INSME
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International Network for SMEs

19th INSME Annual Meeting
"Explore the Impact of Artificial Intelligence on SMEs"

9-10 October, 2023
Berlin, Germany

Co-organised with:

Der Mittelstand. BVMW
Bundesverband mittelständische Wirtschaft
Unternehmerverband Deutschlands e.V.

Issue Paper
AI Revolution: Transforming Industries and Empowering SMEs for Future Growth

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Abstract

This Issues Paper has been prepared for the Annual Summit of the International Network for SMEs (INSME) to be held in Berlin on 9-10 October 2023. The paper explores the multifaceted realm of Artificial Intelligence (AI) and its profound influence on various sectors with a particular emphasis on the interests of small and medium sized enterprises (SMEs.)

Beginning with a brief historical overview of AI's evolution, the article provides an account of the transformative impact on industries highlighting AI's application in manufacturing, education, retail, healthcare, and finance. the key verticals in which AI has begun to make a significant mark. We highlight the diverse adoption patterns of AI, drawing comparisons between high technology ('high-tech') firms and other non-'high-tech' players in manufacturing and services. It shows varying rates of adoption and the influence of government initiatives in driving AI integration. The paper demonstrates how AI enhances data analysis, decision-making, and resource management, while also scaling impact, improving accessibility, and promoting collaboration. We do so by quantifying AI usage globally and across sectors, presenting appropriate statistical insights that underscore AI's pivotal role in reshaping industries.

Challenges in and possible solutions to problems of AI adoption for SMEs range from limited AI skills and high costs to the lack of strategy and leadership ownership. Government initiatives for AI adoption among SMEs, including funding, training, collaboration, and regulatory support, which play pivotal roles are also referred to in this paper.

Table of Contents

Tables and Figures

1. Introduction

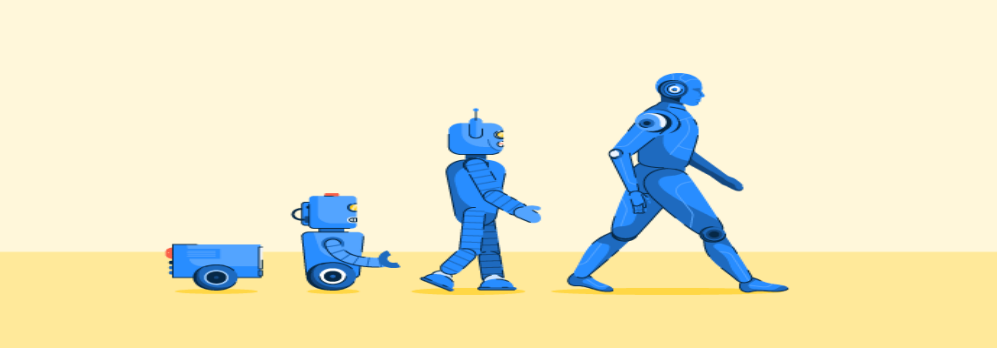
Artificial Intelligence or AI represents the current advanced guard of new technologies and algorithms transforming economies and societies around the world. Significant steps have been taken in the focused development of machine-learning algorithms to generate AI. At its best AI offers considerable benefits especially where applications involve very large amounts of data and high variability. Machine learning is facilitating the understanding of communication among animals for better outcomes for conservation and husbandry. Applications in drug development, chemistry and medicine (particularly in the form of medical robots for the improvement of patient treatment and recovery and platforms for diagnoses and treatment) lead the way. As businesses adapt to this digital age, small and medium enterprises (SMEs) stand at the forefront of harnessing AI's capabilities to drive innovation, efficiency, collaboration and competitiveness. We hear a lot these days about ChatGPT, in the most recent iteration of AI referred to as 'Generative AI'. Chat GPT arrived to shake up our technological structures only in November 2022. With the advent of 'Generative AI' the world is at the cusp of potentially even greater change. Generative AI can learn from existing artifacts to generate new, realistic artifacts (at scale) that reflect the characteristics of the training data but do not repeat it.

However, there are concerns about bias and discrimination not least because of human intervention in the design of and the use of AI. There are equally important questions about employment depletion and retention and the value of human skills. What might a machine-intelligent world look like or mean in the future if it is dominated by machines that cannot smell, cannot work in a team, cannot feel emotions, cannot reason, and crucially cannot invent? How might an existential threat to democracy, economic and human rights, and social justice, play out in the so-called age of the Anthropocene? **(Science 2023).**

In asking these questions and by referring to some of the possible implications of the adoption of AI, we contribute to the ongoing dialogue about AI's and their influence on the operations and management of SMEs. Examining what we know and identifying gaps, should help to inform strategic decision-making and inspire future research endeavours in the realm of AI and SMEs.

We start with a brief introduction to AI.

2. What is Artificial Intelligence (AI)



2.1 Evolution and Definition of AI

The concept of AI can be traced back to around the 17th century when philosophers started contemplating about how human thinking and activities could be *artificially* mechanised to perform activities by machines intelligently. Drawing on those early years of speculation scientists and technologists of the 20th century conducted specific research to invent the programmable digital Atanasoff Berry Computer (ABC) in the 1940s. Despite being a critical milestone in the field of technology, this invention is regarded as a secondary product in the AI journey. In fact, before 1949 computers were not able to use memory and store commands – an essential condition for intelligence. They could only execute these commands. Furthermore, computing was extremely expensive and in the early 1950s, the cost of leasing a computer ran up to $200,000 a month. Science fiction had familiarized the world with the concept of artificially intelligent robots in the early 20th century with the Tin man from the Wizard of Oz and the humanoid robot that impersonated Maria in Metropolis (**Harvard University 2017**). But by the 1950s, we had a generation of scientists, mathematicians, and philosophers with the concept of artificial intelligence (or AI) culturally assimilated in their minds. British mathematician Alan Turing researching gaming imitation, published his research proposal entitled "Computing Machinery and Intelligence" (**Turing 1950**) focusing on the idea of whether a machine could think intelligently as a human being. This proposal came to be known as the *Turing Test*. It was at the first academic conference on the subject in 1956 organized by the American computer scientist John McCarthy, that the term artificial intelligence was first devised, and John McCarthy was named as the *Father of Artificial Intelligence!* Together with Alan Turing, Marvin Minsky, Allen Newell, and Herbert A Simon, John McCarthy founded AI (**Stanford University, u.d**).

Early AI efforts focused on symbolic reasoning and rule-based systems. The field went through periods of optimism and "AI winters," where progress slowed due to high expectations and technical limitations. Now that AI started making large strides policy makers have taken an interest in regulating AI. Consequently, a legal definition of AI was necessary. This has proved difficult because of the conflicting considerations and interpretations of AI by various scientific disciplines. As Table 1 below demonstrates there is a plethora of definitions that have sprung up in the recent past with academics, industry researchers, scientists, and other contending as usual over what a standard definition could look like but not necessarily arriving at a consensus over the meaning and use of the technology. It is, therefore, up to the readers discretion to interpret the definition of AI based on their knowledge, understanding, application and use.

Table 1: Various Definitions of AI

Source/Author	Definition
Alan Turing	**"System that thinks line human"**
John McCarthy (u.d)	"It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not

	have to confine itself to methods that are biologically observable." **(www-formal.stanford.edu, n.d)**
IBM (2023)	"Artificial intelligence leverages computers and machines to mimic the problem-solving and decision-making capabilities of the human mind."
Stuart Russell and Peter Norvig (2016)	Emphasized the distinction computer system between rationality and thinking vs. acting: *The Human Approach* -Systems that think like humans -Systems that act like humans *Ideal Approach* -Systems that think rationally -Systems that act rationally
McKinsey & Company (2023)	"Artificial intelligence is a machine's ability to perform the cognitive functions we usually associate with human minds."
B.J. Copeland (2019)	AI as the ability of a computer or a robot controlled by a computer to do tasks that are usually done by humans because they require human intelligence and discernment

In short AI can be defined as the development of computer systems that can perform tasks that typically require human intelligence. These tasks include reasoning, learning, problem-solving, understanding natural language, perception, and decision-making. AI systems can analyse data, recognize patterns, adapt to changing circumstances, and make predictions or recommendations. AI tools have helped to identify new antibiotics, reveal the Higgs Boson and track regional accents in wolves. Recent advancements in machine learning, particularly deep learning, have driven significant breakthroughs in AI. Deep learning models, inspired by the human brain's neural networks, excel in tasks like image and speech recognition. These advances, coupled with the availability of massive computing power and large datasets, have propelled AI into various applications.

