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Empowering Chinese SMEs through Artificial Intelligence: Improving Efficiency through Strategic Adoption

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Abstract: This paper explores how artificial intelligence (AI) can support the digital transformation of Chinese small and medium-sized enterprises (SMEs) in economic management. Although SMEs play a critical role in China's economy, many face barriers such as limited data infrastructure, talent shortages, high costs, and regulatory challenges under the Personal Information Protection Law (PIPL). Drawing on international practices and four Chinese case studies—Inceptio Technology, Club Factory, JUSDA, and Ping An Smart Healthcare—this study proposes five practical strategies: incremental digitization, ecosystem collaboration, MVP piloting, human centered transformation, and privacy first design. The findings suggest that with phased deployment and external partnerships, SMEs can effectively adopt AI without relying on full in-house capabilities.

Keywords: Artificial Intelligence, Chinese SMEs, Economic Management, Digital Transformation, Innovation Strategy.

1. Introduction

The small and medium-sized enterprises (SMEs) account for 99% of all registered businesses in China. At the same time, SMEs are responsible for 60% of GDP and provide employment to over 80% of urban workers (MIIT, 2024). SMEs play an essential role in economic development in China. The sector encourages innovation and entrepreneurship, creating jobs and absorbing excess labor in the process. At the same time, most SMEs remain un-digitized, with limited talent and facing significant barriers to market entry. The result is that many SMEs find it difficult to adopt new technologies. Artificial intelligence (AI) is one of the emerging technologies that has remained largely inaccessible to SMEs.

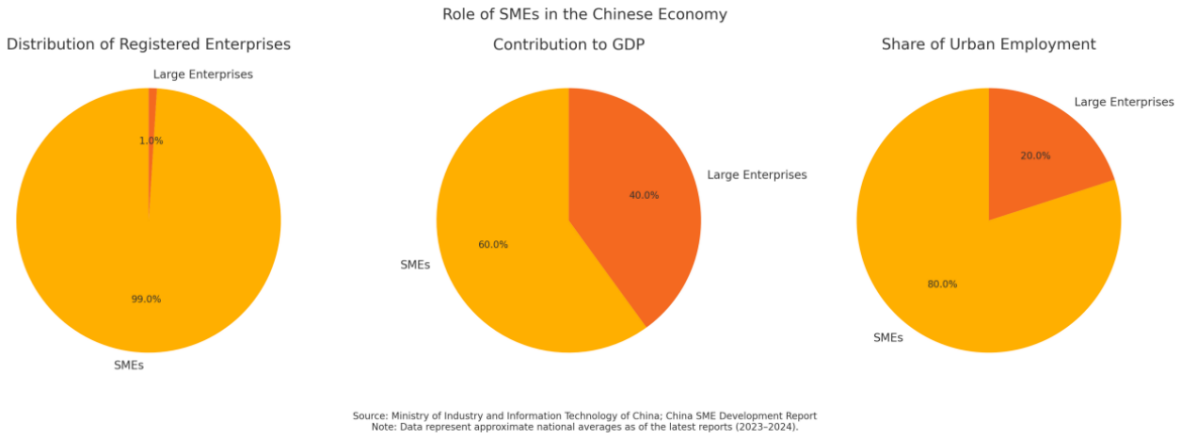


Figure 1. Role of SMEs in the Chinese Economy

AI can both be a blessing and a curse for SMEs and individuals. On the one hand, AI makes life more convenient. On the other hand, AI implies less human control. The goal of this paper is to investigate AI adoption for SMEs. The paper will discuss five low-budget innovation approaches by German SME TRUMPF and four "on the ground" examples by Chinese SMEs. Together, these examples show the ways to take back control of AI adoption.

The central research question of the study is "How can AI be implemented to realistically empower SMEs in their approach to economic management?" It is a complex question because the ecosystem of SMEs in China is so diverse. However, with specific case studies and statistics, it is possible to find answers to the question.

The five innovation approaches include incremental digitization, ecosystem collaboration, MVP piloting, human-centered transformation, and privacy-first design. Four on-the-ground Chinese examples support these points and showcase various SMEs and areas of AI adoption. They include zero-touch production systems, customer engagement CRM systems, intelligent transport systems, and AI HR toolkits. These four examples show that AI can boost efficiency, safety, customer experience, and regulatory compliance in various industries. SMEs do not need to be unicorn giants or global leaders to adopt AI and make it work for them.

