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Review

Artificial Intelligence in SMEs: Enhancing Business Functions Through Technologies and Applications

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Abstract: Artificial intelligence (AI) has significant potential to transform small- and medium-sized enterprises (SMEs), yet its adoption is often hindered by challenges such as limited financial and human resources. This study addresses this issue by investigating the core AI technologies adopted by SMEs, their broad range of applications across business functions, and the strategies required for successful implementation. Through a systematic literature review of 50 studies published between 2016 and 2025, we identify prominent AI technologies, including machine learning, natural language processing, and generative AI, and their applications in enhancing efficiency, decision-making, and innovation across sales and marketing, operations and logistics, finance and other business functions. The findings emphasize the importance of workforce training, robust technological infrastructure, data-driven cultures, and strategic partnerships for SMEs. Furthermore, the review highlights methods for measuring and optimizing AI's value, such as tracking key performance indicators and improving customer satisfaction. While acknowledging challenges like financial constraints and ethical considerations, this research provides practical guidance for SMEs to effectively leverage AI for sustainable growth and provides a foundation for future studies to explore customized AI strategies for diverse SME contexts.

Keywords: artificial intelligence; SME; AI-powered technologies

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1. Introduction

In recent years, artificial intelligence (AI) has emerged as a key driver in reshaping the landscape of business operations across a wide range of sectors [1]. Unlike their larger counterparts, small- and medium-sized enterprises (SMEs) often operate with limited financial and human resources, technical skill shortages, organizational resistance to change, and concerns related to data integration, security, and privacy [2], which makes the strategic adoption of AI both a significant opportunity and a formidable challenge [3], shaping how SMEs adopt and utilize AI in distinct ways. These constraints uniquely shape their AI usage. In general, AI technologies have the potential to greatly improve operational efficiency, product development, customer engagement, and competitive advantage for SMEs [2]. In contrast to larger enterprises that may invest in long-term, large-scale AI initiatives, SMEs often prioritize solutions that offer rapid returns on investment and are easier to implement.

This paper aims to explore the core AI technologies driving adoption among SMEs and examine their diverse applications that contribute to enhanced productivity, improved decision-making, and innovation. Beyond identifying these technologies and applications,

This paper aims to explore the core AI technologies driving adoption among SMEs and examine their diverse applications that contribute to enhanced productivity, improved decision-making, and innovation. Beyond identifying these technologies and applications, the study also focuses on how SMEs can develop the necessary organizational capabilities and infrastructure to successfully overcome the challenges associated with AI adoption. By addressing critical barriers such as limited expertise, financial constraints, and organizational resistance, this research seeks to provide practical strategies that empower SMEs to effectively integrate AI into their operations. Furthermore, the paper investigates methods for measuring and optimizing the value generated by AI adoption, offering insights into how SMEs can maximize their return on investment and continuously refine their AI strategies for sustained growth and competitive advantage.

The subsequent sections of this paper are organized as follows: First, the paper continues with the methodology to clearly and systematically describe how the research was conducted. Thus, the paper provides an overview of the core AI technologies pertinent to SMEs and the various business applications of AI that are currently transforming SME operations. Following this, the paper discusses the organizational and infrastructural strategies SMEs can employ to address the challenges of AI implementation. The study then explores approaches for evaluating and optimizing the impact of AI across business functions. Finally, the paper concludes by highlighting its originality and contributions, presenting its research limitations, and suggesting future directions.

2. Methodology

This study conducts a systematic literature review (SLR) following the foundational guidelines proposed by [4], aiming to evaluate the adoption of artificial intelligence in SMEs (Figure 1).

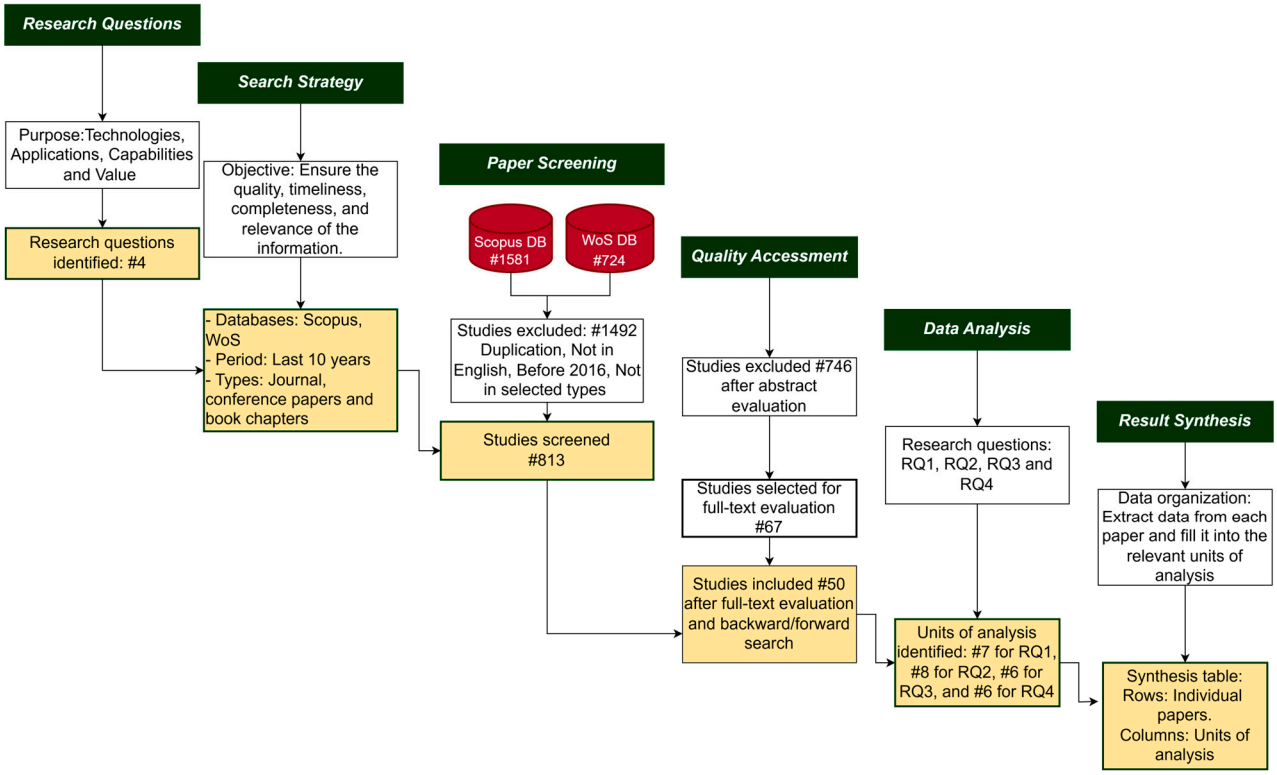

Figure 1. The SLR process.

The review specifically investigates key AI technologies, their applications, organizational capabilities required for successful implementation, and methods for optimizing the value derived from AI adoption. A detailed overview of the SLR process is provided in Figure 1, while the PRISMA flow diagram is included in Appendix A.

