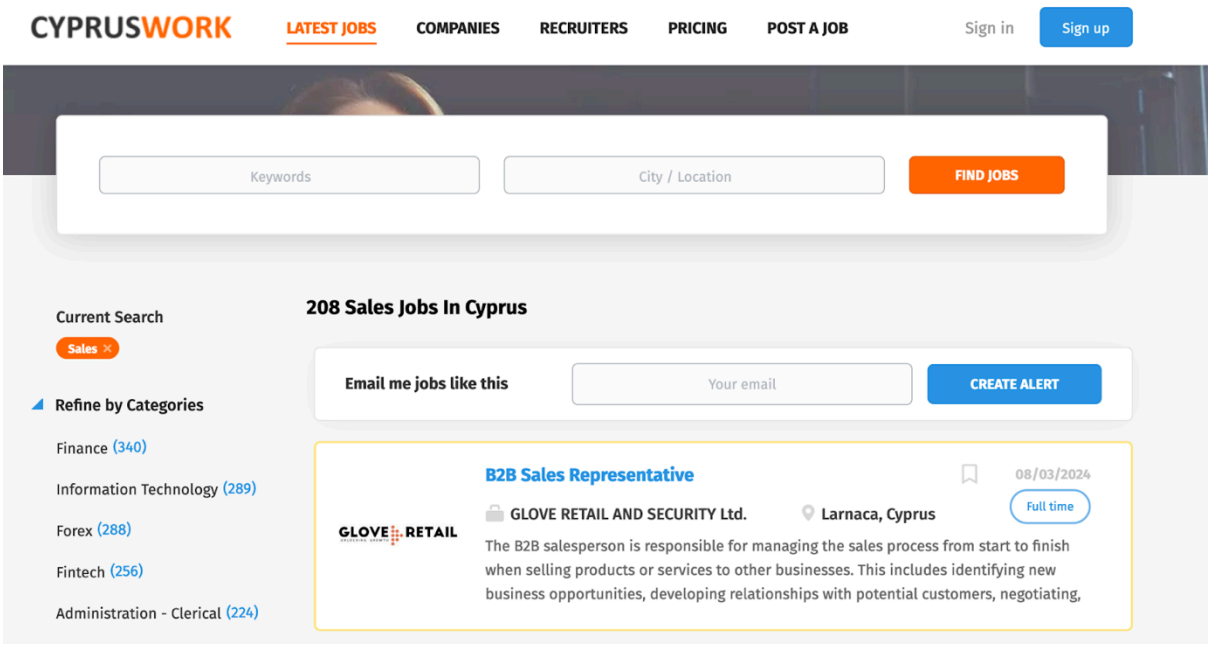
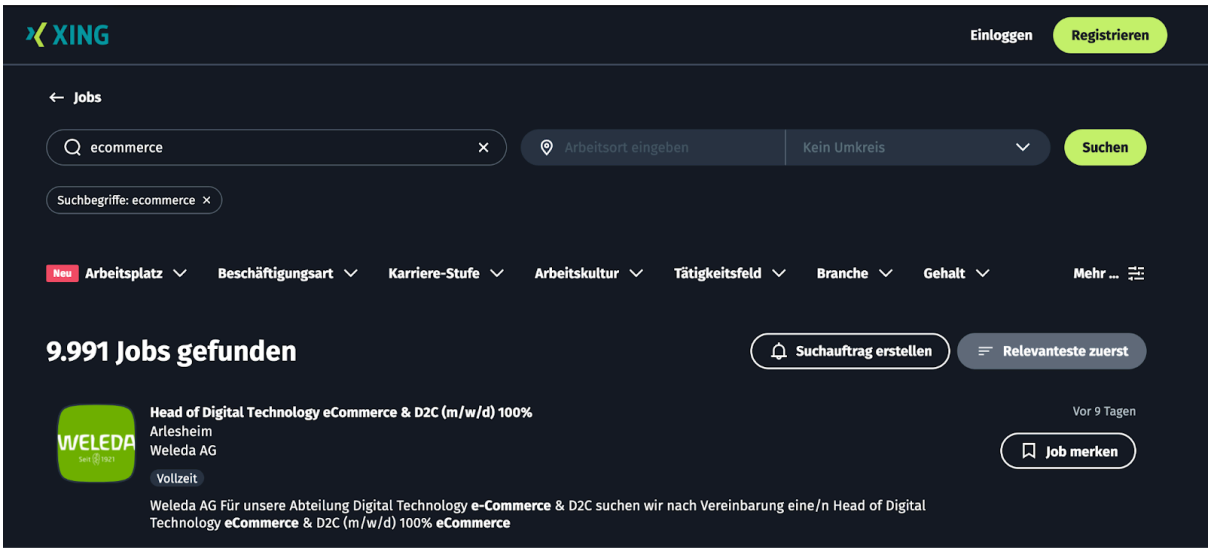
Annex