2.2 Generative AI

Generative AI (GAI) takes what some describe to a meta level of possibilities of intelligent machine work with AI, but that is to ignore other technological developments of the future. Suffice it to state that GAI can create a variety of novel content, such as images, video, music, speech, text, software code and product designs, using several techniques that are still in the

process of evolving. The most outstanding techniques are the AI foundation models, which are trained on a broad set of unlabelled data that can be used for different tasks, with additional fine-tuning and in response to natural language requests. It does not depend on knowledge of or entering code, but they do demand complex mathematics and prodigious computing power to create these trained models. In essence they are prediction algorithms. There are numerous

and noteworthy cases which include innovations in drug and chip design and material science development **(Gartner, 2023)**.

What we know as GAI has a wide range of practical applications including written content creation and augmentation, question answering and discovery. This may take the form of producing a "draft" output of text in a specific style and length as required by the user, assisting users to find answers to questions based on data and prompt information, and text manipulation, to soften language or professionalize. GAI can also offer shortened versions of conversations, articles, emails and webpages, simplify text by breaking down titles, creating outlines and drawing key content, classify content for specific types of use, and sort by sentiment, or topic. Chatbot can enhance performance by improving "sentity" extraction, classify whole conversations by sentiment and generate journey or trajectory flows from general descriptions. Other applications include software coding varying from code generation, translation, explanation and verification. The particularly interesting applications which have long-term impact cover the creation of medical images that can track the future development of a disease, and the use of synthetic data that could help compensate for or augment scarce data, reduce bias, ensure data privacy and simulate future scenarios. Applications could also suggest additional actions to users and providing them with information **(Gartner 2023).**

The essence of GAI can be found in a series of fast and frequent breakthroughs in sense-making of natural language. Around 2010, researchers of natural language found that models which were exposed to vast amounts of text could produce better quality outcomes than those using standard, top-down grammatical rules. By 2014, researchers found that analysing the context of the word with language models could make sense of the meaning of those words. Between 2017-22 language models began to serve as a foundation for customisation, with their initial high cost being compensated by the low marginal cost of customising the models and produce state-of-the-art performance by using only a small amount of additional data. Then, less than twelve months ago, in November 2022, ChatGPT arrived to give users a very simple way to access data across a large foundational model, with its unique value lying in in its ability to have a conversation with the model in natural language. In other words, the English language was good enough as a programming language than programming code **(Gartner 2023).** The latest advances are also very promising. Analysing scientific literature to find new hypotheses, patterns, connections, suggestions for potential research or the generation of new ideas likely to be missed by humans, using ChatGPT-style language analysis, are expected to promote interdisciplinary work enabling innovations often at the intersection between fields, or search for "blind spots" in a specific field. A future of "robot scientists" or robotic systems which can use AI to form new hypotheses by performing countless experiments in fields such as systems biology and materials science, could reduce bias because they are less attached to past results. They could also advance experimental research and even develop unexpected theories outside the scope of human investigation (**The Economist 2023**)

In short what we are witnessing is the transformational impact of AI, where technology itself is both the tool and the innovation. But what is the impact of this transformation on business and the wider economy?

3. The Transformational Impact of AI

The transformation impact of AI on work, business and societal life is deemed to be profound as Table 2 below shows. The range of applications is wide and across myriad different functions of many key industries that constitute the architecture of our economy and civic society.

Table 2: AI's Transformational Impact

Functions	**Transformational Impact**	**Sectors**	**Transformational Impact**
Automation	AI-driven automation is streamlining repetitive tasks across industries, freeing human resources for more creative and strategic work	Agriculture	AI aids in precision farming, optimizing crop yields and resource utilization
Data Insights	AI can analyse massive amounts of data, providing valuable insights for better decision-making in sectors like finance, healthcare, and marketing	Education	AI-powered adaptive learning platforms personalize education, while analytics improve administrative efficiency and student outcomes.
Personalization:	AI enables personalized experiences in areas like e-commerce, entertainment, and healthcare, tailoring products and services to individual preferences.	Energy	AI enhances energy management, grid optimization, and renewable energy production
Social Impact	AI is addressing societal challenges, from disaster response and humanitarian aid to tackling climate change	Entertainment	AI is used in content recommendation, gaming, and even creative content generation.
		Finance	AI automates risk assessment, fraud detection, and customer service, improving efficiency and accuracy
		Healthcare	AI assists in diagnosing diseases, drug discovery, and treatment planning, improving patient outcomes and transforming medical research.
		Manufacturing	AI-driven robotics and predictive maintenance

			optimize production, enhance quality, and enable customization
		Security	AI helps detect and prevent cyber threats, enhancing digital security.
		Transportation:	Self-driving vehicles and AI-powered traffic management are changing the landscape of transportation.

Each of the sectors mentioned above are generally represented by large firms. However, it is the presence of larger firms that allows also for possibilities of niche participation by innovative smaller firms, and in this 'high-tech' environment often by start-ups which have a high impact with the technologies. The permeative capability of AI across both larger and small firms augments the scope of innovations in these sectors through the functions of automation, data-driven insights, and personalisation of products and services, with their combined and cumulative impact spreading quickly across society.

So, how are SMEs faring in the transformative landscape of AI and machine learning? Given their overwhelming presence in the economy (at least in numbers of units), it would be prudent for policy makers, researchers and all students of our changing world to assess the real or projected impact of AI on the smaller and medium sized firm. This briefing paper provides an overview of such impact from both a sectoral and an operational perspective.

4. How SMEs are Leveraging AI: A Sectoral Perspective

The rapid integration of AI into the business environment has prompted SMEs to negotiate current and future business in an arena of rapid, sometimes enforced change. As AI technologies continue to mature, SMEs are exploring a multitude of ways to harness AI's potential across various sectors, including manufacturing, education, and services.

4.1 The Manufacturing Sector: In the manufacturing sector, AI is revolutionizing production processes, supply chain management, and quality control. SMEs are increasingly adopting AI-powered solutions to optimize operations, reduce costs, and enhance product quality. A study by **Zhang et al. (2020)** emphasizes the utilization of AI in predictive maintenance, where sensors and AI algorithms are combined to predict machinery failures, thus minimizing downtime and maintenance costs.

Moreover, AI is empowering SMEs to achieve greater customization and flexibility in production. Through AI-driven algorithms and robotics, SMEs can efficiently adjust production lines to meet dynamic customer demands. Research by **Wang et al. (2019)** highlights how AI-enabled robotics can enable SMEs to manufacture smaller batches of customized products, effectively bridging the gap between mass production and individual customization.

4.2. The Education Sector: AI is reshaping the education sector by personalizing learning experiences, improving administrative efficiency, and enhancing student engagement. SMEs in education are leveraging AI to create tailored learning paths for students, allowing them to progress at their own pace. Research by **Khosla et al. (2021)** demonstrates how AI-driven adaptive learning platforms can analyse student performance data to provide targeted recommendations for improving learning outcomes.

AI is also streamlining administrative tasks within educational SMEs. AI-powered chatbots, as mentioned by **Akter et al. (2019)**, are being used to automate routine inquiries from students and parents, allowing staff to focus on more complex tasks. Additionally, AI-driven analytics are helping educational SMEs gain insights into student performance trends, aiding in the development of data-driven strategies for continuous improvement.

