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Role of Generative AI in Small and Medium Enterprises: Opportunities & Challenges

Komal Amre,
Khyati Gandhi,
Shriya Mhatre,
Nandini Vyas
Chetana's Institute of Management and Research

Abstract

Small and Medium Enterprises (SMEs) are essential contributors to global economic growth, innovation, and employment, yet they face unique barriers in their digital transformation journeys. The emergence of generative artificial intelligence (AI) presents a significant opportunity for SMEs to enhance productivity, strengthen customer engagement, and build competitive advantage. Applications of AI in areas such as process automation, predictive analytics, and personalised services offer potential for innovation and long-term growth. However, adoption remains limited due to persistent challenges, including high implementation costs, shortage of technical expertise, organisational resistance to change, and cybersecurity vulnerabilities. This paper synthesises findings from recent studies (2022–2025) to examine both the opportunities and challenges associated with AI integration in SMEs. The review highlights that while awareness of AI technologies is rising, practical implementation is slow, indicating a critical awareness–adoption gap. To bridge this divide, SMEs must adopt phased and strategic approaches, supported by employee training, enabling policy incentives, and human-centred AI practices that balance technological potential with ethical considerations.

Key words: *Generative AI, SME, Training & Development, HR*

Introduction

Small and midsize enterprises (SMEs) are companies that generally fall between small and large businesses. There is generally a threshold for the revenues, assets, and/or employees held by SMEs. Some industries also define whether a company is small or midsized. Each country has a distinct definition of what constitutes a small and midsize enterprise. Though small, SMEs play an important role in an economy. They outnumber large firms, employ many people, and are generally entrepreneurial. SMEs tend to help to shape innovation.

Small and midsize enterprises can exist in almost any industry but are more likely to operate within industries with fewer employees and smaller up-front capital investments. The most common types of SMEs include legal firms, dental offices, restaurants, and bars.

SMEs are segregated from large, multinational corporations because they fundamentally operate differently. Large, complex firms may require advanced enterprise resource planning (ERP) systems for accounting, supply chain management and financial reporting, and interconnectivity across offices around the world or deeper organisational processes. SMEs, on the other hand, may require fewer systems given their narrower scope of operations.

Generative AI is an artificial intelligence (AI) that can produce content such as audio, text, code, video, images, and other data. While previous AI algorithms were used to identify patterns within a training data set and make predictions, generative AI uses machine learning algorithms to create outputs based on a training data set.

The rise of generative AI is largely due to the fact that people can use natural language to prompt AI now, so the use cases for it have multiplied. Across different industries, AI generators are now being used as a companion for writing, research, coding, designing, and more. And GenAI will continue to evolve as it's trained on more data. There are many generative AI models, including large language models (like ChatGPT), image generation models (like DALL-E), and audio generation models.

Small and medium-sized enterprises (SMEs) can greatly benefit from generative artificial intelligence (AI) tools to streamline operations and improve efficiency. For example, AI tools like ChatGPT can help automate various processes, such as test writing for code, streamlining external communications, creating chatbots, and generating tailored job descriptions. These tools can also provide personalized product recommendations, optimize customer service interactions, and automate threat intelligence briefings, saving time and resources.

Additionally, AI can be used to apply sentiment analysis to online feedback, guide customer service interactions, and assist in crafting tailored job descriptions. SMEs now have the opportunity to leverage generative AI to transform their operations and compete effectively in the digital age.

Generative AI tools such as ChatGPT and GitHub's Copilot can revolutionize SMEs' operations, allowing them to automate tasks, improve customer service, and optimize operational processes. As generative AI advances, SMEs can harness its potential to drive growth and create a distinct competitive advantage.

The latest technological developments in generative artificial intelligence (GenAI) offer powerful capabilities to small and medium enterprises (SMEs) as they facilitate the democratization of scalability and creativity. With little technical expertise or financial resources, SMEs can leverage this technology to streamline work processes and unleash innovation, improving their product offerings and long-term competitiveness

The rapid advancements in artificial intelligence (AI) and natural language processing (NLP) have unveiled novel possibilities for addressing the barriers encountered by micro, small, and medium enterprises (MSMEs).