Appendix 1. Snapshots from job portals included in the job advertisements analysis (section 5)

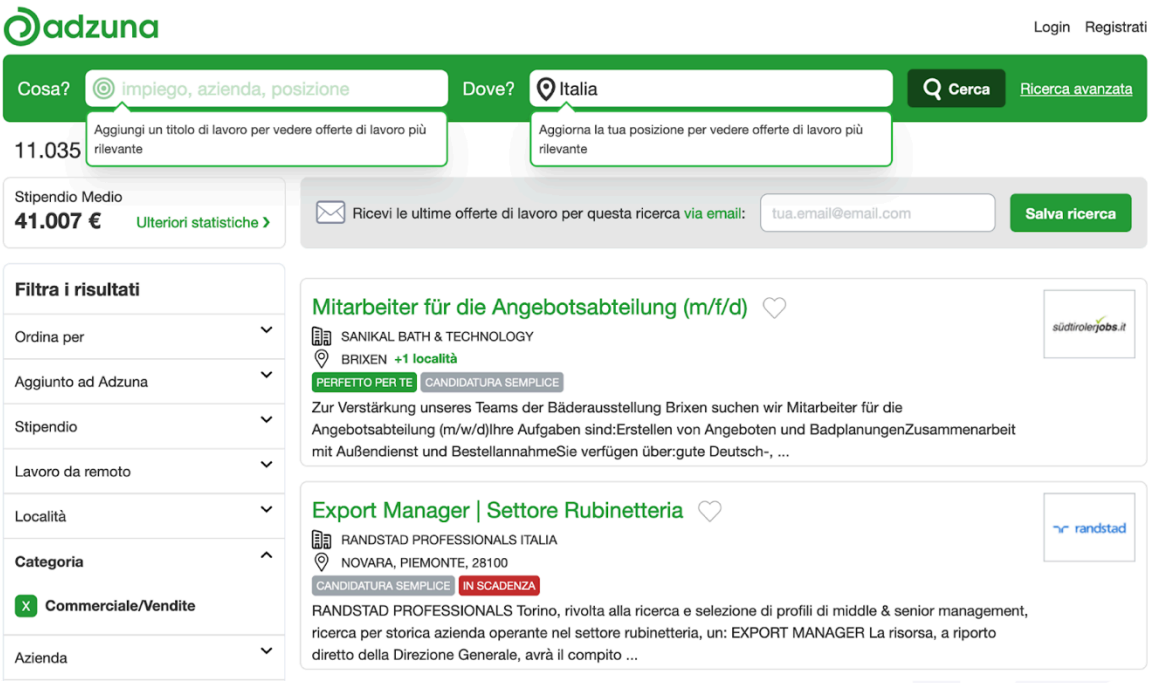
CY: cypruswork.com



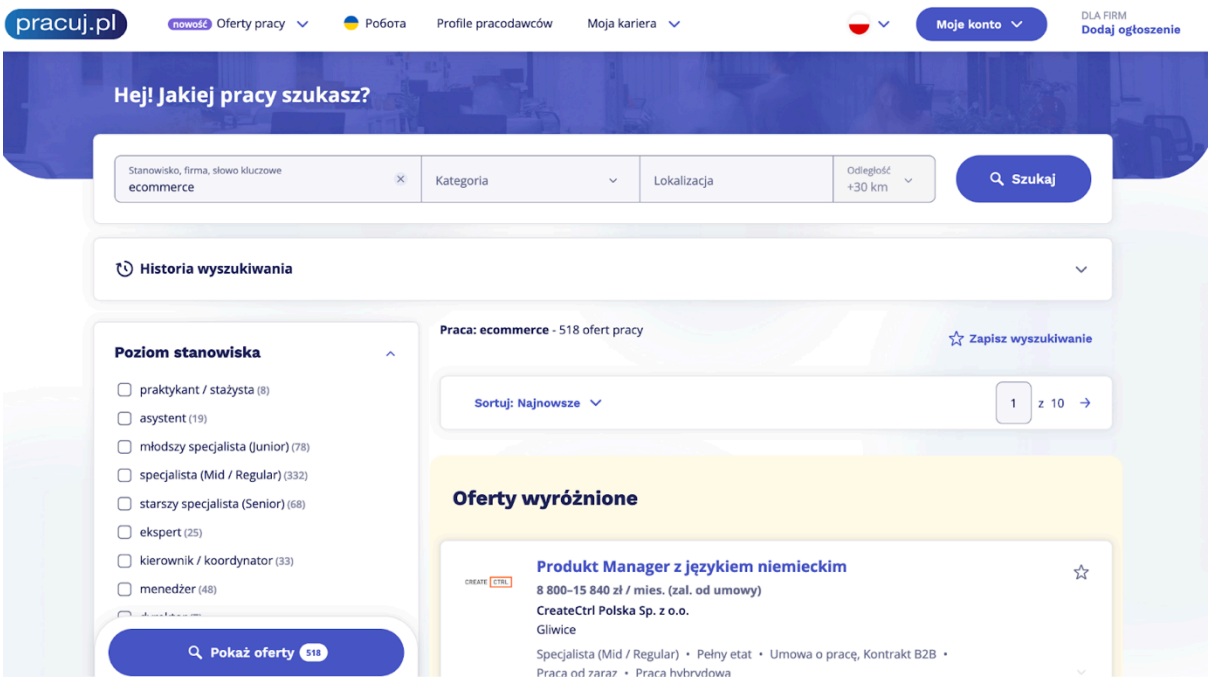
DE: xing.com



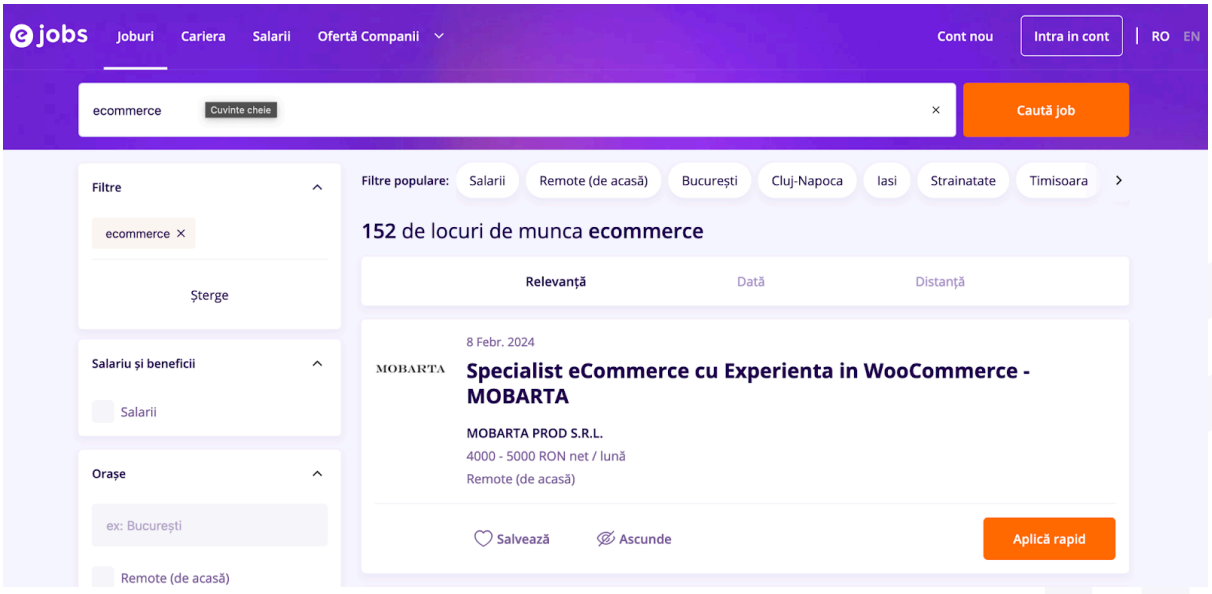
IT: azduna.it



PL: pracuj.pl



RO: ejobs.ro



Appendix 2. Co-creation workshop scenario

Design and realization: Agata Komendant-Brodowska

Format: online workshop

Tool: Zoom

Participants: relevant chambers of commerce representatives, trade unions with branches representing retail sector, employers of small and medium-sized retail enterprises (managerial level), employers of small and medium-sized retail enterprises (rank-and-file employee/non-managerial), specialized retail consultants, technology experts (ideally with expertise in retail-related digital technology), retail business owners , academics researching the respective country's retail sector

