

PRASHANT BARI
POORNIMA TAPAS

AI adoption in small and medium-sized e-commerce enterprise: current state and future research agenda

Abstract

Research background and purpose: Artificial intelligence (AI) is being increasingly used in digital commerce. It helps small and medium-sized enterprises (SMEs) improve efficiency, enhance customer engagement, and support data-based decisions. However, research on AI adoption in SME e-commerce is still in emerging stage. This study aims to synthesize existing work and identify key applications, drivers, and constraints.

Design/methodology/approach: The study uses a systematic literature review (SLR) based on the PRISMA framework. Relevant studies were identified, screened, verified, and included from major databases using PRISMA. A total of 92 peer-reviewed articles were selected and analysed using thematic analysis.

Findings: The findings show that SMEs have yet leveraged very limited capabilities of AI for business operations. Common applications include chatbots, recommendation systems, predictive analytics, and AI-enabled CRM tools. Key contributor to adoption is technological, organizational, and environmental factors. While AI offers benefits such as cost efficiency and improved decision-making, challenges such as limited infrastructure, skill gaps, and governance concerns persist.

Value added and limitations: The study aims to integrate diverse literature and presents in unified format in context of AI adoption in case of SMEs in e-commerce. Key theories such as TOE, Dynamic Capabilities, Diffusion of Innovation, and Resource Dependency Theory and their interrelation is discussed. Finally, research gap and scope for future research is presented.

Keywords: *artificial intelligence; SMEs; e-commerce; technology adoption; digital transformation*

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1. Introduction

The increasing integration of artificial intelligence (AI) within digital commerce environments has reshaped how firms automate processes, analyze large-scale data, and deliver personalized customer experiences. AI-enabled technologies, including machine learning, natural language processing, and deep learning, have facilitated the processing of large volumes of data, supported automated decision-making, and enhanced service personalization (Jöhnk et al., 2021). In e-commerce ecosystems, these capabilities influence how firms interact with customers, manage supply chains, and design digital strategies. Major platforms such as Amazon, Alibaba, and Shopify have integrated AI-enabled applications into their operations through recommendation systems, automated logistics, and predictive analytics, thereby enhancing operational efficiency and customer engagement (Kumar et al., 2024; Huang & Rust, 2021).

Large digital platforms have led the way in AI-enabled commerce, but small and medium-sized enterprises (SMEs) are adopting these technologies to strengthen their competitiveness and improve performance. SMEs make up a major share of global economic activity and play a vital role in jobs and development. Compared with large firms, however, they face challenges such as limited funds, weaker digital infrastructure, and less access to technical expertise (Del Giudice et al., 2021). As a result, AI adoption in SMEs is usually gradual and focused on specific operations rather than full organizational transformation.

Recent advancements in digital tools have lowered barriers to adoption. Cloud systems, AI as a service platform, and modular solutions allow SMEs to use AI with less upfront investment (Ransbotham et al., 2021; Gallastegui & Forradellas, 2024). Many now employ AI applications like chatbots, recommendation engines, predictive analytics, and CRM systems to improve customer engagement, efficiency, and data-driven decision-making (Wamba-Taguimdje et al., 2020). Still, research shows that access to technology is not enough. Organizational readiness, leadership commitment, and supportive external ecosystems remain key to the success of AI integration.

Previous studies have explored the adoption of artificial intelligence (AI) in small and medium-sized enterprises (SMEs) using different theoretical approaches, such as the Technology, Organization–Environment (TOE) framework, the Resource-Based View, and Dynamic Capabilities Theory (Tornatzky & Fleischer, 1990; Teece, 2007). These perspectives suggest that adopting new technologies is not influenced by a single factor, but rather by a combination of technological features, organizational strengths, and external environmental conditions. Research findings also show that factors like a strong digital culture, the ability to innovate, and supportive leadership play an important role in ensuring successful AI adoption (Wamba et al., 2017; Papadopoulos et al., 2020; Arroyabe et al., 2024).

However, with less growing interest in this area, the research on AI adoption in SMEs is still somewhat scattered and limited in scope. Many studies focus mainly on developed countries, while there is less attention given to developing or resource-constrained environments (Akpan et al., 2022). SMEs in emerging markets often deal with additional challenges, such as poor digital infrastructure, a lack of technical expertise, and uncertainty about the benefits or returns of investing in AI. In addition, concerns related to cybersecurity, data management, algorithmic bias, and trust in automated systems also affect decision-making (Chmielarz, 2024; Díaz-Rodríguez et al., 2023). These challenges indicate that a deeper and more complete understanding of AI adoption in SMEs is still needed.

To address these gaps, this study uses a systematic literature review to examine how SMEs involved in e-commerce are adopting AI. The review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to systematically identify, evaluate, and combine relevant studies from different fields (Moher et al., 2009; Page et al., 2021). The focus of the analysis is on identifying key applications of AI, understanding the main factors that encourage adoption, and examining the barriers that may hinder its implementation. By bringing together existing research, this study contributes to the field of digital transformation in SMEs by highlighting emerging trends in AI adoption and explaining the key opportunities as well as challenges. It also offers useful insights for researchers, business owners, and policymakers who aim to support the effective and responsible use of AI in e-commerce.