4.3 The Services Sector: AI's impact on the services sector of SMEs is particularly pronounced in areas such as customer service, marketing, and data analysis. Customer service automation, using AI-powered chatbots and virtual assistants, is becoming a common practice among SMEs. These tools, as highlighted by **Sharma et al. (2020),** enhance customer interactions by providing instant responses, reducing response times, and ensuring round-the-clock availability.

In marketing, SMEs are utilizing AI for personalized customer engagement. Through data analysis and machine learning, AI assists SMEs in tailoring marketing campaigns to individual preferences and behaviours. Research by **McCall et al. (2018)** underscores the role of AI in deciphering consumer data patterns to deliver targeted promotions and recommendations, thus driving customer engagement and loyalty.

The integration of AI within SMEs is not only pervasive but also diverse, with varying applications across different sectors. Through AI-powered solutions, SMEs in manufacturing, education, and services are achieving operational efficiencies, facilitating innovation, and bolstering their competitive advantage. As AI technologies continue to evolve, SMEs are poised to experience even more transformative impacts, solidifying their position in the ever-changing business landscape.

5. Adoption of AI: ‘Techie’ vs ‘Non-techie’ manufacturing or services firms

The adoption of AI within business operations is a topic of immense interest, particularly in understanding whether AI integration is predominantly confined to technology-driven companies or whether it spans across diverse industry sectors.

5.1 AI in Manufacturing: Contrary to the widely held perception that AI adoption is limited to technology-focused enterprises, evidence from academic literature suggests a significant presence of AI in the manufacturing sector. Research by **Lacity et al. (2020)** underscores the increasing incorporation of AI applications within both high-tech and traditional manufacturing SMEs. AI is harnessed to optimize production processes, automate quality control, and enhance supply chain management. For instance, AI-driven predictive maintenance, as highlighted by

Zhang et al. (2020), helps to identify machinery failures, enabling SMEs to curtail downtime and maintenance costs. This indicates that AI has become an integral part of manufacturing operations, irrespective of the 'techie' label.

5.2 AI in Services: Similarly, the services sector, encompassing industries such as finance, healthcare, and hospitality, is witnessing substantial AI integration. The literature suggests that services firms are utilizing AI to enhance customer engagement, automate routine tasks, and improve decision-making. While technology companies might have an initial advantage in AI expertise, services firms are increasingly harnessing AI tools to streamline operations and offer enhanced customer experiences. **Sharma et al. (2020)** highlights the adoption of AI-powered chatbots in customer service, improving response times and customer interactions. This trend demonstrates that AI is permeating services industries, reflecting a broad-based integration beyond the 'techie' sector.

5.3 AI on Social Entrepreneurs and Organizations: AI is emerging as a dynamic force reshaping the landscape of social entrepreneurship and organizations dedicated to creating positive societal impact. This phenomenon introduces new avenues for addressing complex challenges, elevating operational efficiency, and magnifying the potency of initiatives geared towards societal betterment. AI empowers social entrepreneurs and organizations by offering robust data analytics tools capable of extracting intricate insights from extensive datasets. This capability enables deeper comprehension of societal issues and identification of trends that drive informed decisions. The utilization of AI-driven predictive analytics aids in pre-emptively recognizing community needs, optimizing resource allocation, and refining strategies for optimal outcomes **(Gandomi & Haider, 2015)**. Resource Management and Real-Time Monitoring stand out as key developments.

> **Resource Management Excellence*:*** Efficient resource allocation is enhanced through AI-driven optimization techniques. Predictive models empower organizations to forecast resource requirements accurately, enabling efficient allocation of funds, time, and efforts to effectively address pressing societal issues **(Li et al., 2019).**
>
> **Real-time Monitoring and Evaluation*:*** AI technology facilitates real-time monitoring and evaluation of projects. This capability enables social entrepreneurs to track outcomes, measure impact, and pivot strategies based on data-driven insights, thereby fostering a cycle of continuous improvement **(United Nations Global Pulse, 2017).**

5.4 Precision Solutions for Social Issues: AI brings forth the potential for crafting customized solutions tailored to address specific social challenges. Machine learning algorithms have the capacity to synthesize multifaceted data sources, leading to the formulation of personalized interventions. In the healthcare sector, AI plays a pivotal role in precise disease diagnosis and prediction of potential outbreaks, thus facilitating focused interventions that amplify impact **(Topol, 2019).** AI-powered automation grants social programs the ability to scale seamlessly. Automating routine tasks liberates resources, allowing organizations to focus on strategic and impactful initiatives. Furthermore, AI-driven platforms hold the potential to provide underserved communities with access to critical information and services, thereby bridging gaps in education, healthcare, and financial inclusion **(UNDP, 2020).**

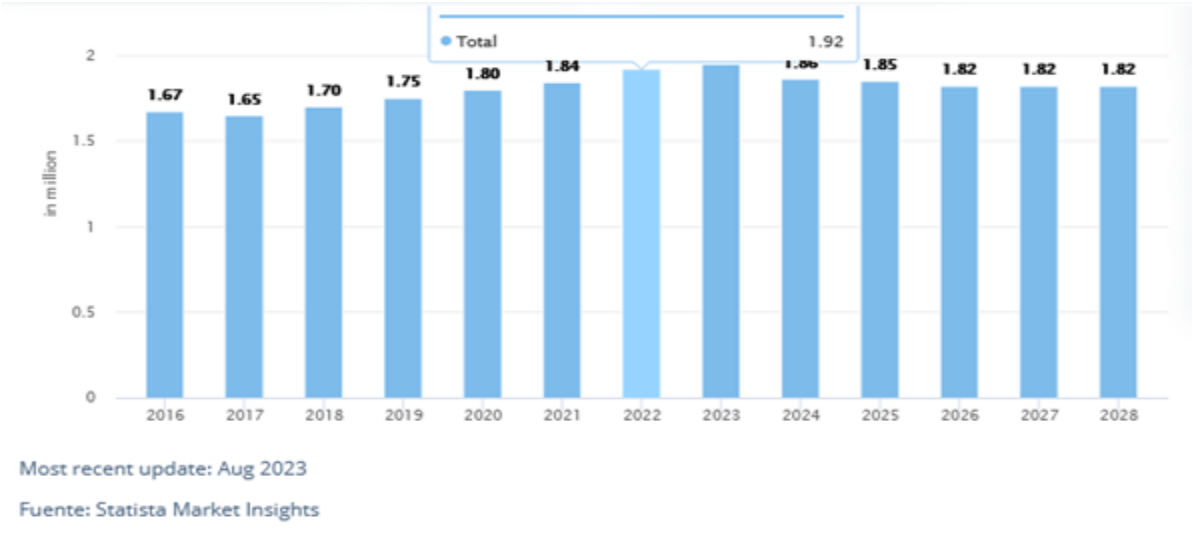
While AI provides substantial advantages, ethical concerns demand careful consideration. Fairness, transparency, and bias mitigation are paramount to ensuring that AI solutions do not inadvertently perpetuate existing societal inequalities **(Jobin et al., 2019).** AI has the potential to foster unprecedented collaboration among social entrepreneurs, organizations, governments, and corporations. Shared insights derived from AI-generated data can catalyse collective action, fuelling synergies aimed at addressing intricate societal challenges **(World Economic Forum, 2018).**

Overall, the notion that AI adoption is predominantly driven by 'techie' companies is challenged by empirical evidence from academic research. While technology-focused SMEs do leverage AI extensively, AI's impact is not confined to these firms alone. Manufacturing and services sectors are incorporating AI applications to optimize operations, enhance customer experiences, and achieve competitive advantages. The study by **Lacity et al. (2020)** underscores that AI integration is witnessed across sectors, suggesting that AI adoption is more influenced by strategic alignment with business objectives rather than the industry's 'techie' label. Also, the transformative potential of AI on social entrepreneurs and organizations spans from data-driven decision-making and tailored solutions to scalability and resource optimization. As this evolution unfolds, ethical considerations remain central. Harnessing AI's power responsibly has the potential to expedite positive change, aligning with the missions of social entrepreneurship and organizations dedicated to societal betterment.