Duration: 165 minutes + biobreak - appr. 2 hours 45 minutes

DESCRIPTION	TECHNICAL NOTES (AND OUTPUTS)	RESEARCH QUESTIONS ADDRESSED
Part I: Introduction Introduction of the moderator. Short description of the project as a whole and of the purpose of the workshop and its structure. *Important: underline the **co-creation element** and the impact that those workshops will have on the results of the whole project.* Introduction of participants: name, organization, role *Important: underline that we don't have to be experts in IT, programming, machine learning, AI in general.* *Activator: playing with AI image generator - using prompts to generate images related to retail business (or to AI). Which ones do you like? Which ones don't you like? Why? Preparing a prompt together *OR choosing between AI generated images*	20 min *additional result - picking one image to save	- *some ideas on the attitudes towards AI

Part II: AI potential ***(working with canvas)*** On the left you can see some activities/aspects important in the retail sector. Can you name a few **typical challenges** related to them? E.g. acquiring new customers or finding the right suppliers or changing prices or competition? Anything that comes to your mind. Possible additional prompts: do you think those challenges are general or typical for micro, small and medium businesses? Are they general or typical for your country? Are they always-present or new? Now let's do some brainstorming about **AI and its role** in the sector. AI technologies are quite versatile. It's not only chatGPT but different types of technologies that can help in prediction or in creating typologies or in finding some cases that are different than the general pattern. On the right there are **some examples of AI technologies**. In your opinion, **can AI technologies help in addressing any of those challenges** or some specific elements in those challenges? Task: add some cards with AI technologies to the challenges we have on the right. *Discussion on the basis of what is drawn.* How could those technologies help? *(just brainstorming)* Do you think AI technologies can be used to **replace tasks** performed by employees? What kind of tasks? Why? Do you think AI technologies can be used to **enhance the way tasks are performed** by employees? What kind of tasks? Why? Can you think of any AI technologies that are **already used** by some companies in your country? What kind of companies? What kind of technologies?	30 minutes *output to save*	Which AI technologies are particularly useful in the retail sector? In what aspects do AI technologies replace tasks performed by employees? In what aspects do AI technologies enhance the way tasks are performed by employees?
biobreak*	10 minutes	
Part III: Case studies: implementing AI in an SME business (part 1) We'll have a look at two stories of real businesses together and	20 minutes	In what aspects do AI technologies replace tasks

how they used AI technologies and we'll discuss them together Case 1:... Case 2:...[anonymised cases from our case study short descriptions (one case more related to customers and the other one to internal functioning of the company)] What are your first impressions? Why do you think those companies decided to make use of these technologies? What were they afraid of? What did they hope for? Do you think implementing those technologies was difficult? In what way?		performed by employees? In what aspects do AI technologies enhance the way tasks are performed by employees? What types of AI technologies are MSMEs using in your country?
Part IV: Competences Let's get back to our cases. What do you think **had to be there already** in those companies to make use of these technologies? Now let's think about **skills and knowledge that were needed**. Can you think of particular skills/knowledge that either the managers of those companies or the employees had to have to use AI technologies and to benefit from them? We will discuss what they needed first, in order to start, and then what they needed later on, while implementing these technologies. Task for the group: Finish the sentence (with maximum 3 points): In order to **introduce AI technologies** to a company the managers of those companies **first** had to (know/be able to): ..... Finish the sentence (with maximum 3 points): In order to **implement AI technologies** to a company **efficiently** the managers of those companies have to (know/be able to): ..... Can you think of particular skills/knowledge that the employees of those companies had to have/gain/learn to use AI technologies? Task for the group: Finish the sentence (with maximum 3 points): In order to **make use of AI technologies** in a company the employees of those companies have to (know/be able to):	30 minutes	What skills do MSME employees need to use AI technologies efficiently and effectively? What kind of support and in which areas do employees need to acquire new skills enabling the use of AI technologies? What skills do managers and executives in retail MSMEs need to effectively support their employees in acquiring AI competencies? Skills of managers vs skills of

		employees
Part V: Creating the course together - what skills are needed? Now, we'll think about a course that would be helpful so that the owners/managers and employees are more able to efficiently introduce AI technologies in those areas and make use of those technologies. First, you have to **decide together whether we want one version of the course for everyone or two different versions, e.g. one for the owners/managers and the second one for the employees.** Or maybe you would see a different kind of division? (but not more than two versions) Now, we have to pick our **learning goals**. These are the competencies that people learn throughout the course. **Creating lists of competencies and ranking.** Task for the group: choose up to 8 most important skills from this list. Now rank them from the most to the least important *[list of competencies both AI related, data literacy and management, competencies from the previous part are added]* *If there are two versions, we're doing the same task for the second version as well.* Sometimes, while creating something it's really good to think about it from another perspective and see what we don't need and what we don't want. So, as the last task, could you please come up with some **ideas for a course about AI for retail that <u>you would never sign up for</u>**? Do you have any other suggestions for the courses that will be created within the INAIR project?	40 minutes	What kind of support and in which areas do employees need to acquire new skills enabling the use of AI technologies? What skills do managers and executives in retail MSMEs need to effectively support their employees in acquiring AI competencies? Do you have any specific suggestions regarding modules or skills that should be developed in online training for retail employees? What type of knowledge should an online course offer to develop AI competencies among retail sector employees? **The last task should help us see what to avoid in creating the course*
SUMMING UP AND THANK YOU Information about certificates after the workshops		