2. Literature review

2.1. AI applications in SME e-commerce contexts

Artificial intelligence is being used more widely across industries today. The extent to which companies adopt new technologies depends on their organizational size and their ability to use advanced technologies. Studies show that larger, technology-focused firms tend to rely more on AI in their operations. They use it for tasks such as dynamic pricing, automated logistics, and advanced customer analytics (Huang & Rust, 2021; Kumar et al., 2024). AI implementation in small and medium-sized enterprises (SMEs) occurs through restricted use of specific functions because organizations face resource and operational restrictions.

The technology adoption process in SMEs exists at the intersection of their available resources, their existing digital infrastructure, and their capacity to obtain technical knowledge. SMEs represent a substantial proportion of global businesses; however, they often operate with constrained financial resources, modest digital capabilities, and limited access to specialized skills. The existing structural conditions determine

both the extent of AI implementation and the speed of its implementation process. The modular AI systems that SMEs utilize, together with cloud-based AI applications, exist to meet their particular business requirements. Organizations commonly use chatbots to handle customer inquiries, while recommendation systems deliver tailored marketing solutions, and predictive analytics help companies project future product demand. The implementation process of third-party platform solutions becomes simpler because organizations can adopt these systems step by step (Gallastegui & Forradellas, 2024).

The research shows that AI adoption patterns among SMEs differ based on their specific circumstances. The organizations choose to use single AI solutions instead of adopting complete digital transformation initiatives. The short-term operational requirements, together with competitive market demands, drive organizations to adopt AI technologies instead of using long-term strategic planning. The established pattern leads to two results because organizations break their AI projects into separate components, which they sometimes stop altogether (Faiz et al., 2024; Ransbotham et al., 2021).

Previous research investigated the benefits that SMEs can obtain through AI implementation. For instance, Kumar et al. (2024) proposed a framework that shows how AI-powered applications, including predictive analytics chatbots and recommendation systems, help businesses improve their customer engagement and marketing performance. The study by Ritala et al. (2024) explains that industrial SMEs adopt AI technologies through their ongoing capability development process, which uses learning from previous experiences. The study results show that organizations achieve successful implementation through their organizational learning processes and innovation capabilities, and their leadership backing (Faiz et al., 2024).

The existing constraints create obstacles that prevent the successful adoption of solutions. AI systems require extensive data sets for their algorithmic systems, yet security and governance issues create major obstacles because their internal operations remain hidden from view. The absence of IT resources makes it challenging for SMEs to protect their systems against cyber threats while maintaining proper data management practices (Chmielarz, 2024; Díaz-Rodríguez et al., 2023). The availability of AI-as-a-service platforms, together with supportive governmental policies have helped to decrease multiple obstacles that existed before.

The existing research indicates that SMEs adopt AI technology through a slow process, which depends on specific circumstances and their internal strengths and outside technological environment. Organizations make adoption decisions based on their technological resources, their preparedness for implementation, their dedication from leadership, and their availability of outside assistance.

2.2. heoretical perspectives on AI adoption in SMEs

Theoretical foundations of AI adoption in SMEs, the research about artificial intelligence adoption in small and medium-sized enterprises has utilized different theoretical frameworks to show how organizations adopt new digital technologies. The existing literature about AI adoption shows that multiple factors drive the adoption process, which includes both technological, organizational, and environmental elements. Theoretical perspectives about AI adoption research include the Technology Organization Environment (TOE) framework, Dynamic Capabilities Theory (DCT), Diffusion of Innovation (DOI), and Resource Dependency Theory (RDT) as major theoretical frameworks.

The TOE framework enables researchers to study technology adoption because it shows how technological systems, organizational structures, and environmental factors work together to create adoption patterns (Tornatzky & Fleischer, 1990). The technological aspects of a system include compatibility and complexity, while organizational aspects include leadership support and resource availability, and environmental aspects contain regulatory requirements and market competition (Baker, 2012; Oliveira & Martins, 2011). The TOE framework has been extensively used in SME research studies because it shows how both internal and external factors affect technology adoption in organizations.

Building on this perspective, Dynamic Capabilities Theory explains how firms develop their capacity to adapt and resource integration and reconfiguration activities during periods of technological change (Teece, 2007). DCT explains that organizations need particular capabilities, which include learning and innovation and strategic flexibility, to achieve successful AI implementation. The research shows that SMEs that possess advanced innovation capabilities and create learning-focused environments will successfully adopt and use AI technology in their business operations (Arroyabe et al., 2024; Wamba et al., 2017).

The Diffusion of Innovation theory offers a complementary perspective by focusing on how innovations are perceived and adopted within organizations (Rogers, 1962). DOI introduces fundamental characteristics, which include relative advantage, complexity, and compatibility, which together determine the process of adoption. Managers in SMEs need to assess both the usefulness and the operational simplicity of a product before they decide to implement it (Faiz et al., 2024). This approach helps organizations adopt frameworks more effectively by explaining how decision-makers' thinking affects the choices they make.