6. Quantifying AI Usage Across Sectors: A Statistical Insight

The utilization of AI has witnessed a meteoric rise across sectors, with significant implications for manufacturing, education, and services firms. This section presents some key data on AI usage within each sector, drawing insights from consultancy reports and surveys, to provide a comprehensive understanding of the extent to which AI has permeated these domains.

6.1 The Manufacturing Sector: AI's penetration in the manufacturing sector has been substantial, revolutionizing traditional processes and catalysing growth. According to a report by the International Federation of Robotics **(**IFR**)**, the number of operational industrial robots worldwide is projected to reach 4.4 million by 2023 **(IFR, 2020).** This growth exemplifies how



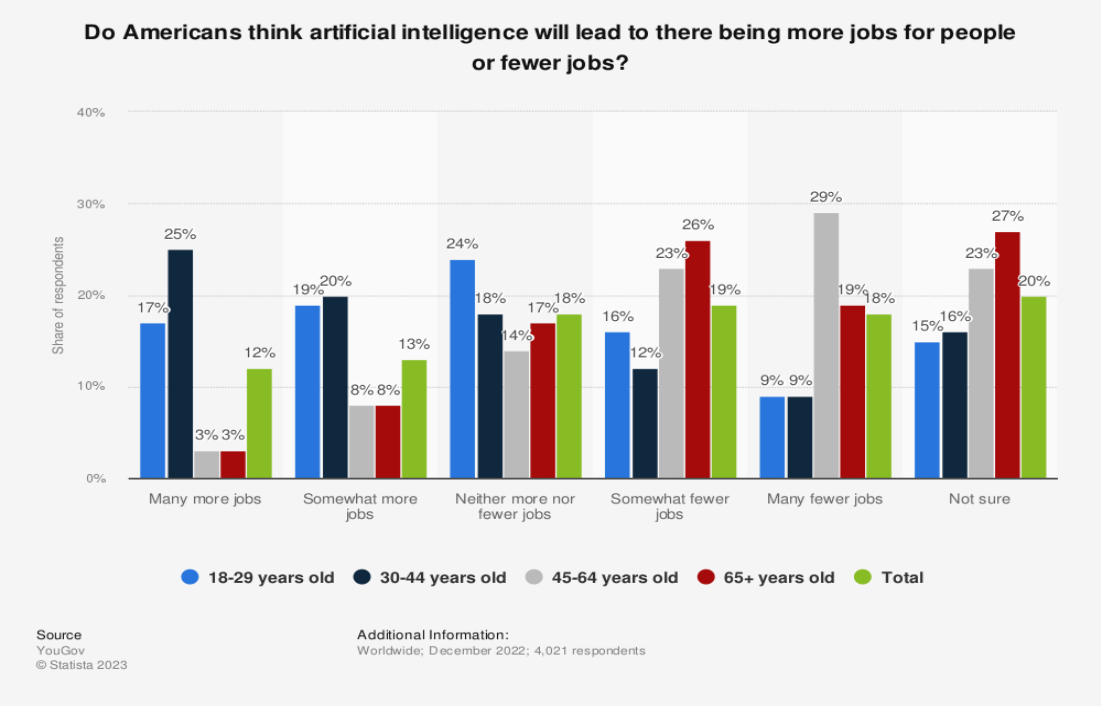
AI-driven automation is being embraced by manufacturing SMEs to streamline production, enhance product quality, and optimize supply chain management.

Figure 1: AI Penetration in the Manufacturing Sector

Source: Fuente Statista Market Insights (2023)

6.2 Education Sector: The education sector has also experienced a surge in AI adoption, with personalized learning and administrative efficiency at the forefront. According to HolonIQ, global investment in AI in education technology reached US$900 million in 2021, reflecting a 59% increase from the previous year **(HolonIQ, 2021).** This substantial investment underscores the commitment of educational SMEs to leverage AI for adaptive learning platforms, intelligent tutoring systems, and data-driven decision-making. The implications for the education sector are various demanding a range of answers to critical questions as shown in Figure 2 below.

Figure 2: AI in Education (US data only)



Source: Statista (HolonIQ, 2021)

6.3 Services Sector: The services sector, encompassing diverse industries like finance, healthcare, and hospitality, has been quick to embrace AI-driven solutions. Deloitte's "Global Human Capital Trends" report **(2021)** states that 82 of Financial Services SMEs have adopted AI-powered chatbots to enhance customer experiences. Globally, 37% of Financial Services firms adopt AI to reduce operational costs, followed by increased predictive analytics to enhance decision-making and increased employee capacity to handle volume tasks. In healthcare, a survey conducted by OptumIQ reveals that 47% of healthcare organizations are

using AI in clinical applications, thereby improving patient outcomes **(OptumIQ, 2020).** The data-driven insights highlight the substantial adoption of AI within manufacturing, education, and services sectors among SMEs. The statistics and trends illuminate the transformative potential of AI across industries, as evidenced by the proliferation of industrial robots in manufacturing, investment in AI education technology, and the integration of AI-powered solutions in financial services and healthcare.

The adoption of AI by companies is a global phenomenon. Table 3 below provides some interesting data on AI adoption from the IBM Global AI Adoption Index 2022, which underline the scale, depth and geography of adoption.

Table 3: Selected Data from the IBM Global AI Adoption Index

- **13%** more companies adopted AI in 2022, than 2021.
- **35%** companies are using AI in their business**.**
- **44%** organizations are working to embed AI into current applications processes**.**
- **42%** companies are exploring the use of AI.
- **66%** companies either currently executing or planning to apply AI to address their sustainability goals.
- **69%** Larger org. are more likely using AI than smaller enterprise in 2021.
- **100%** Larger org. are more likely using AI than smaller enterprise in 2022.
- **30%** Global IT professionals said they are saving time for repetitive tasks.
- **43%** of Global IT professionals said they accelerated AI rollout in 2021.
- **53%** of Global IT professionals said they accelerated AI rollout in 2022 & 2023.
- **54%** improved the cost and efficiencies.
- **53%** improved IT or network performances.
- **48%** better customer experience**.**
- **34%** companies facing barriers due to limited AI skills, expertise or knowledge**.**
- **29%** companies facing barriers due to the price is too high**.**
- **25%** companies facing barriers due to the lack of tools or platforms to develop models**.**
- **24%** companies facing barriers due to projects are too complex or difficult to integrate and scale.
- **24%** companies facing barriers due to too much data complexity**.**
- **74%** companies haven't acted to reduce bias while using the AI.
- **68% c**ompanies haven't acted to track performance variations and model drift.
- **61%** companies haven't acted to make sure they can explain AI powered decision**.**
- **60%** IT companies actively uses AI in India
- **60%** IT companies actively uses AI in China
- **26%** IT companies actively uses AI in UK
- **25%** IT companies actively uses AI in USA
- **24%** IT companies actively uses AI in Australia
- **22%** IT companies actively uses AI in South Korea