Appendix 3. Interviews and questionnaires scenario

Open-ended questions, including following questions

- Which AI technologies are particularly useful in the retail sector?
- What types of AI technologies are MSMEs using in your country?
- What are the main challenges associated with implementing these technologies?
- Are there any challenges specific to MSMEs?
- What challenges are specific to MSMEs in your country?
- In what aspects do AI technologies replace tasks performed by employees?
- In what aspects do AI technologies enhance the way tasks are performed by employees?
- What skills do MSME employees need to use AI technologies efficiently and effectively?
- What kind of support and in which areas do employees need to acquire new skills enabling the use of AI technologies?
- What skills do managers and executives in retail MSMEs need to effectively support their employees in acquiring AI competencies?
- Do you have any specific suggestions regarding modules or skills that should be developed in online training for retail employees?
- What type of knowledge should an online course offer to develop AI competencies among retail sector employees?

Appendix 4. Suggested levels of skills and competences development through INAiR open education resources as presented in the project application

Foundation Level

- Introduction to AI: Fundamentals of AI, its relevance for retailers and impact on business models, jobs, skills and consumer behaviors;
- Basic operational dynamic of AI: Fundamentals of Machine Learning and Natural Language Processing;
- Applications of Artificial Intelligence in Retail: Practical uses of AI across the retail value chain;
- Data-driven decision-making: Pre-processing, interpreting and validating AI-generated data to inform decision-making;
- Ethics: Ethical considerations surrounding AI technologies and the principles of transparency and accountability for AI-generated outcomes and decisions.

Intermediate Level

- Machine Learning in Retail (e.g., Targeted ads, Contextual shopping, Recommender engines, Dynamic pricing, Chatbots, Supply chain management, Delivery optimisation, Video surveillance, Fraud detection);
- Natural Language Processing (NLP) in Retail (e.g., Sentiment Analysis, NLP-powered chatbots, In-store bots, Semantic-based search, Azure Cognitive Services);
- Driving Human-centred Innovation with AI: Using AI to create innovative services, products and solutions that align with customer needs and values;
- AI for Sustainability: Identifying and selecting the set of insight data that impact the environmental footprint in order to understand what AI-powered sustainability solutions can reduce energy consumption, optimize resource utilisation, minimise waste for a sustainable digital future while accelerating the transition towards a circular economy);
- Regulations and Trustworthy AI: Relevant EU regulations, including the General Data Protection Regulation and the Artificial Intelligence Act, and Ethics guidelines for Trustworthy AI.

Advanced Level

- AI-Enabled Value Chain: Integrating AI technologies to improve multiple functions across the value chain.
- AI for Knowledge and Insights Management: Managing, sharing, using, creating and processing value chain data to gain actionable insights and contribute to the organisation's knowledge base;

- AI for Operations Optimization: Using AI technologies to minimise business costs and maximise operational capabilities, thus improving operations efficiently and effectively (e.g., computer vision, deep learning, intelligent applications and virtual assistants);
- AI-powered Customer Engagement: Using AI to understand, shape, customise and optimise the customer journey (e.g., via insight engines, augmented intelligence, chatbot, virtual assistants, speech recognition);
- AI for Inventory Management: Streamlining inventory management using AI data-driven insights about historical sales patterns, real-time demand signals and predictive models in order to prevent overstocking and understocking, to improve efficiency and reduce carrying costs and waste;
- AI-driven Business Intelligence (BI): Leveraging BI and analytics tools for sales forecasting, competitive analysis, and fraud prevention.