2.1. Defining the Research Questions (RQs)

The research questions guiding this study were developed through an iterative process of initial scoping and refinement, grounded in the principles of Service Science, Management, and Engineering (SSME). SSME represents the interdisciplinary application of scientific, managerial, and engineering approaches to the design and implementation of complex service systems [5]. Our inquiry began with a broad interest in how SMEs adopt AI. An initial review of the literature, focused on technology adoption and its role across various business functions, helped shape the early formulation of research questions. These preliminary questions were then refined through iterative literature searches and thematic analysis based on the perspective of service science, ensuring alignment with key scholarly discussions and the identification of underexplored areas.

The finalized research questions are as follows:

- RQ1 (Technologies): What are the most effective AI technologies currently adopted by SMEs?
- RQ2 (Applications): How do SMEs apply AI to enhance specific business functions?
- RQ3 (Capabilities): What organizational capabilities and infrastructure do SMEs need to overcome challenges in AI adoption?
- RQ4 (Value): How do SMEs measure and optimize the value generated from AI adoption?

RQ1 and RQ2 address core technological and functional aspects of AI adoption in SMEs. RQ1 aligns with the engineering component of SSME, focusing on the technologies themselves, while RQ2 draws on the science component, examining how these technologies are operationalized across various business activities. RQ3 and RQ4 correspond to the management component of SSME, exploring the strategic and organizational elements essential to successful AI implementation. These questions respond to a recognized gap in the literature concerning how SMEs can build the internal capacity to support AI adoption and evaluate its return on investment. Together, these four research questions provide a comprehensive and structured framework for understanding the adoption of AI in SMEs, thereby providing practical insights for both academic researchers and industry practitioners.

2.2. Developing the Search Strategy

In this step, specific criteria and tools were established to systematically identify relevant publications:

- Databases: Scopus and Web of Science (WoS) were chosen because they are comprehensive, multidisciplinary, and reputable databases containing high-quality academic literature.
- Search Expression and Keywords: A carefully constructed search expression was created using specific keywords related to SMEs and AI, including their synonyms and subfields (e.g., “small and medium enterprises”, “SMEs”, “AI”, “machine learning”, “deep learning”, “data analytics”). These keywords were combined logically using Boolean operators (“AND”, “OR”) to precisely locate relevant literature.
- Search Limitations: The search was limited to:
  - ✓ Document types: journal articles, conference papers, and book chapters.
  - ✓ Language: English.
  - ✓ Timeframe: Publications between 2016 and 2025, capturing the period of rapid advancements in AI adoption by SMEs.

2.3. Identifying and Screening Papers

This step involved identifying and screening relevant literature from the chosen databases:

- Identification: Initially, 2305 papers were identified (1581 from Scopus, 724 from Web of Science—WoS). These papers were exported into reference management software (EndNote 21) for easier handling.
- Removing Duplicates and Screening: Duplicates were removed, and papers were screened based on inclusion criteria:
  - Relevance to SMEs.
  - Relevance to AI adoption and applications.
  - Publication date range (2016–2025).
  - Language and document type criteria.

  After applying these criteria, 813 papers remained for further quality assessment.

2.4. Conducting the Quality Assessment

This step involved rigorously assessing the quality and relevance of the remaining papers:

- Title and Abstract Evaluation: The titles and abstracts of the remaining 813 papers were carefully reviewed. In the first screening step, 416 papers were excluded for not directly addressing the research objectives. This left 397 papers for further relevance assessment. Following our search protocol, all three authors independently evaluated the remaining articles in EndNote, assigning relevance scores on a scale from 1 (low) to 5 (high), based on how well each paper aligned with the research objectives. Papers that received low scores (1–2) from at least two reviewers were excluded due to limited thematic alignment, methodological shortcomings, or insufficient focus on specific business functions. Ultimately, 67 highly relevant and methodologically robust studies were selected for full-text quality assessment, while 330 were excluded at this stage.
- Full-text Evaluation: The remaining 67 papers underwent a comprehensive full-text assessment aligned with the research questions. Reviewers independently evaluated each study, and their results were then compared. In cases of disagreement, the reviewers engaged in structured discussions to clarify interpretations and refine the application of inclusion criteria. Discrepancies were resolved through the joint re-examination of the relevant papers, with both reviewers revisiting the specific criteria in question and collaboratively reaching a consensus.
- Final Selection: After this comprehensive evaluation, the 50 most relevant and representative papers were selected for inclusion in the systematic literature review.

2.5. Extracting and Analyzing Data

The SLR process resulted in the selection of 50 relevant articles. While all 50 articles contributed to providing a comprehensive understanding of AI in SMEs, 27 of these articles provided the primary data and evidence for answering the four research questions (RQ1-4). The remaining 23 articles served to provide context, justify the methodology, or support the discussion of findings. For instance, some articles were used to establish the background and significance of the research problem, while others informed the development of the search strategy and inclusion/exclusion criteria. Although the 23 articles might have allowed for the formulation of additional research questions, the current study focused on the four core RQs to maintain a clear and manageable scope. The selected 50 papers were systematically analyzed to identify the relevant units of analysis and to synthesize insights related to the four research questions based on these units of analysis. The elements

within each research question were defined based on a thematic analysis of the reviewed literature. For example, the AI technologies identified in RQ1 (Machine Learning, Deep Learning, NLP, etc.) represent the technologies most frequently discussed in the context of AI adoption by SMEs. While pre-existing classifications of AI techniques and business functions informed our analysis, the specific elements included were determined by their prevalence and relevance within the 50 reviewed articles. For instance, Machine Learning was commonly discussed in relation to credit scoring and sales forecasting, and NLP was frequently applied to customer service and chatbot development.

It is important to note that some potentially relevant aspects were not as prominent in the reviewed literature. For example, while the role of the Chief Executive Officer (CEO) in digital transformation and the challenges of workforce expertise are crucial for AI adoption in SMEs, these themes were not extensively addressed in the selected articles. Similarly, while predictive maintenance is a significant AI application, it was less frequently discussed than other applications within operations and logistics, such as inventory optimization. These underrepresented areas represent important avenues for future research.

- AI Technologies: Machine Learning (ML), Deep Learning (DL), Natural Language processing (NLP), Generative AI (GenAI), Explainable AI (XAI), Robotic Process Automation (RPA), and Computer Vision (CV) [6].
- AI-Powered Business Applications: Sales and Marketing (SM), Operations and Logistics (OL), Finance and Accounting (FA), Human Resources (HR), Risk Management and Cybersecurity (RC), Information Systems (IS), Research and Development (RD), Business Intelligence and Analytics (BIA) [7].
- Organizational Capabilities: Employee training, technological infrastructure, data-driven culture, strategic partnerships, risk management, and AI-driven strategies.
- Value Optimization: Methods for measuring AI's impact, such as performance indicators, process optimization, customer satisfaction, culture of innovation, and strategic decision-making.

2.6. Summarizing and Reporting Results

The insights gained from analyzing these papers were summarized, structured, and clearly presented to address each research question. Table 1 presents the summary of selected papers related to AI technologies and AI-powered business applications in SMEs.

Table 1. List of papers included in the literature review.