Resource Dependency Theory provides additional analysis through its demonstration of how organizational decisions depend on both external relationships and institutional environments (Pfeffer & Salancik, 2015). The digital resources and capabilities that SMEs need to operate their businesses can be obtained through their partnerships

with external organizations, their use of technology vendors, and their access to policy support mechanisms. The research studies indicate that organizations that engage in partnerships with digital platforms and innovation networks experience better results in artificial intelligence implementation because these partnerships help organizations overcome resource limitations and facilitate their access to essential knowledge (Papadopoulos et al., 2020; Arroyabe et al., 2024).

The literature has applied additional theoretical frameworks, which include the Technology Acceptance Model (TAM), Knowledge-Based View (KBV), Institutional Theory, and Sociotechnical Systems Theory. The frameworks provide different insights that help understand how users accept technology, how organizations combine knowledge, how institutional forces affect their operations, and how technological systems combine with social systems.

The theoretical perspectives of this research study, through their connections between technological characteristics and organizational capabilities, managerial attitudes, and external ecosystem conditions, create a complete understanding of AI adoption. The study combines multiple frameworks to demonstrate how small and medium-sized enterprises implement artificial intelligence technologies in their digital business operations.

Table 1 provides an integrated overview of the principal theoretical frameworks applicable to AI adoption in SMEs. The table outlines key concepts, explains their significance, and illustrates notable applications from both classical works and contemporary studies. The table presents key concepts, outlines their relevance, and provides examples from both classical sources and recent research.

Table 1. Key theoretical frameworks informing AI adoption in SMEs

Framework	Core concept	Relevance to SMEs	Key references
TOE (Tornatzky & Fleischer, 1990)	Adoption shaped by technological, organizational, and environmental factors	Integrates internal readiness and external pressures	Faiz et al. (2024); Oliveira & Martins (2011); Webster & Gardner (2019)
DCT (Teece et al., 1997)	Firms develop capabilities to adapt and reconfigure resources	Explains learning and agility in AI adoption	Arroyabe et al. (2024); Wamba et al. (2017); Ritala et al. (2024)
DOI (Rogers, 1962)	Adoption driven by perceived innovation attributes	Explains perceived usefulness and complexity	Faiz et al. (2024)
RDT (Pfeffer & Salancik, 2015)	Firms depend on external resources and networks	Critical for SMEs with limited internal capabilities	Papadopoulos et al. (2020); Arroyabe et al. (2024)

TAM/UTAUT	Behavioral intention shaped by usefulness and ease of use	Relevant for employee-level adoption	Venkatesh et al. (2003); Jeyaraj et al. (2006)
Institutional Theory	Adoption influenced by institutional pressures	Explains regulatory and competitive pressures	Akpan et al. (2022)
FASECO	SME-focused AI transformation model	Practical roadmap for e-commerce SMEs	Gallastegui & Forradellas (2024)
KBV	Knowledge as strategic resource	AI enhances knowledge utilization	Del Giudice et al. (2021)
Sociotechnical Theory	Interaction of social and technical systems	Explains trust and resistance	Díaz-Rodríguez et al. (2023)

Source: own study

2.3. Research gaps and emerging directions

The research field has established numerous studies about AI implementation in small and medium-sized enterprises, yet three key research areas remain unaddressed. The current research indicates that organizations need both internal resources and external market forces for AI implementation, but researchers have not yet determined which element has a greater impact on the implementation process.

Organizations adopt artificial intelligence technology because their business needs require the development of their internal resources. The Technology–Organization–Environment model, together with the Resource Dependency Theory model, establishes basic frameworks that demonstrate how environmental factors like regulatory support, competitive dynamics, and technology vendor ecosystems impact organizational outcomes. Recent research demonstrates that organizations develop their adoption results through their internal elements, which include their leadership dedication, digital competence, and ability to innovate (Arroyabe et al., 2024; Faiz et al., 2024). The two viewpoints deliver useful information, but researchers have not established complete evidence for their study in small and medium-sized enterprise environments.

The second gap studies how AI technologies help or hinder the operational limits that small and medium-sized enterprises experience. The development of cloud-based systems together with AI-as-a-service platforms has decreased particular entry restrictions, which now allow more people to use AI-powered software systems. Research shows that most SMEs in developing countries, which lack resources, face ongoing problems, which include their unavailability of digital systems, a lack of skilled workers, and confusion about investment returns (Gallastegui & Forradellas, 2024). The research indicates that

organizations need technology access to develop their operational capabilities because organizations need to develop processes that enable them to use technological resources for ongoing technology implementation.

The field of research shows different methodological problems that limit the current research about how organizations adopt artificial intelligence technologies. Existing research studies use cross-sectional survey designs or small qualitative methods, which restrict their ability to show how adoption progresses through different periods of time. The research field needs to study AI adoption as a process that involves organizations moving from testing to full system implementation. Research studies that use longitudinal and mixed-method approaches provide a better understanding of how organizations develop capabilities and learn about their learning processes, according to (Tornatzky & Fleischer, 1990; Teece, 2007).