Appendix 5. The scope of the Work Package 3

Work package number	3
Work package title	Analysis of AI Skills Needs and Gaps in Retail

Objectives

WP3 aims at identifying multi-level AI skills needs and gaps for MSMEs working in the Retail sector in Cyprus, Germany, Italy, Poland, and Romania by M12, together with at least 50 (i.e., 10/country) relevant stakeholders. Particularly, the scope of the research work will include the following:

[1] **Analysis of transversal skills and competences needed to adopt AI** - The research will cover the analysis of the skills needs and gaps for the target group in relation to ESCO's transversal skills and competences needed for AI, particularly in relation to *Core skills and competences* (T1), *Thinking skills and competences* (T2), *Social and communication skills and competences* (T4) and *Life skills and competences* (T6). This analysis will take into account accelerated evolution of Large Language Models and impact of its implementation in business operation on the retail sector.

[2] **Analysis of information and digital skills needed to adopt AI –** The research will cover the analysis of the skills needs and gaps for the target group in relation to ESCO's *Information skills* (S2) and *Working with computers skills* (S5).

[3] **Identification of sector-specific technical skills needed by the target group to adopt AI**, including (a) high-level knowledge of AI, Machine Learning and Natural language processing, (b) awareness and understanding of AI, its implications and societal impacts, (c) data processing, visualization and management, (d) knowledge representation and reasoning, planning, search, optimisation, (e) multi-agent systems, and (e) AI regulation, ethics, philosophy and trustworthiness.

[4] **Identification of green competences needed by the target group to use AI to make their companies greener** - The research will cover the relevant ESCO's cross-sectoral and transversal green skills and knowledge needed by the target group to use AI to make their companies, processes and products more sustainable (e.g., *Develop energy-saving concepts, Adopt ways to reduce pollution, Climate change impact, Circular Economy, Evaluate the environmental impact of personal behaviour, Monitor environmental parameters, Waste management, Promote sustainability, Adopt ways to reduce the negative impact of consumption, Advice on pollution prevention).*

Description of work

Task 3.1: Desk Research *(UNIWARSAW, M2-M5).* The desk research, including academic and grey literature, will focus on: (a) analysing the transversal, information, digital, technical and green skills needs for MSMEs working in Retail and (b) the related skills gaps in the consortium's countries; (c) identifying use cases and best practices of AI adoption for greener retailers with particular focus on the consortium's countries, and analysing the success and failure factors; (d) reviewing the results of relevant projects (e.g. Bridges 5.0, and AI4Europe). Desk research will be complemented by analysing relevant statistical datasets and open data, as well as original, web-scraping analysis of AI-related online job adverts at micro, small and medium-sized retailers in all consortium countries.

Task 3.2: Co-creation workshops *(UNIWARSAW leads, ALL partners contribute, M3-M5).* Qualitative insights for validation of results of T3.1 and mapping out various stakeholders' needs, with special

emphasis to be put on addressing the needs of workers at risk of becoming redundant due to the uptake of new AI related technologies, will be gathered during online co-creation workshops (one per country) with relevant industry experts, led by UNIWARSAW. Workshop participants will be recruited by the Partners according to the instructions provided by UNIWARSAW to include specialized retail consultants and technology experts, retail business owners and academics, trade unions, chambers of commerce, and representatives of other relevant national and EU-funded projects and initiatives, incl. the Bridges 5.0 and AI4Europe consortia and the members of the Pact for skills' Large-scale Partnerships in Digital and Retail. The empirical results of the workshops (research notes, schemes and transcriptions) will undergo CAQDAS thematic analysis to better inform activities in WP 4.

Task 3.3: Development of the Research Report (*UNIWARSAW, ALL partners* contribute, *M6-M7*). T3.3 includes the analysis of the results of the quantitative and qualitative data generated through desk research and co-creation workshops, and the collaborative (between consortium partners) and participatory (inviting representatives of the target groups to comment and co-create) development of the Research Report providing recommendations and guidelines for designing the AI Core curriculum for MSMEs in Retail (WP4). The report would be also of value for various stakeholders willing to work on skilling, reskilling and up-skilling the workforce in wake of AI technologies proliferation in EU retail.