Paper	AI Technologies							AI-Powered Business Applications							
	ML	**DL**	**NLP**	**GAI**	**XAI**	**RPA**	**CV**	**SM**	**OL**	**FA**	**HR**	**RC**	**IS**	**RD**	**BIA**
Shi et al. (2024) [8]	*	*								*		*			
Abdullah et al. (2024) [9]			*					*	*						
Ghobakhloo & Ching (2019) [10]	*								*		*				
Panigrahi et al. (2023) [11]			*					*	*						
Bettoni et al. (2021) [12]	*		*					*	*						*
Khan et al. (2020) [13]	*		*							*					*
Wang et al. (2024) [14]	*	*								*		*			*
Kang & Kim (2024) [15]	*								*				*	*	*
Fuentes et al. (2024) [16]	*								*				*	*	*
Cubric & Li (2024) [17]	*	*	*					*	*	*		*	*	*	

Table 1. *Cont.*

Paper	AI Technologies							AI-Powered Business Applications							
	ML	DL	NLP	GAI	XAI	RPA	CV	SM	OL	FA	HR	RC	IS	RD	BIA
Härting & Sprengel (2019) [18]	*		*					*					*		*
Wang & Zhang (2024) [19]	*							*	*						*
Werheid et al. (2024) [20]	*	*					*		*						
Soundattikar et al. (2020) [21]	*						*		*						
Zhong (2023) [22]	*	*						*	*						*
Chiu et al. (2024) [23]	*								*						*
Lee et al. (2021) [24]			*					*					*		
Yang & Xiao (2024) [25]	*									*		*	*		*
Rawindaran et al. (2021) [26]	*											*	*		*
Willenbacher et al. (2021) [27]	*								*						*
Ferraro et al. (2024) [28]				*					*						
Bauer et al. (2020) [29]	*								*						
Zhao et al. (2023) [30]	*	*								*		*			
Mohanta & Mahanty (2021) [31]									*				*		
Bañales et al. (2024) [32]									*				*	*	
Xia et al. (2023) [33]	*								*	*		*			
Yoo et al. (2023) [34]	*	*												*	
Erdmann et al. (2024) [35]	*		*					*		*					*
Vargas et al. (2024) [36]	*								*						
Rajaram et al. (2024) [37]	*		*	*					*	*	*	*		*	
Villa et al. (2018) [38]	*								*	*					*
Wen & Iop (2019) [39]	*												*		
Yao et al. (2024) [40]	*								*	*		*			
Zhang et al. (2023) [41]	*									*					
Goga et al. (2024) [42]	*						*		*		*	*			*
Tawil et al. (2024) [43]	*							*						*	*
Mohamed & Weber (2020) [44]	*								*						
Chen et al. (2024) [45]	*									*		*			*
Wang (2024) [46]	*							*							*
Basar et al. (2022) [47]		*					*		*						
Sutrisno et al. (2025) [48]									*						
McCloskey et al. (2024) [49]			*	*				*							
Mathieu et al. (2024) [50]			*						*					*	
Sharma et al. (2024) [51]			*					*	*					*	
Cordera et al. (2022) [52]			*					*							
Selamat et al. (2021) [53]		*	*		*			*	*			*			

Table 1. *Cont.*

Paper	AI Technologies							AI-Powered Business Applications							
	ML	**DL**	**NLP**	**GAI**	**XAI**	**RPA**	**CV**	**SM**	**OL**	**FA**	**HR**	**RC**	**IS**	**RD**	**BIA**
Pyplacz & Žukovskis (2023) [54]						*			*						
Sven & Kurt (2023) [55]						*			*						
Han et al. (2023) [56]					*			*							
Das et al. (2024) [57]		*	*		*				*			*			
Total: 50 articles	*33*	*10*	*15*	*3*	*3*	*2*	*4*	*16*	*32*	*13*	*3*	*13*	*10*	*9*	*18*

Note: RPA has characteristics of both an AI technology and an AI-powered business application. It is classified as a technology in this table due to its core function of automating tasks. The asterisks (*) in the table cells indicate that the corresponding paper is related to the specific categories listed in the headers.

Table 1 presents the distribution of AI technologies and their applications in SMEs, addressing RQ1 and RQ2. This format effectively illustrates the relationships between specific AI technologies and the business functions they serve. RQ3 and RQ4, which explore organizational capabilities and value optimization, are addressed in detail in Sections 3.3 and 3.4, respectively, as their findings are more effectively presented using descriptive text to capture the nuances of these strategic elements.

3. Research Findings

As presented in Figure 2, the distribution of the publication dates spans from 2018 to 2025. The topic has gained increasing momentum from 2023 to 2024 (33 papers). The analysis of AI technologies and their applications in SMEs reveals significant trends and insights. Concerning AI technologies, Machine Learning and NLP received the most attention, with 33 and 15 papers, respectively, indicating their widespread use in business contexts. In terms of business applications, Operations and Logistics, and Business Intelligence and Analytics garnered the highest response counts, with 32 and 18 papers, respectively, suggesting strong interest in how AI enhances these areas.

3.1. AI Technologies in SMEs (RQ1)

This subsection identifies key AI technologies adopted by SMEs, including Machine Learning, Deep Learning, NLP, Generative AI, Explainable AI, Robotic Process Automation, and Computer Vision. These technologies enable SMEs to automate processes, optimize decision-making, enhance customer interactions, and drive innovation, thus improving their overall competitiveness and efficiency.

3.1.1. Machine Learning (ML)

ML is a branch of AI that enables computers to learn from data and make decisions or predictions without being explicitly programmed [25,29]. SMEs are leveraging ML to enhance operations and support data-driven decision-making [25,29,33]. *Supervised Learning* techniques like Support Vector Machines and Random Forests are used for credit scoring and financial risk prediction [33]. *Ensemble Learning* methods such as XGBoost and Light Gradient Boosting Machine enhance sales forecasting and market predictions to support inventory management [19,23], neighborhood rough sets-based approach for SME creditworthiness assessment using big data to generate interval number rules for addressing complexities and equifinality [8]. *Feature Engineering* and *Semi-Supervised Learning* help SMEs analyze customer behavior and optimize manufacturing processes [25,29]. Moreover, a game-theoretic model with different financing options helps analyze how AI influences

financing preferences and strategies among e-commerce supply chain participants [40]. In general, these ML techniques enable SMEs to mitigate risks and improve business processes more effectively.