Research on small and medium enterprises needs a better assessment of ethical and governance factors. AI technologies have become common tools for making pricing decisions, detecting fraud, and creating customer profiles, which increases problems with transparency and accountability and algorithmic bias. Only a small amount of empirical evidence exists to show how SMEs handle these challenges, which has been reported by Díaz-Rodríguez et al. (2023). The particular gap exists in e-commerce environments because businesses depend on data-based decision-making for their operational processes.

The existing gaps in knowledge demonstrate that researchers need to establish a unified approach that considers specific contextual factors when studying AI adoption in small and medium enterprises. The study combines existing research to identify factors that drive AI adoption and create obstacles for its implementation in e-commerce small and medium enterprises, while explaining how different factors affect adoption results.

3. Research methods

This study uses a systematic literature review to explore how artificial intelligence is being adopted by small and medium-sized enterprises in the e-commerce sector. A systematic review offers a clear and organized way to collect, examine, and combine findings from existing research. It is commonly used in fields such as management and information systems to bring together scattered knowledge and present it in a meaningful way (Denyer & Tranfield, 2009; Snyder, 2019). Since research on AI adoption in SMEs is spread across different areas like information systems, entrepreneurship, and digital innovation, using an SLR helps in connecting ideas from various studies while also minimizing bias in the selection process.

To maintain accuracy and transparency, this study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses framework (Moher

et al., 2009; Page et al., 2021). This framework provides a step-by-step method for identifying, screening, and selecting relevant research studies. It is widely used in interdisciplinary research where information is available across different fields (Kitchenham & Charters, 2007). By following a structured review process, the study becomes easier to replicate, and the findings become more dependable (Tranfield et al., 2003; Durach et al., 2017).

3.1. PRISMA-based literature selection process

The literature selection process follows the PRISMA framework, consisting of four sequential stages: identification, screening, eligibility, and inclusion.

Relevant studies were identified through a structured search across several well-known academic databases, such as Scopus, Web of Science, ScienceDirect, Emerald Insight, SpringerLink, IEEE Xplore, and Google Scholar. To ensure a thorough search, Boolean keywords were used by combining terms related to artificial intelligence (for example, “AI,” “machine learning,” and “natural language processing”), SMEs (such as “small and medium enterprises” and “microbusiness”), and digital commerce (including “e-commerce” and “online retail”). The search process was refined step by step to capture as much relevant literature as possible. As a result, the initial search produced a total of 304 records. The study selection process adopted for the systematic literature review was conducted following the PRISMA guidelines and is illustrated in Figure 1.

Following the removal of duplicate records, titles and abstracts were screened to exclude studies not directly related to AI adoption, SME contexts, or digital commerce. To maintain research quality, non-peer-reviewed materials, including conference papers, reports, and non-English publications, were excluded (Paul et al., 2015). After this stage, 202 studies were retained for further evaluation.

In the next step, the full texts of the selected articles were carefully evaluated using predefined inclusion and exclusion criteria. Studies were included if they were published in peer-reviewed journals between 2010 and 2024, focused on AI adoption or its applications in SMEs, and were relevant to e-commerce or digital commerce contexts. On the other hand, studies that focused only on large organizations, public sector strategies, or those that mentioned AI only briefly without a detailed analysis were excluded. This approach follows standard guidelines for conducting systematic literature reviews (Kitchenham & Charters, 2007).

The final set of studies was selected based on their methodological quality results, theoretical relevance, and direct contribution to understanding AI adoption in SMEs. After a detailed evaluation it was observed that 83 peer-reviewed articles met all the inclusion criteria and were included in the final analysis. These studies come from well-established journals in the fields of entrepreneurship, innovation, and information systems.