Appendix 6. Indicators of the goal realization in WP3

Indicators (as presented in project application)	Target	Outcome	Description
No. of use cases and best practices of AI adoption for greener retailers reviewed (Target: 15)	15	**16**	Information on use cases (13) and best practices (3) collected from company websites and interviews with experts or industry representatives. Cases limited to examples of European retail SMEs with specific implementation results (KPIs or first-hand accounts of operational change).
No. of statistical datasets on areas related to AI adoption in MSMEs (e.g., technology adoption, investments in AI and advanced ICT skill development by MSMEs) – (Target: 10)	10	**14**	- INTERNAL: AI concepts relevant for AI and e-commerce/retail sectors (available at: https://zenodo.org/records/11635993) - INTERNAL: LDA model on scientific articles relevant for INAIR (available at: https://zenodo.org/records/12742625) - INTERNAL: Metadata of articles from SCOPUS (available at: https://zenodo.org/records/12742625) - Turnover and Sales Volume in Wholesale and Retail Trade (available at: https://doi.org/10.2908/STS_TRTU_A) - Number of Small and Medium-Sized Enterprises in the Retail Sector (available at: https://doi.org/10.2908/SBS_SC_OVW) - Digital Intensity (by class size of enterprise (available at: https://doi.org/10.2908/ISOC_E_DII , by NACE Rev. 2 activity available at: https://doi.org/10.2908/ISOC_E_DIIN2) - Value of e-commerce sales by NACE Rev. 2 activity (available at: https://doi.org/10.2908/ISOC_EC_EVALN2) - Artificial Intelligence (by Class Size of Enterprise available at: https://doi.org/10.2908/ISOC_EB_AI , by NACE Rev. 2 activity available at: https://doi.org/10.2908/ISOC_EB_AIN2) - Data analytics by NACE Rev. 2 activity (available at: https://doi.org/10.2908/ISOC_EB_DAN2) - Cloud computing services by NACE Rev.

			2 activity (available at: https://doi.org/10.2908/ISOC_CICCE_USEN2) - Internet of Things by NACE Rev. 2 activity (available at: https://doi.org/10.2908/ISOC_EB_IOTN2) - Digital skills of employees (available at: https://doi.org/10.2908/ISOC_SK_DSKL_I21) - Employees' programming skills (available at: https://doi.org/10.2908/ISOC_SK_CSKL_I21) - Flash Eurobarometer 529 (available at: https://search.gesis.org/research_data/ZA8760)
No. of relevant industry experts (e.g., specialized retail consultants and technology experts, retail business owners and academics, trade unions, chambers of commerce, representatives of other relevant national and EU-funded projects and initiatives, incl. the Bridges 5.0 and AI4Europe consortia, and the Pact for Skills' Large-scale Partnerships in Digital and Retail) engaged in the research activities (Target: 50);	50	**70** named and **22** anonymous contributors in the process of knowledge co-creation	List of participants in workshops, interviews and surveys in Annex 7.
No. of AI-related online job adverts at micro, small and medium-sized retailers analysed via web-scraping analysis (Target: at least 75).	75	**44494**	Dataset is available at: https://zenodo.org/records/11636825

Source: own elaboration

Appendix 7. The list of the stakeholders who contributed to the co-creation of insights presented in the report

Name	Surname	Affiliation	Contribution
Gianluca	Abbruzzese	Lascò	Workshop Italy 22.04.2024
Ovidiu	Acomi	European Foundation for Quality Management (EFQM), TEAM4Excellence	Workshop Romania 25.04.2024
Igor	Akimov	Abasis Limited	Survey
Domnica	Alpetri	Constanta Maritime University	Workshop Romania 09.04.2024
Liana-Elena	Anica-Popa	Bucharest University of Economic Studies	Interview
Luisa	Barrameda	Federfranchising - Confesercenti	Workshop Italy 23.05.2024
Grzegorz	Basta	Sortmund	Interview
Giusi	Bastone	La Yogurteria	Workshop Italy 23.05.2024
Elisabeth	Beigl	European Association of Institutes for Vocational Training (EVBB)	Workshop Germany 23.04.2024
Sebastian	Błaszkiewicz	Unity Group	Survey
Florentina	Boariu	My Creative Steps	Workshop Romania 09.04.2024
Maurizio	Bonmassari	System Retail	Workshop Italy 23.05.2024
Loredana	Bucseneanu	European DIGITAL SME Alliance	Workshop Italy 05.04.2024
Stefan	Bugu	A.P. Moller - Maersk	Workshop Romania 25.04.2024
Ahmet	Burdu	PwC	Workshop Italy 05.04.2024
Eliana	Calò	Interessenvereinigung Mittelständische Wirtschaft e.V. (IMW)	Workshop Germany 23.04.2024
Bogdan-Ciprian	Cazan	Constanta Chamber of Commerce, Industry, Navigation and Agriculture	Workshop Romania 09.04.2024
Mirek	Cerny	Insightee	Interview
Andrea	Ceschini	Università degli studi di Roma "La Sapienza"	Workshop Italy 23.05.2024