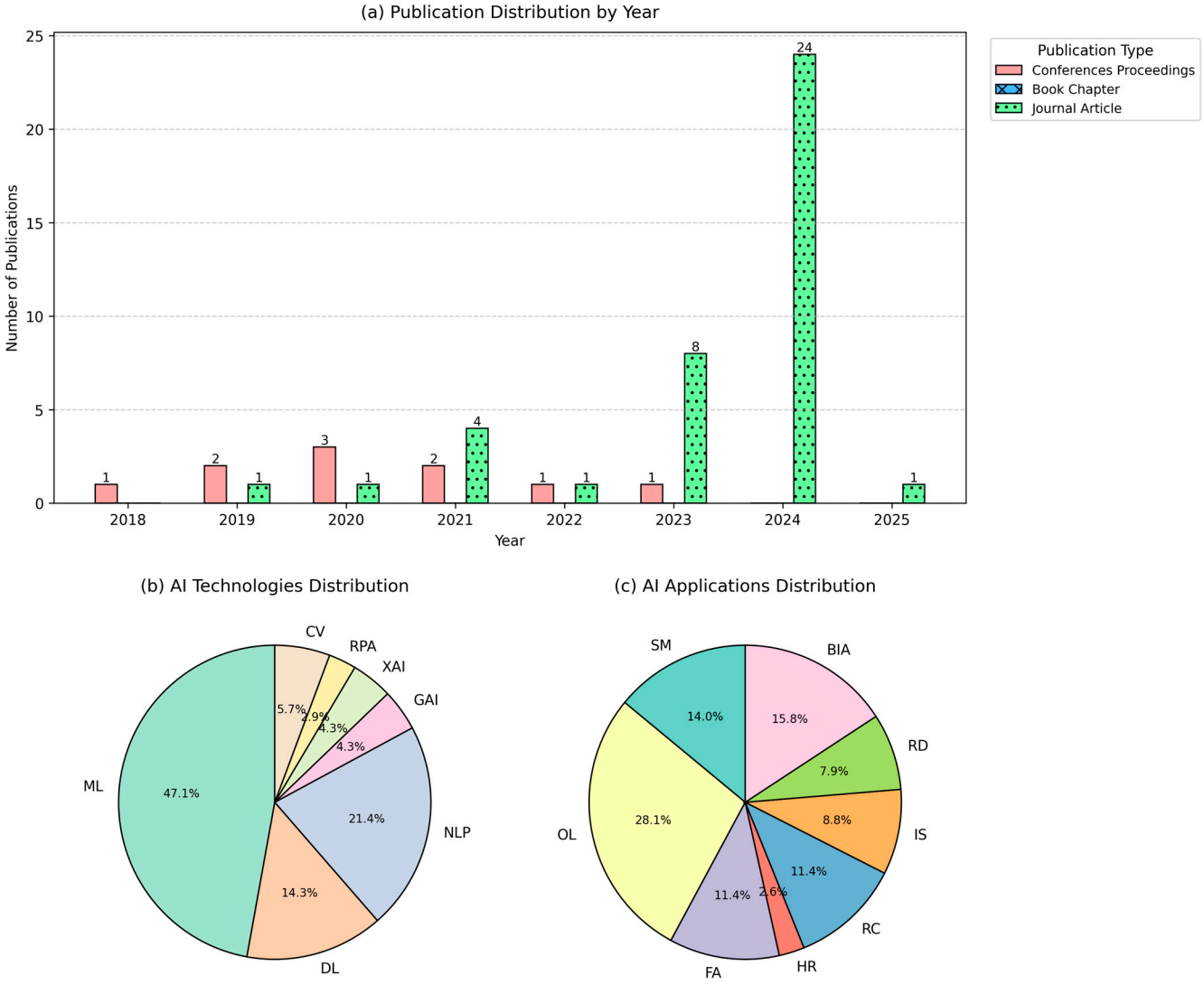

Figure 2. Distribution of the publications.

3.1.2. Deep Learning (DL)

DL uses multilayered neural networks to analyze and learn from large amounts of data, enabling systems to recognize patterns and make decisions with minimal human intervention [17,20]. DL can empower SMEs by enhancing various business operations through advanced data analysis and automation. For instance, neural networks and graph neural networks assess creditworthiness and financial distress [20,22,34,57]. In the FinTech sector, deep learning customizes solutions and improves computer vision tasks using models like VGG16 [17,20]. Sales prediction and e-commerce growth are driven by Deep Convolutional Neural Networks [22]. Additionally, DL techniques such as bi-directional Long Short-Term Memory (bi-LSTM) and Bidirectional Encoder Representations from Transformers (BERT) are used to classify fake reviews to boost customer trust [51,57].

3.1.3. Natural Language Processing (NLP) and Chatbots

NLP enables computers to understand, interpret, and respond to human language in a meaningful way [13,17]. In SMEs, advanced chatbots provide 24/7 customer support,

understand the user intent, and manage complex supply chains [11,51–53]. Concerning FinTech, NLP processes natural language texts for recommendation systems and loan assessments [13,17]. In addition, the Best Worst Method is used to rank key components and to determine the most important stakeholder criteria for sustainable AI implementation in pricing for SMEs [9,35]. SMEs utilize NLP for text recognition, sentiment analysis, and voice recognition to streamline customer service and document management [18]. Combining topic modeling and large language models (LLMs) showed the greatest potential for extracting actionable insights and making advanced analytical approaches accessible to small organizations [11]. Additionally, techniques like Word2Vec and BERT facilitate understanding customer behavior and classifying reviews, thereby boosting customer trust and operational efficiency [24,57].

3.1.4. Generative AI (GenAI)

GenAI refers to AI systems designed to create content by learning patterns from large datasets [28,37,49]. GenAI is revolutionizing SMEs by enhancing services like marketing, customer support, and report generation through LLMs [49]. One study proposed a roadmap for SMEs to successfully implement generative AI, using a sailing metaphor to highlight key strategic dimensions and providing practical recommendations [37]. Another study explores the potential of GenAI chatbots in customer service by identifying six key paradoxes and proposing brand response strategies to address them [28]. Besides the challenges, generative AI offers significant potential for innovation and operational optimization in SMEs [28,37,49].

3.1.5. Explainable AI (XAI)

XAI refers to AI systems designed to make their decision-making processes transparent and understandable to humans and empowers SMEs by enhancing transparency and trust in AI systems [53,56,57]. Techniques like LIME provide clear explanations for model decisions to highlight key features driving classifications [57]. Partial dependence plots visually depict important factors affecting credit risk, aiding in decision-making [56,57]. Additionally, XAI facilitates organizational risk assessments by developing interpretable models that reduce uncertainty and validate AI predictions [53,56,57].

3.1.6. Robotic Process Automation (RPA)

RPA is a technology that uses software robots to automate repetitive and structured business tasks, mimicking human actions to enhance efficiency and reduce costs [54,55]. RPA empowers SMEs by automating routine tasks such as data extraction, data entry, and system logging with software robots, effectively acting as virtual assistants [54,55]. However, SMEs often face challenges in implementing RPA due to limited financial resources to invest in the necessary software and infrastructure, as well as a lack of employees with the expertise to design and maintain RPA systems. These robots operate across various applications without needing extensive programming or system integration, making RPA a cost-effective and easily adaptable solution for businesses [54,55]. It is important to note that while RPA can be more affordable than full system overhauls, the initial investment may still pose a challenge for resource-constrained SMEs. By reducing manual labor in error-prone processes, RPA improves data quality and accelerates digitization [54]. Additionally, RPA supports both fully automated and partially assisted workflows, allowing SMEs to enhance operational efficiency and focus on strategic activities without significant infrastructure changes [54,55]. However, even partial workflow adjustments may present obstacles for SMEs lacking adequate IT support.

While classified here as a technology due to its use of software robots to automate tasks, RPA also exhibits characteristics of an AI-powered business application, as its value is derived from automating specific business processes.