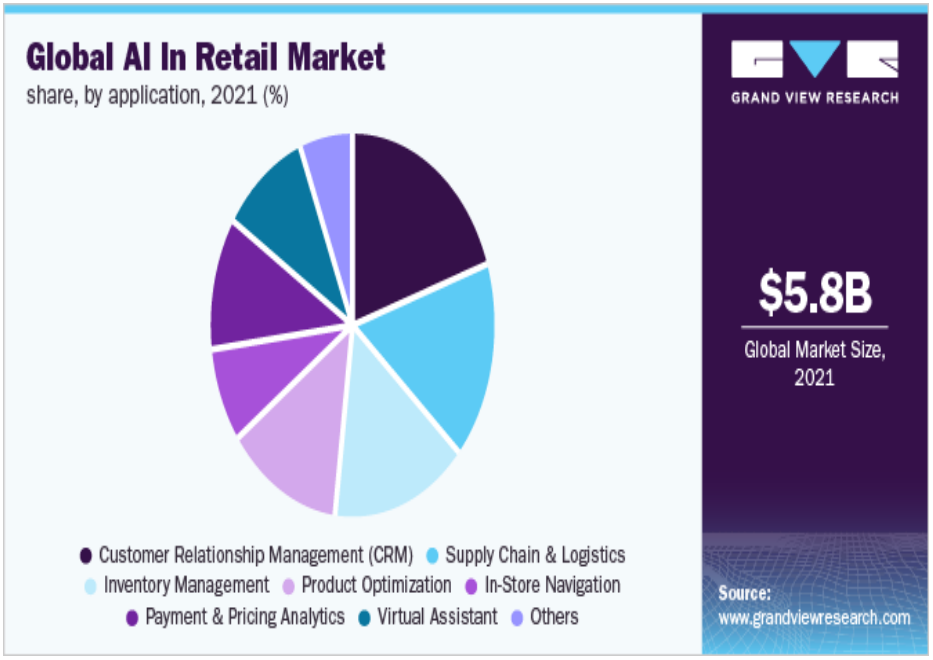
Source**:** IBM Global AI Adoption Index (2022).

7. AI Adoption Across Prominent Sectors: A Sectoral Analysis

The prevalence of AI adoption varies across sectors, with distinct trends emerging in industries such as retail, healthcare, and finance. We consider specific sectors that exhibit a higher prevalence of AI usage among SMEs supported by data from various sources.

7.1 The Retail Sector: The retail sector has emerged as a trailblazer in AI integration among SMEs, harnessing AI-driven solutions for enhanced customer experiences and operational efficiency in a global AI retail market estimated to be worth US$5.8billion (**see Figure 3: Grandview Research, 2021**)A study by McKinsey **(2020)** points to the fact that retail SMEs are leveraging AI for diverse applications, such as inventory management and personalized customer engagement. AI-powered demand forecasting algorithms aid in optimizing inventory levels, reducing stockouts, and minimizing excess inventory costs.

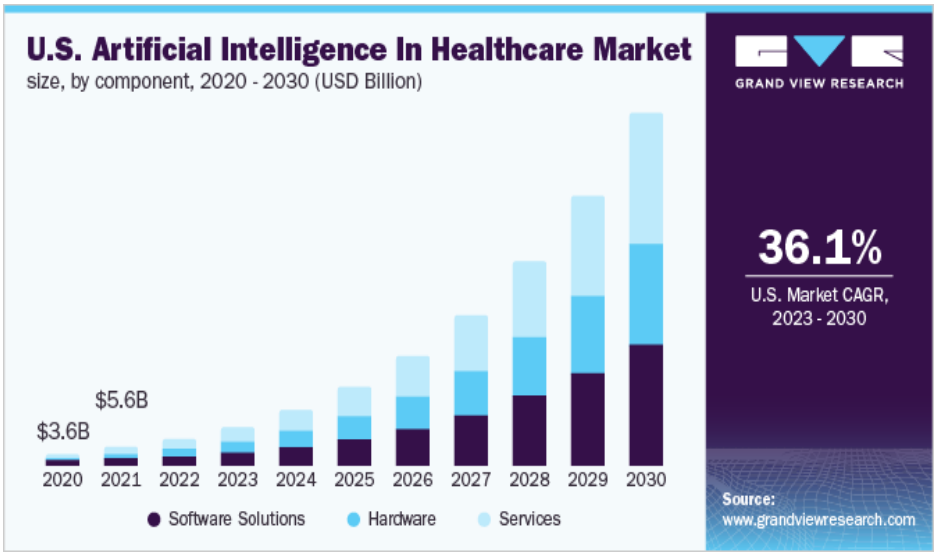
Figure 3: AI and the Global Retail Market



Source: Grandview Research (2021)

7.2 The Healthcare Sector: The healthcare sector has witnessed significant AI adoption, transforming patient care and diagnostic processes. According to a report by Grandview Research **(2021 – see Figure 4 for US data),** the global market for AI in healthcare is projected to reach US$17.8 billion by 2025. Healthcare SMEs are deploying AI-driven solutions for diagnostics, drug discovery, and telehealth services.

Figure 4: AI and the US Health Care Market

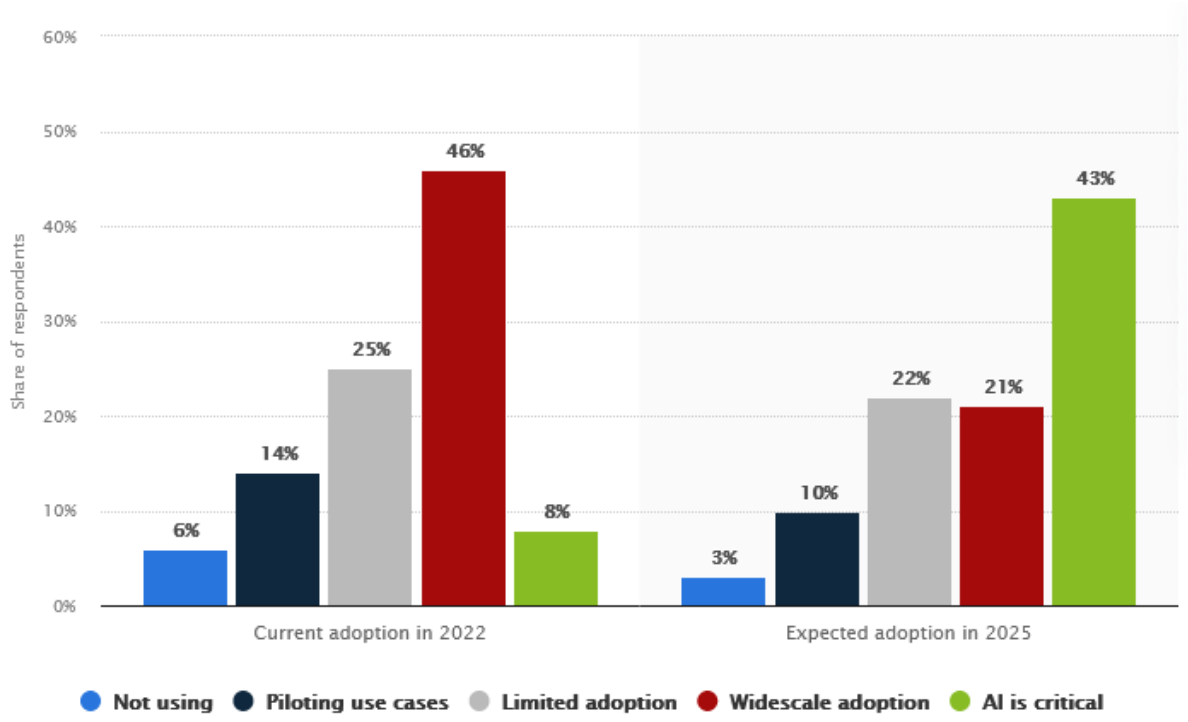


Source: Grandview Research (2021)

AI-powered diagnostics enhance the accuracy of medical imaging analysis, leading to improved disease detection and treatment planning.

7.3 The Finance Sector: The finance sector is another frontrunner in AI adoption, driven by the need for risk assessment, fraud detection, and operational efficiency. A study by Deloitte **(2021)** indicates that 73% of financial services SMEs are investing in AI and automation to improve operations. AI-powered risk assessment models analyse vast datasets to identify potential threats, while fraud detection algorithms mitigate financial losses and enhance customer trust. Figure 5 below shows the journey SMEs in the Financial Services have begun to take in 2022 and what the scenario is expected to look like in 2025, with the criticality of AI rising to level far beyond the simple adoption of the technology.