Soti	Christou	Cyprus Chamber of Commerce and Industry	Survey
Marco	Cossu	CBO Consulting	Workshop Italy 23.05.2024
Cristina	Dragomir	Constanta Maritime University; WISTA Romania	Workshop Romania 09.04.2024
Valentina	Fikardou	Fikardos Winery	Survey
Monia	Fresiello	101 CAFFE'	Workshop Italy 23.05.2024
George	Georgiou	Founder NOVATEX SOLUTIONS LTD	Survey
Konrad	Grabowski	Biosfera	Workshop Poland 08.04.2024
Mihaela	Hnatiuc	Constanta Maritime University	Workshop Romania 25.04.2024
Andros	Ioannou	Handy Spa	Survey
Agnieszka	Jasińska	Warmia and Mazury Regional Development Agency	Workshop Poland 08.04.2024
Thomas	Jerwin	Vogelsbergschule Lauterbach	Workshop Germany 24.04.2024
Frederic	Kerber	Innovative Retail Laboratory	Interview
Krzysztof	Klimczak	Transparentni Sp. z o.o. / SGH w Warszawie	Survey
Arkadiusz	Kosecki	Elbląski Park Technologiczny (EPT Elbląg)	Workshop Poland 08.04.2024
Sławomir	Kowalski	Kowalskimark	Workshop Poland 08.04.2024
Tomasz	Krawczyk	University of Warsaw; Enterprise Europe Network	Workshop Poland 09.05.2024
Miriam	Lanzetta	Lascò	Workshop Italy 23.05.2024
Jens	Lehmann	European IT Consultancy EITCO GmbH	Interview
Andrea	Lösch	German Research Center for Artificial Intelligence (DFKI)	Interview
Mateusz	Łukianiuk	Admitad Polska Sp.z o.o.	Survey
Alessandra	Marcandalli	DAO Soc. Coop.	Workshop Italy 23.05.2024
Alessandro	Mastropasqua	Custom S.p.A.	Workshop Italy 23.05.2024
Periklis	Mathioudakis	CallMe20	Workshop Italy 05.04.2024
Angelo	Merola	DEMETRAMKT	Workshop Italy

			05.04.2024
Alessandro	Montanari	Talent Garden	Workshop Italy 23.05.2024
Cristiano	Nervegna	Deep Lab srl	Workshop Italy 23.05.2024
Lidia	Nica	Romalimenta	Workshop Romania 25.04.2024
Socratis	Nicolaou	Ni & St Trading Co. Ltd	Survey
Ada-Lorena	Niculiţă	National Institute for Research & Development in Chemistry and Petrochemistry (ICECHIM)	Workshop Romania 09.04.2024
Vincenzo	Piscitelli	RawStone Games	Workshop Italy 22.04.2024
Marta	Piskorz	Warmia and Mazury Regional Development Agency	Workshop Poland 08.04.2024
Paweł	Pomin	DARE MEDIA	Interview
Agnieszka	Pugacewicz	Fundacja Rozwiązać Autyzm	Workshop Poland 09.05.2024
Daniela	Raiciu	Titu Maiorescu University	Workshop Romania 09.04.2024
Lisa	Renner	ARBEIT UND LEBEN Sachsen, Zentrum Zukunft der Arbeitswelt	Workshop Germany 24.04.2024
Salvatore	Rosania	Cubitlab	Workshop Italy 05.04.2024
Patrycja	Sass-Staniszewska	Chamber of Digital Economy	Interview
Matteo	Sasselli	Smart Consulting	Workshop Italy 23.05.2024
Hauke	Schlüter	House of Digital Transformation e.V.	Interview
Ben	Schuering	EasyRain	Interview
Justyna	Skorupska	Chamber of Digital Economy; Kozminski University	Interview
Alexandru	Strujac	ASSIST Software	Workshop Romania 09.04.2024
Christian	Stur	LIME	Workshop Germany 24.04.2024
Grażyna	Szabuniewicz	mindShift point	Interview
Thrasos	Tilemachou	STANDOutEDU	Survey
Valeria	Vangelista	Eurosportello Confesercenti	Workshop Italy 22.04.2024
Aaron	Visaggio	University of Sannio	Workshop Italy

			05.04.2024
Andrea	Vittoria	Gruppo Balletta, Zero4	Workshop Italy 22.04.2024
Agata	Witkowska	GS1 Polska	Workshop Poland 09.05.2024
Mateusz	Wróbel	LivePrice	Survey
Daniel	Zalewski	Visciola Fashion	Workshop Poland 08.04.2024
Silvano	Zipoli Caiani	Università degli Studi di Firenze	Workshop Italy 23.05.2024

The list does not include 22 contributors who provided valuable insights and greatly contributed to co-creation of knowledge but decided not to share their personal data.