3.1.7. Computer Vision (CV)

CV, which enables computers to interpret and understand visual information from images and videos, enhances SMEs by automating tasks such as defect detection, quality control, inventory management, and process optimization [20,21,42,47]. Affordable and portable CV systems use cameras and advanced software to help businesses maintain high standards and efficiently manage their inventory [20,21]. Additionally, CV-powered tools like autonomous forklifts streamline warehouse operations by accurately sorting and navigating goods [42]. Despite these advantages, many SMEs find it challenging to adopt CV technologies due to resource constraints and limited technical expertise [47].

3.2. AI-Powered Application in SMEs (RQ2)

The subsection highlights how AI-powered applications transform SMEs by enhancing a wide range of business functions. In this study, AI-powered business applications across different functional domains are selected, including Sales and Marketing, Operations and Logistics, Finance and Accounting, and Human Resources [7]. Additionally, enterprise-level applications are incorporated, such as Risk management and Cybersecurity, Information Systems, Research and Development, and Business Intelligence and Analytics. In general, the adoption of AI-powered applications drives efficiency, automates workflows, delivers personalized customer experiences, enhances decision-making, reinforces cybersecurity, and stimulates innovation across diverse business functions.

3.2.1. Sales and Marketing

AI-powered applications transform sales and marketing in SMEs by enabling consumer behavior analysis and personalized advertising [9]. Chatbots can provide 24/7 support to enhance customer satisfaction and loyalty [51–53]. AI tools aid in sales engagement and optimize conversion rates [11]. Data mining supports customer segmentation, behavior prediction, and sales forecasting [22]. Models like DCNN-SPM facilitate e-commerce growth and supply chain management [22]; meanwhile, models like CRISP-DM aim at cost optimization [18]. Furthermore, AI enables dynamic pricing, personalized recommendations, and effective market positioning [35,43,46].

3.2.2. Operations and Logistics

AI supports operations and logistics in SMEs by automating processes, optimizing inventory, and improving supply chain management [9,11,12,17,54,55]. Robotics and augmented reality support manufacturing and material handling, increasing efficiency and reducing errors [9,21]. Machine learning models and digital twins forecast sales, optimize production, and manage resources effectively [15,16,22,23,27,29]. Internet of Things (IoT) integration provides real-time data for monitoring and decision-making, enhancing operational control and minimizing waste [19,31,32]. Computer vision aids in visual inventory and quality management, while NLP streamlines communication and problem-solving [20,47,48,50,51,53]. These AI technologies enable SMEs to boost productivity, reduce costs, and support sustainable growth [33,36,38,40,42,44,47,48,57].

3.2.3. Finance and Accounting

AI enhances finance and accounting in SMEs by improving credit risk assessment, cash flow prediction, and fraud detection [35,37,38,40,41]. AI-powered FinTech models and machine learning techniques enable better credit underwriting and financial distress pre-

diction to facilitate informed lending decisions [13,14,30]. Recommender systems connect lenders with borrowers, promoting financial inclusion [13]. Machine learning also refines credit scoring and manages financing decisions to increase efficiency [37,38,40]. Additionally, AI assists in financial price predictions to support asset and wealth management for SMEs [35,41].

3.2.4. Human Resource

AI transforms human resources in SMEs by automating repetitive tasks, freeing up employees to focus on more strategic, creative, and value-added activities [10]. This shift enhances job satisfaction and productivity by reducing work monotony. However, the adoption of AI also poses challenges, notably the potential displacement of low-skilled workers, with a significant reduction in such roles expected over the coming years [42]. The rate of job losses will depend on factors like the pace of technological advancements, the cost of implementing AI and robotics, and the willingness of businesses to integrate these new technologies [42]. Striking a balance between leveraging AI's benefits and maintaining workforce sustainability remains a critical consideration for SMEs [10,42].

3.2.5. Risk Management and Cybersecurity

AI improves risk management and cybersecurity for SMEs by refining credit risk analysis, improving fraud detection, and predicting financial distress [17,26,33,45,53,57]. AI models analyze financial and non-financial data to assess creditworthiness and predict defaults to enable better lending decisions and financial stability [33,45]. In cybersecurity, AI-driven tools detect anomalies and protect against cyber threats to ensure data security and reduce the risk of breaches [17,26]. Additionally, AI supports crisis management by identifying fake reviews and mitigating their impact on business reputation [53,57].

3.2.6. Information Systems

AI augments information systems in SMEs by streamlining data management, enabling real-time analysis, and improving decision-making [15–18,25,31,32,39]. AI-powered server systems integrate and store diverse data types to provide accessible web applications for data analysis [15]. Furthermore, multidimensional data models organize and analyze complex data on production and markets to optimize business processes [16]. In e-commerce, AI-driven solutions personalize user experiences using transaction data [18]. AI also manages customer and employee information systems to automate processes, improve engagement, and enhance efficiency [17]. AI significantly enhances data security by actively monitoring network traffic, detecting anomalies, and identifying potential cyber threats [26]. Intelligent ERP platforms leverage AI to manage finances, supply chains, and human resources effectively [39].

3.2.7. Research and Development

AI advances R&D in SMEs by streamlining manufacturing, optimizing decision-making, and fostering innovation [14–16,31,33,42,49,50]. AI-driven tools enable businesses to assess and manage risks more effectively [14]. Decision-making is improved through data analysis and autonomous methodologies [15]. AI predicts market trends and customer behaviors to aid product development [16]. Advanced clustering techniques segment customers for better service delivery [32]. Machine learning models enhance the success of R&D projects by analyzing key factors [34]. Moreover, AI optimizes manufacturing parameters [42] and uses NLP to identify research partners and analyze patents [49,50].

3.2.8. Business Intelligence and Analytics

AI revolutionizes business intelligence and analytics in SMEs by boosting data processing capabilities, improving strategic insights, and optimizing performance [12–16,18,19,22,23,25–27,35,38,42,43,45,46]. AI integrates with IoT devices to collect real-time data to generate key performance indicators and optimize operations [12,15,19]. Recommender systems use machine learning and NLP to match lenders with borrowers [13], while frameworks like NetRisk employ advanced analytics to assess financial distress [14]. AI models predict customer behavior and product quality, enabling targeted marketing and improved manufacturing [22,23,27]. Furthermore, AI tools enhance cybersecurity, streamline supply chains, and provide actionable insights through data analytics and visualization [25,26,35,38,42,43,45,46].

3.3. Organizational Capabilities and Infrastructure (RQ3)

This subsection explores how SMEs can enhance organizational capabilities and infrastructure to successfully navigate the challenges associated with AI adoption. It emphasizes the important role of employee training, modern technological infrastructure, a strong data-driven culture, strategic partnerships, phased implementation strategies, and robust risk management. These strategies enable SMEs to integrate AI for improved efficiency and competitiveness.

3.3.1. Employee Training

Employee training and skill development are foundational to ensure staff have competencies in data analysis, machine learning, and AI tools [17,35]. Collaborations with universities and research institutions, along with leveraging technology providers and online platforms, can facilitate knowledge sharing and innovation [30,43]. Building internal data science expertise allows SMEs to tailor AI solutions to their specific needs [17,43].

3.3.2. Technological Infrastructure

A robust technological infrastructure is essential for AI initiatives. SMEs should strategically invest in necessary hardware, software, and cloud services to support AI deployment [51]. Cloud-based AI solutions and AI-as-a-Service platforms offer scalable and cost-effective options, which help SMEs overcome financial and technical barriers [19,43].