Identification

Screening

Eligibility

Inclusion

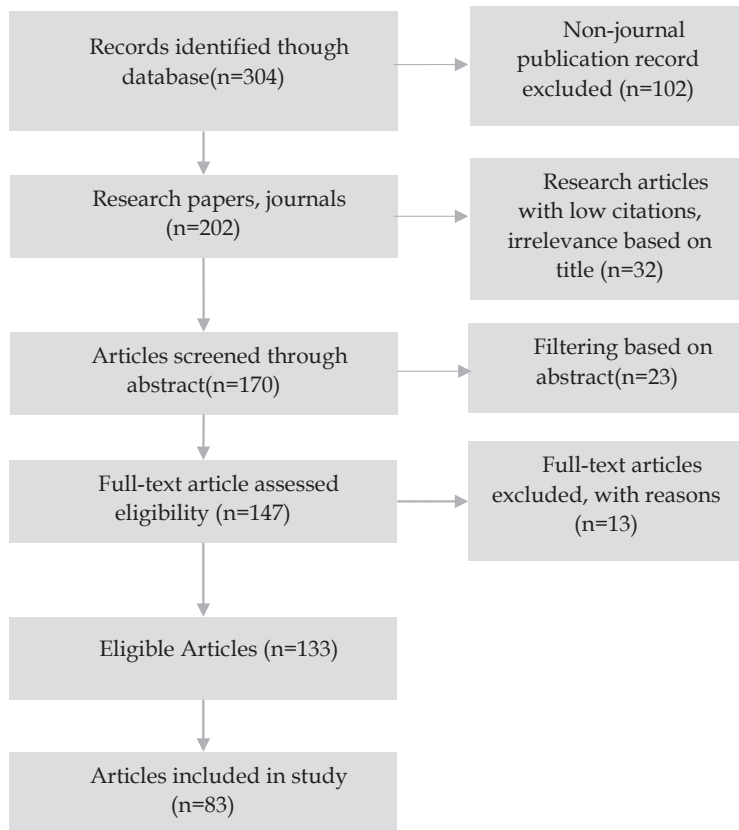


Figure 1. **PRISMA flow diagram of study selection process**

Source: own study

To analyze and combine the selected studies, a thematic analysis approach was used, following the six-step framework developed by Braun and Clarke (2006). This method allowed for a systematic identification and coding of important themes, such as AI applications, factors influencing adoption, organizational capabilities, and the challenges faced by SMEs. The coding process was conducted by using Microsoft Excel, which helped in organizing the data, identifying recurring patterns, and creating the summary tables presented in the findings section.

4. Findings

The reviewed literature reveals a growing body of research examining how artificial intelligence is adopted and applied by small and medium-sized enterprises in e-commerce environments. Across the selected studies, AI technologies are primarily used to enhance operational efficiency, improve customer engagement, and support data-driven decision-making. Common applications include chatbots, natural language processing (NLP), predictive analytics, AI-enabled customer relationship management (CRM) systems, and emerging technologies such as generative AI and AI-integrated Internet of Things (IoT) tools. While these technologies offer significant opportunities for SMEs, the literature also highlights persistent challenges related to digital capabilities, resource constraints, and governance issues.

Table 2 summarizes the studies included in the review, highlighting their geographic context, methodological approach, and AI technologies examined.

Table 2. Overview of reviewed studies on AI adoption in SMEs

Study	Region	SME context	Method	AI focus	Key insight
Kumar et al. (2024)	Global	E-commerce	Conceptual	NLP, Chatbots	Enhances engagement and personalization
Arroyabe et al. (2024)	Europe	Multi-sector	Survey	AI platforms	Capabilities drive adoption
Faiz et al. (2024)	Indonesia	SMEs	Mixed	Digital tools	Leadership + culture critical
Chmielarz (2024)	Poland	Digital SMEs	Thematic	Cybersecurity	Dual risk-benefit nature
Gallastegui & Forradellas (2024)	Spain	E-commerce	Conceptual	NLP, CRM	FASECO model
Ritala et al. (2024)	Finland	Industrial SMEs	Qualitative	AI capability	Learning-driven adoption
Zirar et al. (2023)	Global	Cross-sector	SLR	ML, Robotics	Human-AI collaboration
Knayer & Kryvinska (2023)	US/Germany	Energy SMEs	Review	Big Data AI	Implementation challenges
Wei & Pardo (2022)	EU/China	B2B SMEs	Survey	SaaS AI	External support key

Ranjan et al. (2023)	India	SMEs	Qualitative	GenAI	Policy importance
Hansen & Bøgh (2021)	Denmark	Manufacturing	Survey	IoT+AI	Modular adoption needed

Source: own study

Most of the reviewed studies were published after 2020, reflecting the increasing scholarly attention to AI adoption following rapid digitalization in global markets. A substantial portion of the research originates from Europe, with additional contributions from Asia and emerging economies. Methodologically, the studies employ diverse approaches – including systematic reviews, surveys, case studies, and qualitative interviews – providing complementary insights into AI adoption across different SME sectors.

4.1. AI applications in SME e-commerce

The literature identifies several functional domains where AI technologies are actively used by SMEs engaged in e-commerce. These applications are largely oriented toward improving customer experience, automating routine operations, and enabling data-driven decision-making.

One of the most widely adopted applications is personalization and recommendation systems. Machine learning algorithms analyze browsing patterns and purchase histories to deliver personalized product suggestions and targeted marketing content (Kumar et al., 2024; Arora et al., 2023). Such systems help SMEs improve customer engagement and increase conversion rates in online marketplaces. Another prominent application involves automated customer service through chatbots and conversational AI systems. These tools enable SMEs to provide continuous customer support while reducing service costs and response times. Chatbot technologies are often integrated into cloud-based CRM platforms, making them accessible even for firms with limited technical infrastructure (Han et al., 2023; Faiz et al., 2024).

AI is also increasingly used to support fraud detection, inventory management, and logistics optimization. Predictive analytics and anomaly detection models allow firms to identify suspicious transactions and manage operational risks more effectively (Chmielarz, 2024). Similarly, demand forecasting tools help SMEs optimize inventory levels and improve supply chain responsiveness (Ritala et al., 2024). More advanced applications are emerging in areas such as product development and innovation. Generative AI systems can assist firms in analyzing customer feedback, generating product design ideas, and accelerating product development cycles (Cooper & Brem,

2024). However, these applications remain less common among SMEs because they require greater technical capabilities and data resources.