Figure 5: Adoption of AI in the Financial Services Industry: From Adoption to Criticality



Source: Statista,(2023

The sectors of retail, healthcare, and finance stand out as domains where AI adoption is significantly prevalent among SMEs. These data-driven insights underline the transformative impact of AI in these sectors, leading to improved inventory management in retail, advanced diagnostics in healthcare, and risk mitigation in finance. The trends signify the potential for AI to reshape business practices and drive operational excellence in diverse industry landscapes.

8. Global Landscape of AI Adoption Among SMEs

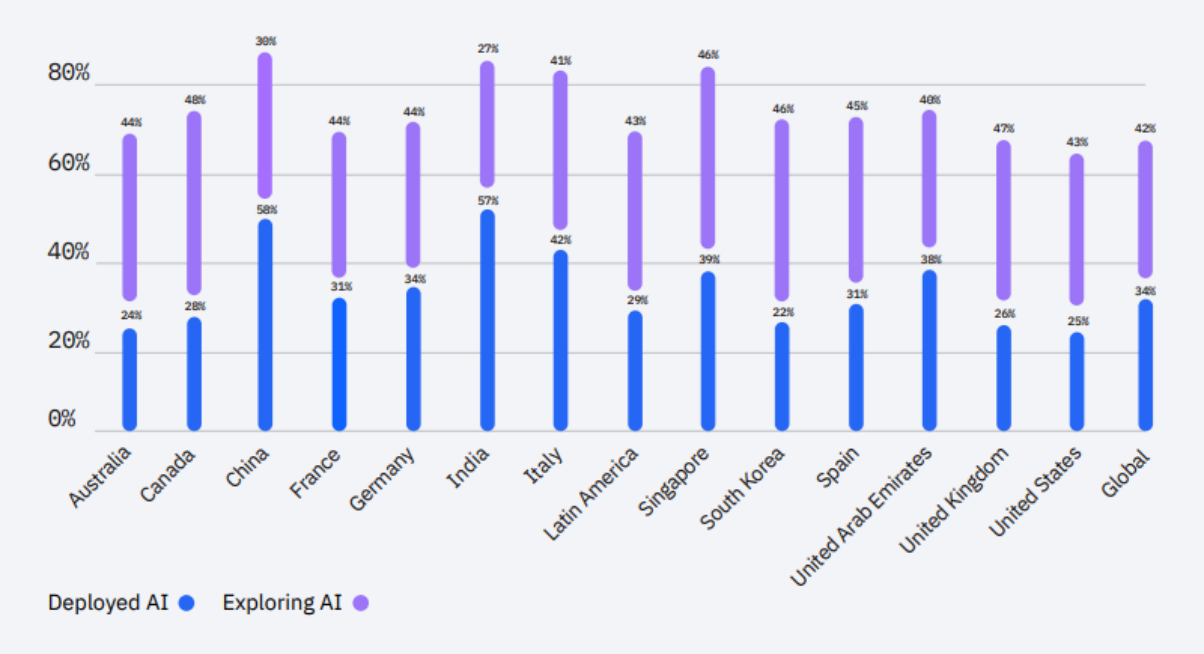
As mentioned earlier AI adoption among SMEs is very much a global phenomenon but the scale and scope of adoption varies by country. Research conducted by CB Insights **(2021)** indicates that countries like the United States, China, and Germany are at the forefront of AI integration in SMEs. These nations benefit from robust technology ecosystems, government support, and skilled talent pools, fostering an environment conducive to AI innovation and adoption.

However, AI adoption differs across companies, geographies, and industries. The industry wise data shows an interesting fact. If we focus attention on information technology (or what we refer to as 'techie') companies from China and India are leading the way. Sixty per cent of the IT professionals in these regions admitted that their companies have started using AI actively and observing better cost & efficiencies (54%), IT network and performances and producing better customer experiences (48%. This rate is considerably higher than UK, USA, Australia and South Korea **(IBM 2022).**

The IBM Global AI Adoption Index 2022 survey identifies China at the top of the AI adoption hierarchy, rolling out the AI across most industries **(84%)** with most of the take up occurring in the automotive industry (67%)). Below is the representation of the industry and geography wise data that accelerates the roll-out of AI.

Overall, in terms of AI adoption intensity of both deployment and exploration, China & India lead the adoption race with Italy and Singapore being the closest contenders. The graphic below (Figure 6) displays the AI adoption rates around the world according to the IBM Global AI Adoption Index 2022 survey.

8.1 Figure 6: AI adoption rates around the world



Source**:** IBM Global AI Adoption Index 2022 survey

9. Navigating Challenges and Solutions in AI Adoption for SMEs

Despite the ostensible benefits, SMEs encounter challenges in AI adoption, including high implementation costs, lack of skilled workforce, and data security concerns. Academic studies, such as those by **Cachon et al. (2020),** emphasize the financial burden of AI implementation on SMEs, often exceeding their budget constraints. Data privacy and security issues pose significant barriers, with SMEs apprehensive about potential breaches and regulatory compliance challenges. Let us look at the main obstacles hindering SMEs from adopting AI for businesses. Table 4 and Figure 7 below provide qualitative and quantitative evidence of the barriers and obstacles faced by SMEs in adopting AI.

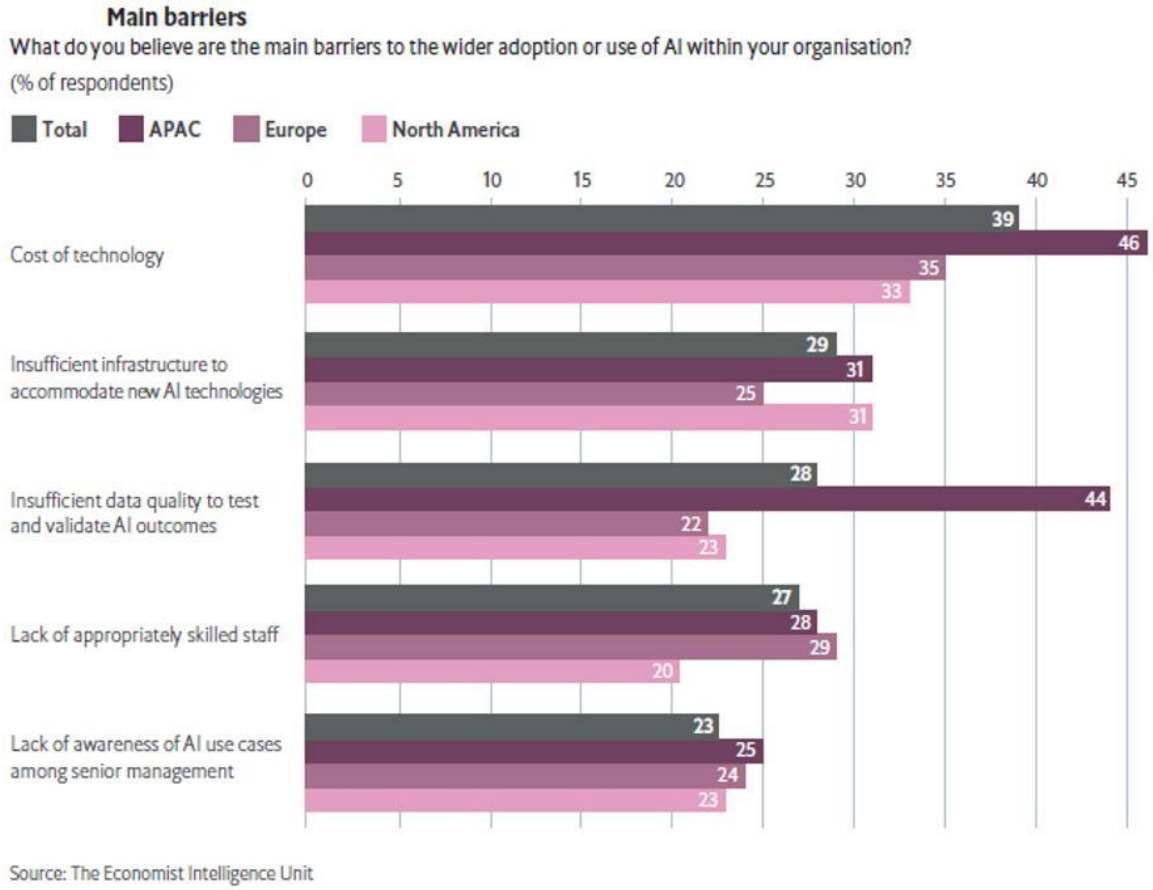
9.1 Table 4: The Key Obstacles to AI Adoption for SMEs: A Qualitative Overview