3.3.3. Data-Driven Culture

A data-driven culture is also important for successful AI integration that involves emphasizing data collection, management, protection, and processing to support decision-making [43]. Increasing awareness among SME leaders about the benefits of AI and machine learning can drive AI efforts, while historical data analysis aids in predictive modeling and identifying market opportunities [17,19,43,47].

3.3.4. Strategic Partnerships

Collaboration and strategic partnerships with AI technology vendors, consultants, academic institutions, and peer SMEs can help overcome AI-related challenges by providing access to expertise and best practices [30,50,51]. A phased and adaptive implementation approach allows SMEs to start with pilot projects, which minimize financial risks and enable gradual scaling [15,46]. Long-term success also hinges on the organization's ability to remain agile and responsive to evolving technologies and shifting market dynamics [8,17,22].

3.3.5. Risk Management

Risk management and compliance frameworks are vital for the responsible and ethical adoption of AI in SMEs. Businesses must proactively address data privacy, cybersecu-

rity, algorithmic fairness, and system transparency to establish and maintain stakeholder trust [35,56]. Choosing interpretable and auditable AI models, along with maintaining thorough documentation of AI development and deployment processes, is crucial for meeting regulatory requirements and mitigating legal and reputational risks [8,35].

3.3.6. AI-Driven Strategies

Prioritizing AI in strategic business functions such as marketing, supply chain, financial risk management, and customer service maximizes its impact. AI can enhance sales forecasting, streamline inventory management, personalize customer interactions, and optimize processes to drive operational efficiency and productivity [17,22,42,48]. For SMEs, aligning AI initiatives with broader business goals ensures sustainable growth and long-term performance gains.

3.4. Value Optimization (RQ4)

This subsection focuses on optimizing the value SMEs derive from AI adoption to maximize the overall value derived from resources, processes, or systems within an organization. It highlights strategies like tracking key performance indicators, implementing data collection frameworks, automating processes, enhancing customer satisfaction, and supporting strategic decision-making. These approaches help SMEs maximize AI's potential for efficiency, growth, and long-term competitive advantage.

3.4.1. Performance Indicators

Key performance indicators are essential for aligning AI initiatives with objectives such as cost reduction, operational efficiency, revenue growth, and customer satisfaction [42]. For example, in logistics, KPIs may include reductions in inventory costs and improved routing efficiency; in customer service, response time and satisfaction ratings are key metrics. In AI-driven applications like chatbots, usability scores, resolution times, and sentiment analysis help assess performance and guide future improvements [52].

3.4.2. Data Analysis

A well-structured data collection and analysis framework is essential for continuously monitoring and refining AI performance. Effective data collection mechanisms enable SMEs to capture real-time information on AI-driven processes and outcomes [17,43]. Utilizing data analytics tools helps identify trends, patterns, and areas for improvement to facilitate evidence-based decisions [8,43]. For instance, analyzing historical data offers insights into the long-term impact of AI, while comparative analyses ensure AI solutions outperform traditional methods [19,33]. Moreover, customer data analysis can support market expansion by uncovering new opportunities and unmet needs [48].

3.4.3. Process Optimization

AI enables process optimization by automating repetitive tasks, which increases efficiency and allows for the redeployment of resources toward innovation and strategic planning [17,36]. Identifying and addressing inefficiencies within workflows allows AI-driven solutions to boost performance [36,43]. Technologies like digital twins and predictive maintenance improve operational reliability and reduce downtime and costs [15]. Continuously adapting AI models based on real-time feedback ensures they remain effective and relevant [17].

3.4.4. Customer Satisfaction

Customer satisfaction is significantly enhanced through advanced AI technologies such as sentiment analysis and AI-powered chatbots. Sentiment analysis enables SMEs to

understand customer emotions and feedback, uncovering trends and improving decision-making. AI-powered chatbots provide 24/7 support, assess customer perceptions in real-time, personalize product or service recommendations, streamline issue resolution, and improve overall service efficiency [11]. By leveraging these tools, businesses can build stronger customer relationships, foster loyalty, and deliver tailored experiences that align with customer preferences and expectations [9,42].

3.4.5. Strategic Decision-Making

Strategic decision-making is significantly strengthened by AI-powered dashboards and predictive analytics, which provide real-time visibility, enable proactive planning, and support data-informed, timely decision-making [11,19]. Furthermore, AI enhances risk management and compliance by promoting ethical, secure, and transparent deployment practices, addressing issues such as data privacy, algorithmic bias, regulatory compliance, and explainability [35,56]. These capabilities collectively empower SMEs to make smarter, more reliable strategic choices while mitigating potential risks.

3.4.6. Culture of Innovation

Cultivating a culture of innovation is vital to fostering AI readiness and organizational adaptability. This involves encouraging creative thinking, openness to technological change, and a willingness to experiment with new ideas [11,17]. This culture not only facilitates smoother AI integration but also drives engagement and collaboration. Furthermore, continuous improvement through iterative learning, feedback loops, and process optimization ensures that SMEs remain competitive, responsive to market changes, and capable of achieving sustainable growth in the long term [11,23,36].

3.5. Summary of Key Insights

3.5.1. AI Technologies Commonly Adopted by SMEs

Table 2 presents a synthesis of AI technologies commonly adopted by SMEs, linking each to specific use cases and resulting benefits. Machine Learning (ML) and Deep Learning (DL) are prominently featured for their predictive capabilities, supporting applications such as credit risk assessment and quality prediction. Natural Language Processing (NLP) enhances customer service and document analysis through chatbots and sentiment analysis. Generative AI and Explainable AI offer creative content generation and transparency in decision-making, respectively, while RPA and Computer Vision streamline repetitive tasks and enable visual inspections. Overall, the table illustrates how diverse AI technologies collectively contribute to efficiency, trust, and innovation in SMEs.

Table 2. Summary of AI technologies and their benefits.

Technology	Use Case	Benefit
ML	Credit risk prediction [33]	More accurate prediction/assessment
	Product quality prediction [23]	Superior prediction precision
	R&D performance prediction [34]	Predict equipment failures
	Predictive maintenance [20]	Risk mitigation
	Game-theoretic financing models [40]	
DL	Credit risk assessment [8]	Superior prediction performance
	Manufacturing process control [36]	Accurate temp/humidity classification
	FinTech customization [17]	Enhanced customer trust
	Fake review detection [51,57]	Tailored financial solutions

Table 2. *Cont.*

Technology	Use Case	Benefit
NLP	Automating business processes [17] Customer service (Chatbots) [11,13,17,35,43,51,52] Extracting information from documents [17,49] Maintenance report analysis [50]	Text recognition, document classification 24/7 availability Gain feedback insights Identify recurrent issues/time savings
GAI	Streamlining work processes [37] Unleashing innovation [37] GenAI chatbot paradox resolution [28]	Leverage scalability and creativity Improve product offerings Improved brand response strategies
XAI	Credit analysis [56] Operational risks evaluation and Model validation [57]	Understand reasons behind decisions Evaluate risks of AI systems Trustworthy decision explanations
RPA	Hybrid workflow automation [55]	Balances automation and human oversight
CV	Visual fault detection [20] Autonomous forklifts (warehousing) [42] Portable CV systems for SMEs [47]	Ensure quality (manufacturing) Labor cost reduction Low-cost quality control

3.5.2. AI Applications by Business Function in SMEs

Table 3 provides a structured overview of how AI applications are mapped to specific business functions within SMEs, highlighting both the use cases and the resulting benefits. It illustrates the broad functional scope of AI, from customer service and dynamic pricing in sales and marketing, to fraud detection and financial forecasting in accounting. Operations benefit through automation and predictive maintenance, while HR, risk management, and R&D leverage AI for enhanced decision-making and innovation. This table reinforces the multifunctional potential of AI across enterprise domains and supports the study's core claim: that AI enables SMEs to enhance efficiency, competitiveness, and strategic agility.