A consolidated overview of AI applications and their associated business functions is presented in Table 3.

Table 3. AI applications and business functions in SME e-commerce

Application Area	AI tools	Key benefits	Supporting studies
Personalization	ML, Recommender Systems	Higher engagement, conversion	Kumar et al. (2024); Arora et al. (2023)
Chatbots	NLP, Conversational AI	Cost reduction, 24/7 support	Han et al. (2023); Faiz et al. (2024)
Cybersecurity	ML, Anomaly Detection	Risk mitigation	Chmielarz (2024)
Inventory	Predictive Analytics, IoT	Efficiency, forecasting	Ritala et al. (2024)
CRM	AI-CRM, NLP	Sales optimization	Ozay et al. (2024)

Source: own study

Overall, the evidence suggests that SMEs tend to prioritize AI tools that deliver immediate operational benefits. Foundational applications such as chatbots, CRM analytics, and recommendation systems dominate current adoption patterns, while more advanced AI capabilities are still emerging.

4.2. Strategic and operational opportunities of AI adoption

The literature consistently highlights several strategic and operational benefits associated with AI adoption in SMEs (Arroyabe et al., 2024; Kumar et al., 2024). Among these, operational efficiency improvements are most frequently reported. AI-enabled automation reduces manual workloads and enables firms to streamline internal processes. Empirical studies of European SMEs show that AI-driven digital platforms significantly improve productivity when supported by strong innovation capabilities (Arroyabe et al., 2024). AI adoption also contributes to cost optimization. Cloud-based AI tools allow SMEs to automate repetitive tasks and reduce dependence on large in-house IT infrastructures. Predictive marketing tools and AI-enabled CRM systems further reduce customer acquisition costs by enabling targeted marketing campaigns and more precise customer segmentation (Faiz et al., 2024; Pelletier & Cloutier, 2019).

Another major advantage involves enhanced decision-making capabilities. AI systems enable firms to analyze large volumes of customer and operational data, supporting more accurate forecasting and strategic planning. Predictive analytics tools help SMEs understand purchasing behavior, anticipate market trends, and respond more effectively to changing demand patterns (Jordan & Mitchell, 2015; Ghobakhloo & Ching, 2019). AI also supports scalable digital growth. Cloud-based platforms and modular AI services allow SMEs to expand their technological capabilities incrementally without substantial capital investment. This flexibility enables firms to adopt AI gradually as their digital maturity increases (Gallastegui & Forradellas, 2024; Wei & Pardo, 2022).

Taken together, these findings suggest that AI adoption can strengthen SME competitiveness by improving operational efficiency, enabling data-driven decision-making, and supporting scalable digital transformation.

4.3. Barriers and constraints to AI adoption

The literature shows that organizations face multiple ongoing challenges that hinder their ability to adopt artificial intelligence technologies in their small and medium-sized enterprises. The most common problem that organizations encounter involves their inability to access high-quality data. Most small and medium-sized enterprises around the world lack organized data systems needed to create machine learning models that produce trustworthy outcomes (Joshi et al., 2025; Gallastegui & Forradellas, 2024).

The financial limitations continue to function as an essential obstacle. The entry expenses for cloud-based solutions have decreased according to market trends, yet small and medium-sized enterprises still view artificial intelligence technologies, infrastructure improvements, and consulting services as major financial commitments (Faiz et al., 2024; Kumar et al., 2024). In addition, shortages of AI-related technical expertise limit the ability of SMEs to implement and maintain advanced systems. Empirical evidence indicates that a lack of skills in data science and system integration remains a critical constraint (Arroyabe et al., 2024; Díaz-Rodríguez et al., 2023).

Infrastructure restrictions create challenges for the implementation of adoption processes. AI technology implementation in traditional industries will face obstacles because of existing legacy IT systems and a lack of digital infrastructure, which exists in areas with low digital development (Chmielarz, 2024).

The governance-related problems have a significant effect on. Issues related to cybersecurity, data privacy, transparency, and algorithmic accountability may discourage SMEs from adopting AI systems, particularly when decision-making processes are not easily interpretable (Díaz-Rodríguez et al., 2023). Overall, the findings indicate that AI adoption in SMEs is constrained not only by technological

factors but also by organizational capabilities, resource limitations, and governance considerations.

4.4. Organizational and environmental drivers

The literature identifies several internal and external drivers that influence AI adoption in SMEs. These drivers follow established theoretical frameworks, which include the Technology-Organization-Environment model, Diffusion of Innovation, and Resource Dependency Theory.

The internal element that most influences adoption decisions stands as top management support. The commitment from leadership establishes resource distribution procedures while it backs strategic decision processes and promotes organizations to test new technological developments (Faiz et al., 2024; Arroyabe et al., 2024). Research evidence shows that when managers provide support to their staff members, they will be more likely to adopt new digital technologies that are used in SMEs (Faiz et al., 2024).

The main factors that determine organizational capabilities are digital readiness and innovation capacity (Teece et al., 1997; Rialti et al., 2020). The research shows that SMEs that have better digital infrastructure and an innovation-driven workplace environment will succeed in implementing AI technology for their business operations (Arroyabe et al., 2024).