Especially in emerging markets, they make a substantial contribution to regional development, entrepreneurship, and innovation. Notwithstanding their size, SMEs frequently encounter major obstacles like restricted financial access, a lack of qualified personnel, and inadequate technology infrastructure. These limitations threaten their long-term viability and competitiveness in a time characterized by the Fourth Industrial Revolution and digital transformation.

SMEs	Big Companies
Limited budget	More extensive financial resources
Limited Knowledge	Dedicated teams for AI projects
Cultural resistance	More innovation-oriented culture
Limited tech infrastructure	Easier Integration

Personalisation of consumer experience	Data Analytics	HR Management	Process Automation
Process data from social media, IOT, and other sources	Process massive datasets quickly	Screen resumes and evaluate candidate suitability	Handle routine tasks to free up strategic decision-making
Help companies understand customer emotions and preferences	Generate insights about consumer preferences in minutes	Recommend staff training oppurtunities	Optimize supply chains to avoid disruption
Power recommendation systems (Netflix, spotify)	Provide sales forecasts	Identify important skills to develop	Reduce costs and improve order fulfilment
Adapt marketing strategies based on sentiment analysis	Identify weakness in supply chains		Enable instant credit decisions in banking

Objectives of the study

1. To examine opportunities generative AI creates for SMEs.
2. To analyze challenges and barriers to adoption.
3. To recommend strategies for sustainable AI integration

Author	Year	Title of paper	Key Findings
Anna Kramarenko (Source)	2025	Artificial Intelligence for small & medium business: Perspectives & challenges	• There is a clear need for enhanced support mechanisms to help SMEs overcome the identified barriers to AI adoption, particularly in areas of funding access and technical expertise development. • Educational institutions and industry bodies should focus on developing targeted programs to bridge the knowledge gap in AI implementation and management for SME staff. • Policy frameworks should be developed to facilitate data sharing and integration while maintaining appropriate privacy and security standards. • Further research is needed to develop industry-specific AI implementation models that account for the unique constraints and requirements of SMEs. The research identifies critical barriers to AI adoption among SMEs, including: • Limited access to industry-specific data • Insufficient awareness of available data resources and their potential value • Challenges with data integration across systems • Financial constraints affecting both implementation and ongoing operation • Resistance to changing traditional business practices • Shortage of domain-specific data analysis expertise • Technical knowledge gaps among existing staff • Limited understanding of available tools and funding opportunities. Successful AI implementation requires a strategic, phased approach where processes are carefully divided into discrete tasks, with implementation prioritized based on return on investment calculations.
Archie Augustine Ebuka, Nwosu Kanayo Chike, Ugwu anyi Stephen Chigozie and Ibrahim Audu Muhammed	2025	Artificial Intelligence Adoption and Business Performance: Evidence from Small and Medium Enterprises in Emerging Markets	• There was a significant gap between awareness and actual usage of AI technologies by SMEs. • The results indicated that although knowledge of AI tools is relatively high among SMEs, actual utilization is very low. • Obstacles such as insufficient technical expertise, elevated expenses, and infrastructural difficulties persist in hindering wider implementation.
Peiqian Wu, Yingze Zhu, Wenli Chen,	2025	Leveraging AI to Ignite Innovation in Small	**Applications of AI in SME are**: • **Data analysis and Insights.** AI helps SMEs save time on data collection and analysis by quickly processing large amounts of