Table 3. Summary of AI applications by business function in SMEs.

Technology	Use Case	Benefit
SM	Customer service (Chatbots) [52] Leverage customer data [51–53] Consumer behavior analysis [51–53] Dynamic pricing [35]	Enables 24/7 availability Tailor marketing strategies, gain insights Personalized advertising Cost optimization
OL	Automating business processes [17,55] Visual fault detection, inventory management [47] Quality prediction [20]	Predict equipment failures Improve productivity Sales forecasting, production optimization, resource management
FA	Creditworthiness/risk assessment [35,37,38,40,41] Financial crisis early warning [8] AI-powered FinTech models and machine learning [13,14,30]	Cash flow prediction, fraud detection Reduces loss Better credit underwriting, financial distress prediction
HR	Automate HR data transfer [55] AI-driven automation [42]	Enables automation Reduces work monotony, enhances job satisfaction and productivity
RC	Assess operational risks of AI systems [17,26,33,45,53,57] Detect fake reviews [57]	Evaluate risks, ensure trustworthiness Detect anomalies and protect against cyber threats

Table 3. *Cont.*

Technology	Use Case	Benefit
IS	Streamlining work processes [15–18,25,31,32,39] Multidimensional data models [16] Intelligent ERP platforms [39]	Leverage scalability and creativity Organize and analyze complex data Manage finances, supply chains, and human resources
RD	Predicting R&D performance [34] Unleashing innovation [37] AI-driven simulation tools [15]	Superior prediction precision Improve product offerings, decision-making Predicts market trends and customer behaviors
BIA	Customer data analysis [25,26] Predictive modeling [22,23,27] NetRisk framework [14]	Identify trends Minimize defect densities Assess financial distress

3.5.3. Key Capabilities for Successful AI Adoption in SMEs

Table 4 highlights the key organizational capabilities that support successful AI adoption in SMEs, addressing RQ3. It underscores the importance of workforce upskilling, technological readiness, and a strong data-driven culture to foster internal readiness for AI. Strategic partnerships with technology providers and academic institutions emerge as crucial enablers, especially for SMEs with limited in-house expertise. The table also points to the growing emphasis on risk management and explainability, particularly through the adoption of XAI frameworks. By developing these capabilities, SMEs can better navigate implementation challenges, align AI initiatives with business goals, and enhance their long-term innovation capacity.

Table 4. Key capabilities for successful AI adoption in SMEs.

Technology	Use Case	Current Trends
Employee Training	Upskilling employees for AI collaboration [8,50] Data analysis, machine learning, AI tools training [8,50] Building internal data science expertise [30,38]	Focus on upskilling workforce for AI access Collaboration with universities/research institutions, leveraging technology providers and online platforms Tailoring AI solutions to specific needs
Data-driven Culture	Gaining insights for decisions/improvement [43] Data collection, management, protection, and processing [49]	Growing adoption for performance/innovation Emphasizing data for decision-making
Strategic Partnerships	Leveraging third-party AI solutions [37] Collaboration with technology providers, consultants, and other SMEs [15,19]	Importance of external collaboration for AI Access to expertise and best practices
Risk Management	Assessing credit risk, mitigating risks [33] Data protection and security [25,56]	Increasing focus on XAI for transparency/trust Ensuring AI transparency and explainability
AI-driven Strategies	Automating processes, enhancing service [11] AI enhancements [22,24]	GenAI democratization, scalability/efficiency Maximizing AI impact in marketing, supply chain, financial risk management, and customer service

3.5.4. Value Optimization Strategies for AI in SMEs

Table 5 outlines key strategies for optimizing the value of AI adoption in SMEs, addressing RQ4. It emphasizes the role of performance indicators, such as KPIs and chatbot metrics, in monitoring operational and customer-related outcomes. Data analysis is high-

lighted as essential for generating actionable insights and guiding continuous improvement. Process optimization strategies, including automation and predictive maintenance, are shown to enhance efficiency and resource allocation. Additionally, AI tools improve customer satisfaction through personalization and 24/7 support, while supporting strategic decision-making with real-time insights. Finally, fostering a culture of innovation is vital for sustaining AI-driven transformation and long-term competitiveness.

Table 5. Value optimization strategies for AI in SMEs.

Technology	Use Case	Current Trends
Performance Indicators	Monitoring operational/cost KPIs [36] Reducing inventory holding costs [41,42] Assessing business risks [56]	AI-powered predictive analytics Inventory cost reductions, route efficiency Usability scores, customer sentiment analysis
Data Analysis	Extracting insights from data/text [10] Predicting customer intentions/fraud [17] Historical data analysis [19,33]	Big data analytics Insights into long-term impact of AI
Process Optimization	Automating repetitive tasks [48,55] Streamlining logistics/manufacturing [36,42] Improving operational efficiency [47] Identifying and address inefficiencies [36,43] Digital twins and predictive maintenance [15,34]	Enhance efficiency, reallocate resources ChatGPT for speed/accuracy Boost performance of AI-driven solutions Improve operational reliability and reduce costs
Customer Satisfaction	Providing 24/7 customer service, AI-powered chatbots [11,51,52] Personalizing customer interactions/ service [22,48,51]	24/7 support, assess customer perceptions, personalize recommendations, streamline issue resolution
Strategic Decision-making	Forecasting future events/outcomes [22,34] Optimizing pricing/revenue [34] Enhancing decision effectiveness [8,10,24,40,56] AI-powered dashboards and predictive analytics [11,17,19,23,43]	AI-powered pricing strategies Real-time insights, proactive planning, data-driven decisions Strengthen risk management and compliance
Culture of Innovation	Improving product offerings [37] Accelerating development processes [17] Fostering AI acceptance and readiness [11,17]	GenAI unleashing innovation/creativity Encouraging adaptability, creativity, and openness to new technologies

4. Conclusions

This paper presents a comprehensive systematic literature review on the adoption and application of artificial intelligence (AI) in small- and medium-sized enterprises (SMEs), focusing on key technologies, business applications, organizational capabilities and infrastructure, and value optimization. By examining 50 representative studies, the research highlights how AI-driven technologies are transforming multiple business functions across the SME landscape. The primary contribution of this paper lies in its broad and up-to-date coverage of recent AI advancements and their practical implications for SMEs, offering a relevant and timely perspective that advances prior research in this domain.