The outcomes of technology adoption are influenced by external factors that exist in the surrounding ecosystem (Gallastegui & Forradellas, 2024). Through partnerships with technology vendors, digital platforms, and innovation networks, SMEs can obtain access to expert knowledge and essential infrastructure that their internal resources cannot provide (Gallastegui & Forradellas, 2024). Companies face two main forces that drive them to adopt AI technology: market competition and changing customer needs, which lead them to use AI for personalized marketing and digital advertising (Wamba et al. 2017; Chauhan et al., 2023; Kumar et al. 2024).

Government support mechanisms function as adoption drivers since they establish better digital networks and deliver both financial resources and institutional assistance to organizations (Papadopoulos et al., 2020). The existing literature shows that organizations achieve maximum results from interventions when they combine them with their essential internal capabilities.

5. Discussion

The results of this systematic review offer useful insights into the dynamic nature of the role of artificial intelligence in small and medium-sized enterprises operating in an electronic commerce environment. Overall results of this systematic review indicate

that the driving factor for the adoption of AI technology in SMEs is mainly to enhance efficiency, customer relationship building, and decision-making. The results of this systematic review indicate that the overall adoption of AI technology in SMEs is restricted to a particular aspect of functioning, which can be attributed to the inherent nature of SMEs, as it is characterized by structural limitations and technological capabilities.

These findings extend existing literature by highlighting that AI adoption in SMEs is not solely determined by technological availability but is shaped by the interaction between organizational capabilities and external ecosystem conditions. In line with prior research, the results suggest that SMEs with stronger digital capabilities, leadership commitment, and access to external partnerships are better positioned to integrate AI technologies effectively. This indicates that AI adoption reflects a capability-driven process rather than a purely technology-driven phenomenon.

From a theoretical point of view, the results confirm the relevance of existing technology adoption models, although they also imply the relevance of an integrative approach. The Technology, Organization, Environment framework has been one of the most popular models of understanding the adoption of AI, as it considers the relationship between technology, organization, and environment, which influence technology adoption (Tornatzky & Fleischer, 1990). The results support the relevance of technology, organization, and environment in influencing AI adoption in SMEs.

The results also expand the generalization of the TOE framework by incorporating other relevant theory streams. In this case, the Dynamic Capabilities Theory offers an appropriate theory to explain the adaptive responses of SMEs to the changing technology environment. The study established that the success of AI adoption lies in the ability of the firm to develop learning capabilities, resource reconfiguration, and technology integration into existing processes, as Teece (2007) noted. Therefore, there is a need to develop organizational capability as a fundamental factor in AI adoption.

In addition, the Diffusion of Innovation theory contributes to understanding how managerial perceptions influence adoption decisions. The results suggest that perceived usefulness, compatibility, and ease of use are factors that influence SMEs' willingness to experiment with AI technologies (Rogers, 1962). This implies that cognitive and perceptual factors may be equally important as structural and organizational factors.

Resource Dependency Theory is another theoretical framework that may complement the aforementioned views by emphasizing the importance of external networks and institutional support in facilitating AI adoption (Pfeffer & Salancik, 2015). This is because the findings indicate that SMEs rely on partnerships and collaborations with other organizations in accessing the required resources in implementing AI technologies.

Overall, these findings indicate that the use of AI in SMEs may be best understood by an integrated theoretical framework, which comprises its technological, organizational, cognitive, and environmental dimensions. The contribution of this study to the literature is its integrative perspective in understanding the mechanisms of AI adoption in SMEs.

The results also have several important implications for SME managers and policy makers. One of the most important insights is that the payoffs from AI adoption are not achieved through technology acquisition, but through the concurrent development of complementary organizational capabilities. SMEs that build capabilities in terms of digital skills, innovation, and organizational learning are more likely to achieve successful implementation outcomes (Gallastegui & Forradellas, 2024).

The importance of leadership commitment to AI adoption in SMEs is a critical finding of this study. The results indicate that managers' support for AI adoption influences the allocation of resources, business strategies, and the propensity to experiment with new technologies. Managers who support digital transformation initiatives create an organizational context that enables learning and innovation.

Additionally, collaboration with external partners has been identified as a key enabler for AI adoption (Zahoor et al., 2023). This is because SMEs can partner with external providers of technology and expertise, which may be difficult for them to develop in-house. This, therefore, eases the barriers for AI adoption, which in turn increases the effectiveness of knowledge transfer.

Overall, the policy implications of the findings suggest that it is critical for governments and other relevant actors to put in place comprehensive measures for SMEs. This is in the understanding that, for SMEs, even if the necessary funding is provided, it may not be enough for the adoption of AI, as SMEs may lack the necessary digital infrastructure and capabilities (Faiz et al., 2024).

Lastly, the aspect of governance is also becoming a critical factor for consideration as a result of the use of AI. The factors relating to cybersecurity, data privacy, and transparency of algorithms, among others, affect the level of trust of organizations regarding AI, which might affect the use of AI. This calls for the formulation of a suitable framework of regulation (Shemi & Procter, 2018; Kumar et al., 2024).