Key Obstacles	Description

Limited AI Skills, Expertise, or Knowledge	The dynamic landscape of AI necessitates expertise that might be beyond the reach of 34% of SMEs **(IBM, 2022).** The scarcity of AI skills, including data scientists and AI engineers, remains a significant hurdle. SMEs often lack the capacity to attract, train, and retain AI talent. This challenge underscores the critical importance of reskilling initiatives and partnerships with educational institutions. To tackle the shortage of AI skills, SMEs are turning to strategies such as upskilling and reskilling their workforce, collaborating with educational institutions, and engaging in talent-sharing networks. Research by **Molla et al. (2019)** demonstrates that SMEs are partnering with universities to access AI expertise and fostering internal training programs to develop AI competencies among existing employees**.**
Expensive Pricing	The financial implications of AI integration can be daunting for 29% of SMEs **(IBM, 2022).** The cost associated with AI software, hardware, and infrastructure can strain limited resources. The pricing structure of AI solutions, often tailored for larger enterprises, poses a hurdle for SMEs. Mitigating this challenge requires exploring cost-effective solutions and transparent pricing models that align with the budgetary constraints of SMEs. SMEs are exploring cost-effective AI solutions through open-source platforms, cloud-based services, and subscription models. **Kagermann et al. (2013)** emphasize the role of strategic partnerships with AI vendors and shared resources in minimizing upfront expenses, making AI more accessible.
Lack of Tools/Platforms to Develop Models	The absence of accessible tools and platforms for AI model development impedes 25% of SMEs' **(IBM, 2022)** progress in AI adoption. Creating AI models demands specialized software and platforms that might be unavailable or unaffordable for SMEs. Addressing this challenge involves fostering the development of user-friendly AI platforms tailored to the unique needs of SMEs, promoting accessibility and ease of use. To address the dearth of AI development tools, SMEs are increasingly leveraging user-friendly platforms and seeking partnerships with technology providers. **Wu et al. (2018)** highlight the importance of collaborative ecosystems where SMEs can access pre-built AI solutions and customize them for their specific needs.
High Complexity to Integrate or Scale AI	The intricacies of integrating and scaling AI solutions within existing business frameworks present challenges for 24% of SMEs **(IBM, 2022).** The complexity of aligning AI with operational processes and customizing solutions to suit specific requirements can be overwhelming. This challenge calls for strategies that simplify integration and scalability while ensuring minimal

	disruption to ongoing operations. SMEs are streamlining integration and scalability challenges by adopting modular AI solutions and agile implementation methodologies. The study by **Karimi et al. (2020)** suggests that breaking down AI initiatives into manageable phases enables iterative improvements and reduces the complexities associated with scaling.
Highly Complex Data	The value of AI hinges on data, yet 24% of SMEs often grapple with data complexities. The intricacies of data quality, structure, and relevance pose challenges. Issues such as data silos, unstructured data formats, and privacy concerns add to the complexity. Overcoming this challenge entails investing in data management practices, data cleansing, and governance strategies that ensure data readiness for AI integration **(IBM, 2022)**. SMEs are enhancing data management practices by investing in data cleansing, structuring, and governance. Research by **Lacity et al. (2018)** underscores the significance of data quality initiatives and the implementation of standardized data management frameworks to alleviate data complexity barriers.
Lack of AI strategy	The result of a report by **McKinsey (2019)** noted the lack of an AI strategy as the most significant challenge. Effective leadership plays a pivotal role in strategizing and driving technology adoption within SMEs. Research conducted by **Ghobakhloo et al. (2012), Thong and Yap (1995)**, and **Thong (1999)** show that small enterprises with innovative CEOs are more inclined to adopt IT. Additionally, organizational leadership should possess a comprehensive understanding of the new technology's significance and purpose **(Wymer & Regan, 2011)**, as they hold decision-making authority. SMEs are formulating AI strategies that align with their business objectives. The research by **Lepak and Snell (1999)** highlights the value of strategic HR practices in driving the development of AI-focused teams and fostering a culture of innovation within SMEs.
Lack of leader's ownership	**Lorica and Nathan's (2019)** results suggest the lack of leaders' ownership as the most challenging aspect towards AI adoption. Facilitating transparent communication about the technology, initiated from higher management, enhances the likelihood of successful adoption. **Caldeira and Ward (2003)** support this notion, revealing that successful IT adoption is often tied to robust interpersonal relationships between top executives and the team. Furthermore, a well-defined articulation of the business case and its practical application plays a vital role in driving adoption **(Ghobakhloo et al., 2012).**

9.2 Figure 7: The Main Barriers to the Adoption of AI: A Quantitative Snapshot



Source: Economist Intelligence Unit Study, The Road Ahead: Artificial Intelligence and the Future of Financial Services; 2020

SMEs are adopting various strategies to overcome AI adoption challenges. Academic literature by **Chofreh et al. (2019**) suggests that SMEs are forming partnerships with technology providers and universities to access AI expertise. Additionally, consultancy reports like **Boston Consulting Group' (BCG's) "AI in Business" (2020)** highlight the emergence of AI consortia, where SMEs collaborate to share resources, knowledge, and costs related to AI adoption.

Overcoming the lack of leader's ownership involves fostering a culture of AI adoption driven by top leadership. Research by **Denison et al. (2012)** emphasizes that leaders who champion AI initiatives and exhibit commitment play a pivotal role in creating an environment conducive to successful adoption. But they also need a wider, public infrastructure and government intervention in setting standards for the use and adoption of AI.

10. Government Initiatives Driving AI Adoption Among SMEs

Governments worldwide are recognizing the potential of AI in SME growth and are taking initiatives to support its adoption. **McKinsey's report (2021)** outlines various government programs aimed at fostering AI ecosystems, offering financial incentives, training programs, and regulatory frameworks to facilitate AI integration in SMEs. Countries such as Singapore, Canada, and France are leading in AI-focused policies to empower SMEs to harness AI's benefits. It's important to note that the extent of government support varies from country to country, reflecting the capabilities for, the stage and scale of adoption in each economy. The specific initiatives can change over time based on economic, technological, and political factors. Recognizing the transformative potential of AI for economic growth, innovation, and competitiveness, governments are implementing various initiatives to facilitate AI adoption among SMEs. These initiatives includer incentives and regulation, infrastructure development and international collaboration, as Table 5 below enumerates.