Our review highlights the increasing adoption of machine learning and natural language processing (NLP) within SMEs, particularly in the domains of operations and logistics and business intelligence and analytics. This aligns with previous research that emphasizes the potential of these technologies to automate processes and improve decision-making. However, our analysis also reveals a persistent challenge for SMEs: the limited availability of high-quality data required for effective machine learning implementation—an issue that is notably less significant in larger enterprises. This finding underscores the importance of developing tailored solutions to address data scarcity, such as collaborative data-sharing initiatives or the application of synthetic data generation techniques.

Concerning the originality, this review distinguishes itself from existing literature such as [2,3,58] through its extensive coverage of recent AI advancements and their specific applications in SMEs to ensure both completeness and relevance. The systematic categorization of AI technologies and their business functions provides a clear, structured framework that makes the findings accessible to both technical and non-technical stakeholders across disciplines. The incorporation of the latest studies ensures that the insights are up to date to provide a fresh perspective compared to earlier reviews. By bridging the gap between AI theory and practical implementation in SMEs, this paper stands out in its originality and utility for both academic and practitioner audiences.

The primary contribution of this study lies in its thorough classification and synthesis of AI technologies and their specific applications across different business domains in the context of SMEs. It provides valuable insights into how AI enhances business functions, and applications at the enterprise level. Additionally, this paper examines the key challenges SMEs encounter in adopting AI and presents strategic approaches to develop the necessary organizational capabilities and infrastructure to address these obstacles effectively. By offering insights into methods for measuring and optimizing the value derived from AI implementation, the study provides SMEs with practical guidance to enhance operational efficiency and achieve long-term growth.

For researchers, this study highlights the multifaceted role of AI in enhancing SME competitiveness and operational efficiency to suggest numerous avenues for future investigations into specialized AI applications and the development of tailored AI frameworks for SMEs. It underscores the need for empirical studies that validate the proposed strategies and explore AI integration across diverse industries. Practitioners and SME leaders can utilize the findings to inform strategic decision-making, prioritize AI investments, and implement best practices for AI integration. The identification of key challenges and proposed solutions serves as a practical guide for SMEs aiming to harness AI's potential while mitigating associated risks.

Despite its comprehensive approach, this study is constrained by its reliance on published literature up to 2025, which may exclude the most recent developments and real-time advancements in AI technologies. Furthermore, the focus on specific business functions may limit the generalizability of the findings across other industries.

While this review aimed to be comprehensive, it is possible that some relevant industry-specific or regionally focused studies may have been overlooked, particularly given the global diversity of SME operations. Future research should aim to broaden the scope to include a wider range of sectors to validate the proposed strategies. Moreover, exploring the long-term impacts of AI adoption on SME sustainability and growth would provide deeper insights. In addition, the particularities of AI adoption on SME can be analyzed through the lens of other studies, such as the Technology–Organization–Environment framework, Diffusion of Innovation theory, or User Acceptance Model [59]. Moreover, integrating knowledge management with AI empowers SMEs to utilize domain expertise and customer intelligence to enable tailored solutions, personalized experiences, improved customer satisfaction, and fostering innovation, adaptability, and sustainable growth for long-term success. Finally, studying smart systems and services is crucial for applying AI effectively in SMEs to bridge the gap between cutting-edge technology and practical solutions tailored to smaller organizations [60,61].

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Appendix A. PRISMA Flow Diagram

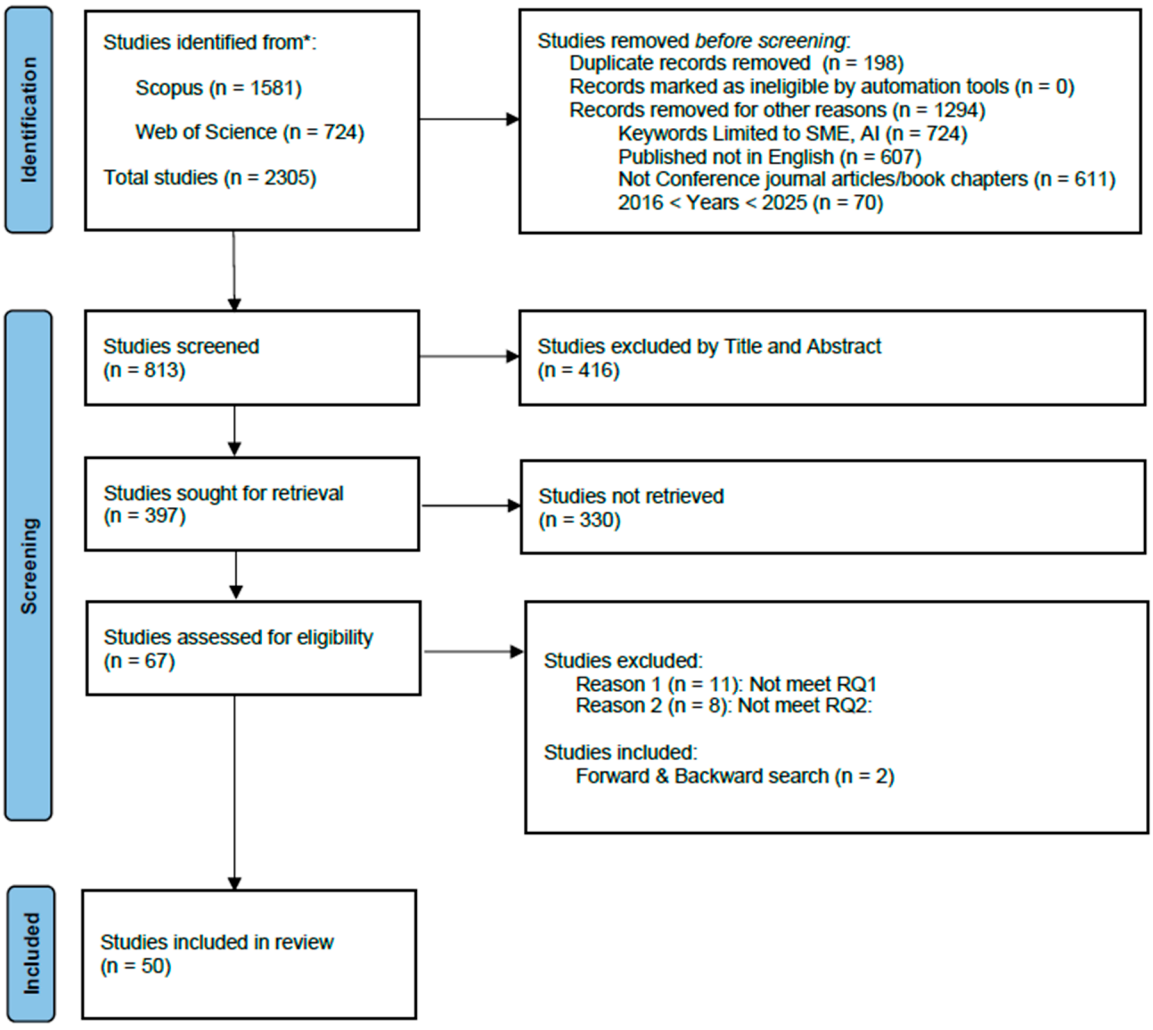

Figure A1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases. * Each study may be associated with more than one exclusion criterion.

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