Yongchao Du (Source)		and Medium Enterprises: Challenges and Opportunities	structured and unstructured data. It uncovers patterns and trends that guide better marketing, product design, and decision-making. With user-friendly dashboards and real-time insights, SMEs can respond faster to market changes, boost competitiveness, and build long-term resilience. • **ML algorithm for predictive analytics.** Machine learning enables SMEs to use predictive analytics for better decision-making. By analyzing past data, market trends, and external factors, SMEs can forecast demand, optimize inventory, and set competitive pricing. This reduces stock issues, improves margins, and helps identify new consumer trends, allowing SMEs to allocate resources more strategically and stay ahead in the market. • **Process optimization**. AI enables SMEs to design tailored products and services by analyzing customer data, speeding up R&D, and reducing guesswork. It supports personalization across marketing, products, and after-sales, boosting customer loyalty. SMEs can also use AI to test new business models, target niche markets, and simulate customer responses, allowing faster innovation. Collaborations with other firms further strengthen knowledge sharing and market reach, enhancing overall competitiveness and the wider innovation ecosystem. **Challenges** • **Technical barriers.** SMEs face challenges in adopting AI due to limited internal resources and lack of technical expertise. Unlike large firms with R&D teams, SMEs often struggle to choose the right AI tools, face compatibility issues with old systems, and lack the skills to integrate and maintain AI. Continuous upskilling is also required, adding extra strain on their small workforce. • **Cost constraints.** AI adoption is expensive for SMEs due to high upfront costs for infrastructure and ongoing expenses for staff, data, and system updates. Hiring AI experts adds further strain, and the uncertain return on investment makes leaders hesitant to commit resources. This cost pressure forces SMEs to juggle daily operations with long-term AI investments, highlighting the need for better financial planning and external support. • **Data Privacy and security.** SMEs face major challenges in meeting strict data privacy and security regulations like GDPR when

adopting AI. Limited resources make compliance and cybersecurity difficult, and failures can lead to heavy fines, reputational loss, and reduced customer trust. Since AI systems require large amounts of data, SMEs must use strong technical measures and staff training to ensure privacy and security, adopting a "privacy-by-design" approach.

Opportunities

- **Enhanced innovation capacity.**
  Despite challenges, AI gives SMEs a powerful chance to boost innovation. With advanced analytics and pattern recognition, they can spot new trends, address unmet customer needs, and speed up product development. AI also helps uncover new customer segments, channels, and business models, while accessible tools allow even non-experts to contribute. This fosters creativity and enables SMEs to achieve "leapfrog development," overcoming limits of traditional R&D.
- **Improved competitive advantage**
  AI gives SMEs a competitive edge by enabling real-time data analysis and predictive insights. This helps them anticipate demand, understand customer behavior, and respond quickly to market shifts. As a result, SMEs can make smarter decisions on products, promotions, and service, building stronger customer relationships and standing out against bigger competitors.
- **Access to new markets.**
  AI helps SMEs expand into new and untapped markets by identifying consumer niches and regional demands through advanced data analysis. Tools like AI-driven translation, localization, and digital marketing make cross-border scaling easier and more affordable. This global reach allows SMEs to diversify revenue, build stronger brands, and secure long-term growth.

Strategies

- **Capacity Building**
  Building capacity should also include forming cross-functional teams of employees with diverse backgrounds, working on AI projects.
  SMEs can bridge the gap by pairing domain experts (such as operations managers or product designers) with data scientists, encouraging knowledge transfer and adoption of a more holistic approach to AI.
  This cross-pollination of ideas provides a degree of assurance that AI tools created will be aligned with the firm's strategic goals and operational realities.