10.1 Table 5: Government Initiatives for AI

Type of Support	Specific Schemes	Description
Incentives	**Funding and Grants**	Many governments provide funding opportunities and grants specifically aimed at SMEs looking to integrate AI technologies. These financial incentives help SMEs overcome the financial challenges associated with AI adoption
	Collaborative Platforms	Governments encourage collaboration between SMEs, research institutions, and larger enterprises to foster innovation in AI. Such collaborative platforms provide SMEs with access to AI expertise, research facilities, and resources
	Training and Workshops	Governments often offer training programs, workshops, and seminars to enhance the AI skills and knowledge of SMEs. These initiatives aim to bridge the AI skills gap and empower SMEs to leverage AI effectively.
Infrastructure (hard and soft) **Development**	**AI Hubs and Clusters**	Establishing AI hubs, innovation clusters, and technology parks can provide SMEs with a conducive environment to collaborate, innovate, and access AI resources.
	Data Accessibility	Governments work to ensure that SMEs have access to quality data that is necessary for AI initiatives. Open data initiatives and data-sharing platforms can enable SMEs to develop AI models more effectively.
	Startup Incubators and Accelerators	Governments often support AI-focused startup incubators and accelerators that provide SMEs with mentorship, resources, and networking opportunities
Regulation and Policy	**Regulatory Support**	Governments may establish regulatory frameworks that promote responsible AI adoption while addressing concerns

		related to privacy, security, and ethics. Clear regulations can provide SMEs with a sense of certainty and facilitate smoother integration.
	Policy Advocacy	Governments may advocate for policies that encourage AI adoption by reducing bureaucratic hurdles and fostering a culture of innovation
International Collaboration	**Global partnerships**	Some governments engage in international collaborations and partnerships to share best practices, knowledge, and experiences related to AI adoption among SMEs.

Source: McKinsey (2021)

AI is recognised by the OCED (Organization of Economic Co-operation & Development) as a technology with broad applications that can have a significant impact on societies and economies. They establish guidelines for governments and other actors to promote the innovative and democratic use of artificial intelligence. As a legal instrument of the OECD, the Principles represent a shared aspiration among its signatory nations to develop a human-centred approach to trustworthy AI.

The Ministerial Council of the OECD adopted the Principles on May 22, 2019. The G20 adopted the same AI Principles in June 2019, establishing a global policy and ethical benchmark. **(OECD, 2019[2])** As of March 2020, 44 states, both members and non-members, adhered to the Recommendation. The Recommendation is the first intergovernmental standard for AI combines economic, technological and social responsibility issues and to this end, it provides five principles for the responsible management of reliable AI.

- First, inclusive expansion Sustainability and well-being go hand in hand. Stakeholders should participate in the development of trustworthy AI that can contribute to generating outcomes that are beneficial for both humans and the planet.
- Second, human-centeredness and justice. Human rights, democracy, and the rule of law should be incorporated throughout the lifecycle of an AI system, along with appropriate mechanisms and safeguards, such as human intervention.
- Third, openness and explicability. AI actors who develop or operate AI systems should provide information to stakeholders to promote a comprehensive comprehension of the systems, allowing those impacted by AI systems to comprehend the outcome and challenge the decision if necessary.
- Fourth, durability, safety, and security. AI systems must function properly while assuring traceability, and AI actors must implement a systematic risk management strategy to mitigate safety risks.
- Fifth, responsibility. AI actors should adhere to the principles and be responsible for the correct operation of AI systems.

The principle emphasises the importance of SMEs and encourages adherents to implement national policies and international cooperation with SMEs in mind. In addition, the OECD **(2019[2])** offers five suggestions for national policies and international cooperation in the development of trustworthy AI. These include:

1. Investing in AI research and development.
2. Fostering a digital ecosystem for AI.
3. Creating an AI-friendly policy environment.
4. Developing human capacity and preparing for labour market transformation.
5. International cooperation for trustworthy AI.

Early in 2020, the OECD launched the OECD AI Policy Observatory and established the OECD Network of Experts on Artificial Intelligence **(ONE AI)** to support the implementation of the OECD AI Principles in policies and practises. ONE AI is developing practical guidance to assist nations in developing and monitoring trustworthy AI systems via four working groups: i) classifying AI systems; ii) implementing trustworthy AI; iii) identifying best practises for national AI policies; and iv) a task force on AI compute.

The adoption of AI by SMEs is a dynamic process influenced by factors such as industry, country context, and governmental support. Academic studies, consulting reports, and data sets collectively underline the significance of AI in transforming SMEs' operations, while also shedding light on the challenges they face and the strategies they employ to overcome them. As the AI landscape evolves, SMEs' ability to navigate these dynamics will determine their ability to thrive in the digital age.

11. Concluding Observations

In the constantly changing landscape of technological advancement, Artificial Intelligence (AI) has emerged as a potent force reshaping SMEs globally. This Issues Paper explores the profound impact of AI on SMEs, unveiling its transformative effects across industries, economies, and societies.

The global landscape of AI adoption reflects a dynamic interplay of factors, with the United States, China, and Germany at the forefront of AI adoption due to their robust technology ecosystems and government support. However, AI's influence transcends geographic boundaries and extends to traditional industries, eradicating the distinction between 'techie' and 'non-techie' businesses. In the ‘techie’ sphere, China and India are the leaders.
The section titled "Navigating Challenges and Solutions in AI Adoption" highlights the obstacles SMEs face in adopting AI, including talent gaps and high costs. Nonetheless, SMEs are proactively resolving these challenges via partnerships, reskilling initiatives, and agile implementation strategies.

In industries such as retail, healthcare, and finance, the transformative impact of AI is undeniable. From improving inventory management to revolutionising diagnostics, artificial intelligence is rewriting the norms of business by delivering efficiency gains and customer-centric solutions. Underpinning this development is a recognition of three key issues in the trajectory of technological development – speed, complexity and volume of data. Each technological era, from steam engines to electricity and electronics to aviation, the internet and now AI has benefited from what went before, with the layering of each era providing for more substantive gains in terms of both the speed with which technologies could augment human activity and provide solutions to complex problems not recognised before.

While AI's potential is vast, it comes with economic, ethical, social, and technological challenges. Ensuring fairness, transparency, privacy, and responsible use of AI is crucial. The impact on jobs and workforce dynamics, along with potential biases in AI algorithms, requires careful attention. A report by Jeffrey Dastin in **Reuters (October 2018**) revealed that Amazon had to scrap its AI led recruiting engine after it was found that it its gender bias discriminates against women candidates. More recently the introduction of generative AI (e.g., ChatGPT by OpenAI), has led to a a lot of debate on the threat posed by its misuse if not regulated and limited soon. A recent BBC report revealed that the 75-year-old Geoffrey Hinton who is widely known as the godfather of modern AI, warned about the growing danger of progress in AI. He resigned from the position of the head of AI in Google stating that he regretted his work now. Governments around the world play a crucial role in accelerating the adoption of artificial intelligence by SMEs by fostering an environment through funding, collaboration, and regulatory frameworks. As a central tenet, the OECD's AI principles emphasise human-centred, responsible AI, ensuring that AI's potential is utilised ethically and inclusively.

AI marks, potentially, a turning point in not just technological development but in the creation of new knowledge across the world. There have been several moments in history when new tools and processes heralded epoch-altering scientific discovery and technological innovation. Microscopes and telescopes in the 17th century deviated from extant wisdom to open new possibilities in astronomy physics, and through new inventions such as the pendulum clock and the steam engine. AI is now being applied in every scientific field and in different ways, enabling quicker dissection of vast amounts of high complex data leading to drug discovery, new materials for batteries or solar cells, analysis of the folding of proteins and the creation of galaxies **(The Economist, 2023).** With this awareness of possibilities, probabilities and realities comes the equally important consideration of the dangers. We fear algorithmic bias and discrimination, massive job losses, and according to some experts even the demise of humanity. Against this backdrop SMEs need to navigate the larger terrain of technology and the apparent domination of larger firms in driving economic development and social progress.

To help the world continue with the influence of AI on SMEs as a story of transformation, innovation, and adaptation, there needs to continuous collaboration between governments, industries, and SMEs. These interactions will define the narrative of AI's voyage into the future, as it shapes and reshapes the landscape of business creation, growth, economic and social development.

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