6. Conclusion

This study brings together existing research on how artificial intelligence is being adopted by small and medium-sized enterprises in e-commerce settings. Using a systematic literature review based on the PRISMA framework, the study combines current findings related to AI applications, factors influencing adoption, and the challenges faced during implementation. The result indicates that SMEs mainly use AI in specific areas, i.e., chatbots, recommendation systems, predictive analytics, and AI-based customer

relationship management tools. These technologies help to improve efficiency, enhance customer interaction, and support better data-driven decision-making.

At the same time, the results show that AI adoption in SMEs is uneven and context-dependent. Persistent constraint including limited financial resources, shortages of digital skills, and challenges related to data governance and cybersecurity, continue to influence adoption outcomes. These findings highlight effective AI adoption depends not only on technological availability but also on the development of organizational capabilities and a supportive external system. From a theoretical point of view, that study contributes by combining different frameworks, including the Technology–Organization–Environment framework, Dynamic Capabilities Theory, Diffusion of Innovation, and Resource Dependency Theory. Bringing these perspectives together offers a broader understanding of AI adoption, showing how technological factors, organizational strengths, managerial thinking, and external conditions are all interconnected. Overall, that study highlights that AI adoption in SMEs is a complex process that depends on multiple factors and the ability of organizations to adapt and grow.

From a practical point of view, the research gives insights to SME managers and policymakers. The results suggest that successful AI adoption requires investment in digital skills, leadership commitment, and collaboration with external partners. In addition, policy interventions that combine financial support with infrastructure development and capacity-building initiatives are likely to be more effective in promoting AI adoption among SMEs. Despite all these contributions, the study has certain limitations. The analysis is based on existing literature, and it reflects the scope and methodological approaches of prior studies. As a result, findings should be interpreted within the context of the reviewed studies. Future research may extend this work by examining emerging AI technologies, exploring diverse geographic and sectoral contexts, and employing longitudinal and mixed-method research designs. Overall, this study improves our understanding of how SMEs adopt artificial intelligence by bringing together existing research and highlighting the key factors that influence the adoption process. As AI technologies continue to develop, further research will be important to explore how SMEs can use these tools effectively and responsibly in fast-changing digital environments.

While research on the adoption of artificial intelligence (AI) in small and medium-sized enterprises (SMEs) has increased manifold in recent times, some critical research areas need to be explored, which will help to improve the understanding of the subject from a theoretical point of view, along with providing a specific context to the subject of SMEs' digitalization.

Firstly, research on new AI technologies and their implications for SMEs: While the current research has focused on established AI technologies, which are already being implemented in SMEs, research in the future may be directed towards

exploring the implications of new AI technologies, which are being developed, for SMEs. For example, generative AI, which was recently introduced, has already started to influence business environments, but its implications for SMEs have not been explored in research.

Another promising area of research relates to geographic and sectoral diversity. The current body of research has a strong focus on developed countries, while little research has been conducted in developing countries (Shemi & Procter, 2018; Akpan et al., 2022). As a result of the diverse environments, research should be conducted to explore the AI adoption process in different geographic environments. Furthermore, research in less represented sectors, such as the agricultural industry, creative industries, and platform-based services, would provide a broader understanding of the influence of industry characteristics on the AI adoption process.

Another area where future research is needed is the advancement of the methodology. It has been found that a considerable amount of existing research is based on cross-sectional designs, which offer a limited perspective on the dynamic nature of AI adoption. Longitudinal research design could offer a more in-depth understanding of the process by which SMEs transform from initial exploration to long-term integration and capability development. Furthermore, mixed-method approaches that combine quantitative analysis with qualitative case studies may provide richer insights into organizational processes, decision-making mechanisms, and contextual influences.

Lastly, there is a need for a greater focus in future research on the ethical and governance implications of AI adoption in SMEs. This is due to the fact that, as AI technologies become even more embedded in areas such as customer profiling, pricing models, and recruitment strategies, the ethical and fairness implications of AI adoption in these areas become even more pertinent (Díaz-Rodríguez et al., 2023). Although there is limited research in this area, future research may wish to examine the ways in which SMEs address these challenges and contribute to the development of a more nuanced understanding of AI adoption in SMEs.

Overall, prior studies employ diverse methodologies, including surveys, case studies, mixed-method approaches, and systematic reviews, each with limitations related to generalizability, sectoral scope, or sample size (Faiz et al., 2024; Arroyabe et al., 2024; Díaz-Rodríguez et al., 2023).

Authors' contribution

P.B.: article conception, theoretical content of the article, research methods applied, conducting the research, data collection, analysis and interpretation of results, draft manuscript preparation. **P.T.:** research methods applied, draft manuscript preparation.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author used ChatGPT (OpenAI) to assist in language refinement, structuring of sections, and formatting of tables and references. The author carefully reviewed, edited, and validated all outputs to ensure accuracy, originality, and alignment with the research objectives. The author takes full responsibility for the content of this publication.

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