			• **Collaboration and Partnerships** Partnerships can help SMEs overcome resource limits. Collaborating with universities gives access to advanced research, labs, experts, and student talent, while also encouraging innovation and experimentation. Working with large corporations provides SMEs with mentorship, data, technical support, and wider market access. Such collaborations not only improve AI adoption but also enhance visibility, credibility, and long-term growth for SMEs. • **Policy Support** Governments play a key role in helping SMEs adopt AI by creating supportive ecosystems. They can offer financial incentives like grants, tax breaks, and loans, while also setting ethical and sustainability guidelines. Public-private partnerships can further aid SMEs by promoting research, easing technology transfer, and providing guidance on compliance and security
Immo Brüggemann, Dr. Stephan Buse, and Nohemi Villarreal (Source)	2025	How AI can increase resilience in small and medium-sized companies	**Opportunities** • **Phase 1 – Collecting and structuring external data:** The challenge is too much unstructured data about the business environment. Generative AI helps by quickly sorting, grouping, and highlighting only the most relevant information (e.g., scanning news feeds and showing only new important topics). This saves time and gives managers a stronger base for decisions. • **Phase 2 – Evaluating and integrating internal** resources**:** Much company knowledge is "sticky" (unwritten, hidden in employees' minds). Generative AI can interact in natural language to extract this knowledge and link it to methods like VRIO. For example, analyzing customer reviews can reveal hidden strengths or weaknesses that leaders didn't notice before. • **Phase 3 – Deriving strategic fields of action:** Once external and internal insights are gathered, they are turned into concrete strategies. Humans still play the biggest role here, but generative AI can suggest new ideas by combining patterns in the data. For instance, using the Ansoff Matrix, AI can propose fresh growth opportunities and practical initiatives. • **Overall:** Generative AI adds value in all phases of strategic management—processing large data, uncovering hidden knowledge, and sparking new ideas—while

			working best when combined with human judgment and strategic methods. • **<u>Challenges</u>** For small and medium sized enterprises (SME's), implementing a structured and method-based strategic management is a challenge.
Eeva Kaakkurivaara	2025	Supporting Small and Medium Enterprises in AI Development: The Role of EU AI Regulatory Sandboxes	• **Challenges with Digital Platforms**: Problems were identified in how digital platforms function and in the lack of systematic, goal-oriented use in teaching. • **Differences Across School Levels**: Teachers in lower and upper secondary schools used digital platforms differently. • **Varying Teacher Perceptions**: Teachers had very different experiences with digital tools, shaped by their comfort level, teaching context, and attitudes. • **Lack of Support**: Teachers reported inadequate support for developing their digital teaching practices. • **Conclusions**: While digital platforms are widely used, their integration is inconsistent. Better support and pedagogical planning are needed for effective use.
Serena Proietti and Roberto Magnani	2025	Assessing AI Adoption and Digitalization in SMEs: A Framework for Implementation	• Most Italian SMEs have low digital maturity relying on basic tools like Excel, with little to no use of advanced technologies. • **AI adoption is minimal**: only about 14% use AI, and just 11% are familiar with generative AI. • **Investment is limited**: nearly half of SMEs have no plans for technological upgrades. • **Barriers** include high costs, lack of expertise, cultural resistance, and poor data/infrastructure. • **Opportunities**: AI could reduce costs, improve competitiveness, and support customer communication, but firms fear job losses and "oss of humanity.
ResearchGate, Edith Ebele Agu, Courage Idemudia	2025	Driving SME innovation with AI solutions: overcoming adoption barriers and future growth opportunities	• **AI as an Innovation Driver:** AI is recognized as a major enabler of efficiency, productivity, and competitive advantage in SMEs. • **Adoption Gaps:** Despite the benefits, SMEs face slower adoption compared to larger firms due to financial constraints, lack of expertise, and technological barriers. **Barriers Identified**: • Limited financial and technical resources. • Data quality and infrastructure challenges. • Skills shortages and resistance to change. • Ethical concerns and trust issues in AI use. • Opportunities for Growth:

			• AI supports decision-making, automation, customer engagement, and innovation. • Collaboration with external partners and ecosystems is key to overcoming internal limitations. • Generative AI presents new opportunities for creativity and business expansion. • Strategic Recommendations: • SMEs should pursue incremental AI adoption with clear objectives. • Policymakers and stakeholders must provide financial incentives, training programs, and infrastructure support. • Building trust, ethical frameworks, and human-centered AI is essential for sustainable growth.
Noptanit Chotisarn & Thadathibesra Phuthong	2025	A bibliometric analysis insights into the intellectual dynamics of artificial intelligence for the micro, small, and medium enterprises	**Low AI Adoption**: Most SMEs are still in the **early stages** of digital maturity, relying on basic tools and showing limited use of AI. **Main Barriers**: • Lack of financial resources. • Limited technical expertise and skilled staff. • Poor data infrastructure. • Cultural resistance and low trust in AI technologies. **Opportunities**: • AI can improve efficiency, decision-making, and customer engagement. • Generative AI offers new possibilities in automation and content creation. • Early adoption can deliver competitive advantages. • Concerns: SMEs fear high implementation costs, potential job losses, and a perceived loss of human touch in business. **Recommendations**: • Encourage incremental adoption with clear goals. • Provide training, financial incentives, and external support. • Build ethical, human-centered AI frameworks to foster trust.
	2025	Ethical Leadership and Management of Small- and Medium-Sized Enterprises: The Role of AI in Decision Making	AI Adoption in SMEs: Adoption is still at an early stage; most SMEs use only basic digital tools and lag behind larger firms in AI integration. **Barriers**: • Limited financial resources. • Lack of AI expertise and skilled workforce. • Poor data quality and inadequate infrastructure. • Cultural resistance and low awareness of AI's potential. **Opportunities**: • AI can enhance efficiency, decision-making, customer service, and innovation.

			• Generative AI opens possibilities in content creation, automation, and business development. • Early adopters could gain a competitive advantage. **Recommendations**: • Gradual AI adoption with clear objectives. • More training, financial incentives, and support programs for SMEs. • Collaboration with external partners and ecosystems to overcome limitations. • Emphasis on human-centered AI to maintain trust and mitigate fears of job loss.
Edward kezron isabiry (Source)	2025	Cybersecurity framework for securing cloud and AI driven services in small and medium enterprises	**SMEs' High Vulnerability** • Due to weak defenses like inadequate training, • dangerous cloud configurations, poor access • controls, and a lack of AI-specific protection, • SMEs are subject to more than 60% of • cyberattacks. A single attack has the potential • to result in monetary loss, harm to one's • reputation, or even the closure of a business. • The Current Frameworks Are Not Sufficient • AI-specific risks like model theft, data • poisoning, and adversarial attacks are not • addressed by standards like NIST CSF, ISO • 27001, and CIS Controls, which are too • complicated and resource-intensive for SMEs. **The suggested framework** • For SMEs, a five-layer model was created: governance, protection, detection, response, and recovery. It translates best practices into useful, user-friendly modules and is straightforward, reasonably priced, scalable, and AI-aware. **Pilot Results** • 92.3% accuracy in detection,60% quicker reaction time (average of 12.8 minutes). An increase in employee awareness of 63% Lightweight design (just 4.8% system overhead) **Security of the AI Lifecycle** • The entire AI lifecycle is uniquely secured by the framework, which guards against data leaks, adversarial inputs, and model poisoning. A comparative advantage surpasses current models in terms of cost effectiveness, speed, and comprehensiveness, encompassing cloud and AI security.

			Impact on Practice • Increases SMEs' resilience, trust, and safe innovation by transforming cybersecurity from an expensive burden into a strategic enabler.
Leila Zare, Marwa Ben Ali, Erwin Rauch , Dominik T. Matt (Source)	2025	Navigating challenges of small and medium-sized enterprises in the Era of Industry 5.0	• SMEs are facing serious hurdles in adopting Industry 5.0, despite its promise of human-centric, sustainable, and resilient growth. The challenges are broad and interconnected. **Technological** • Most SMEs still operate with outdated systems, poor digital infrastructure, and minimal readiness for AI, IoT, or robotics. Cybersecurity risks remain a major threat. **Economic** • High costs and lack of financial resources make advanced technologies and sustainability measures almost impossible for many SMEs. **Organizational** • Weak leadership, absence of clear strategies, and resistance to change cripple transformation efforts. **Workforce** • Severe skill shortages, employee resistance, and well-being issues limit innovation and human–robot collaboration. **Environmental** • SMEs continue to rely heavily on traditional energy sources, with very limited progress in green and sustainable practices. **Community/Policy** • Insufficient stakeholder collaboration, strict regulations, and poor government support leave SMEs isolated and unprepared.
Corresponding author: Toluwalase Vanessa Iyelolu Driving SME innovation with AI solutions: overcoming adoption barriers and future growth opportunities (Source)	Jan 2024	Tochukwu Ijomah	**Benefits of AI for SMEs:** • Automates repetitive tasks, boosts productivity. • Reduces costs through predictive maintenance and optimized supply chains. • Enables better decision-making with data-driven insights. • Helps personalize customer experiences and develop innovative products. **Barriers to Adoption:** • High implementation costs. • Lack of skilled personnel and technical expertise. • Resistance to change within organizations. • Concerns about data privacy and security. **Strategies to Overcome Challenges:** • Government incentives and supportive policies. • Public–private partnerships and collaborations with tech providers.

			• Affordable "AI-as-a-Service" platforms. • Training and skill development programs. **Future Growth Opportunities:** • AI-driven personalization in marketing and services. • Integration of AI with IoT and big data analytics. • Wider access through cloud-based and democratized AI tools. • Development of ethical and responsible AI practices.
Leveraging ChatGPT for Empowering MSMEs: A Paradigm Shift in Problem Solving (Source)	Jan 2024	Gautam Bapat, Rinku Mahindru, Anuj Kumar, Aruna Dev Rroy, Sanjay Bhoyar, and Sonia Vaz	The study highlights how ChatGPT can transform the way Micro, Small, and Medium Enterprises (MSMEs) address challenges and make decisions. The main findings are: **Enhanced Problem-Solving**: • ChatGPT provides real-time, accurate, and customized solutions, helping MSMEs resolve issues faster and with greater precision. **Operational Efficiency**: • By integrating ChatGPT into communication and support systems, MSMEs can significantly reduce response times and improve productivity. **Cost-Effective Growth**: • ChatGPT helps MSMEs overcome resource limitations, offering intelligent support without requiring heavy financial investment. **Competitiveness**: • The use of AI tools like ChatGPT enhances MSMEs' ability to compete with larger firms, despite their smaller scale. **Policy Implications**: • Policymakers must create ethical guidelines and support frameworks to ensure AI adoption remains fair, transparent, and beneficial to all. **Limitations**: • The tool's reliance on existing data can sometimes introduce biases and incomplete insights, requiring human oversight.
Role of generative AI in small and medium enterprises: Opportunities and challenges (Source)	2023	By Utpal Chakraborty, Soumyadeep Roy, Sumit Kumar	**AI/ML as Game-Changers:** By facilitating cost savings, quality assurance, predictive maintenance, and smarter supply chains, these technologies have the potential to completely transform MSMEs. **Boost to Competitiveness**: They help MSMEs compete internationally by providing chances for increased productivity, innovation, and sustainable growth. **Present Barriers:** Low data quality, high expenses, a lack of qualified workers, and uncertainty about the business impact are the main reasons for the limited

			adoption. **Future Prospects:** Integration with IoT and Digital Twins, robust employee upskilling, and reasonably priced and easily navigable AI tools are key to growth. **Transformative Potential:** With the correct strategy, AI/ML can transform MSMEs from companies focused on survival into Industry 4.0 leaders driven by innovation.
An overview on the use of AI/ML in Manufacturing MSMEs: solved issues, limits, and challenges An overview on the use of AI/ML in Manufacturing MSMEs: solved issues, limits, and challenges (Source)	2022	Valentina De Simonea, Valentina Di Pasqualea, Salvatore Mirandaa Valentina De	**Applications identified**: predictive maintenance, quality control, process optimization, demand forecasting, and product innovation. **Benefits noted**: efficiency gains, reduced downtime, smarter supply chains, and improved competitiveness. **Challenges**: poor data quality, lack of skilled workforce, high costs, limited IT infrastructure, and cultural resistance. **Future directions**: adoption of explainable AI, affordable cloud-based solutions, integration with IoT, sustainability focus, and stronger industry–academia collaboration.