2. AI Application Fields in Chinese SME Economic Management

Artificial intelligence (AI) technologies, including machine learning (ML), natural language processing (NLP), generative AI, and robotic process automation (RPA), are now

widely accessible to small and medium-sized enterprises (SMEs) in the form of SaaS AI tools. These tools can be applied to specific business domains or processes for targeted improvements and solutions.

For example, in financial operations, AI can be used to automate bookkeeping, invoice processing, and budgeting, with specific use cases such as OCR-based invoice readers or ML models for forecasting cash flow. In customer and marketing management, AI can be used for behavioral segmentation, dynamic recommendations, or content generation, with CRM systems automating responses and customer lifecycle management. In supply chain management, AI can be used for demand forecasting, intelligent scheduling, or order matching, which will make it possible to reduce stockouts and delivery times. In human resource management, AI can be used to automate job screening, performance evaluation, and employee profiling, with chatbots or KPI analysis helping to reduce hiring time and identify skill gaps.

3. Key Challenges in AI Adoption among Chinese SMEs

While AI has the potential to significantly improve economic management for SMEs, many of these firms in China face significant challenges and barriers when it comes to adopting and integrating it into their operations. Unlike large enterprises, SMEs are often limited by factors such as having fewer resources, greater fragmentation in infrastructure and operations, or being less ready to adopt emerging technologies on technical, operational, or regulatory levels. The following subsections will describe the most common and the most difficult to solve challenges SMEs face when integrating AI.

3.1. Data Quality and Infrastructure Gaps

The lack of data, both in terms of access, availability, and quality, is a fundamental problem when it comes to the AI performance of many Chinese SMEs. Many SMEs still rely on paper-based or manual records, disconnected spreadsheets, or outdated ERP systems that are difficult to train models or integrate intelligent tools with. In addition to that, many SMEs lack basic cloud infrastructure, don't have standardized data pipelines, or only have unstructured data. As a result, even basic automation tasks become an obstacle. The following data digitization, centralization, and clean-up are prerequisites for high-performing AI.

3.2. Talent Shortage and Training Needs

AI development and deployment require specialist skills in data engineering, model training, and system integration that most SMEs are incapable of hiring or retaining. Even when SMEs have access to external vendors who offer AI tools, the staff that will use these tools may not have the technical literacy to optimize, maintain, or interpret AI models or suggestions, which can result in vendor lock-in, customization difficulties, and increased implementation risk. Furthermore, employees can be resistant to these new digital technologies, which can slow down or prevent their adoption.

3.3. Cost Barriers and ROI Uncertainty

For many SMEs operating on thin margins, the added complexity of new technology can be prohibitive. Even SaaS-based AI tools with relatively low operational costs still require a firm to purchase or subscribe to software, pay for data integration, and train employees. As a result of unclear or immeasurable ROI, such tools will be overlooked or delayed. In addition to that, SME decision-makers often lack benchmarks, cost models, or tools to assess whether an AI project is worth the investment. As a result, they will either become overcautious and wait for the technology to become more mature or require full-proof cases of success from the market.

3.4. Legal and Ethical Concerns under China's PIPL

The use of data for AI in China is subject to strict regulation under China's new PIPL, which governs data collection, usage, and consent. SMEs that use AI to process customer data, employee performance, or behavioral data must ensure compliance with the PIPL. However, many SMEs do not have the necessary legal expertise or compliance procedures in place. In addition to legal risk, ethical risks of algorithmic bias, over-surveillance, or misuse of sensitive data can also be a deterrent for SMEs that are considering adopting AI, especially for customer-facing or HR-related applications.

4. Innovation Strategies for Overcoming AI Adoption Barriers in Chinese SMEs

Small and medium-sized enterprises are less likely to be able to integrate AI into their business and production process compared to large enterprises. This is because SMEs are more likely to have limited data and information infrastructure, technical and organizational capabilities, resources, and regulatory preparedness, which are among the main barriers to AI adoption. Here are four innovation strategies that can help SMEs to overcome their core adoption barriers, such as the lack of data infrastructure, internal technical and organizational capabilities, resources, and regulatory preparedness.

4.1. Incremental Digitization to Bridge Data and Infrastructure Gaps

Structured and high-quality data is a prerequisite for any successful AI project. However, without the necessary digital infrastructure to collect, store, and process such data, SMEs will not be able to integrate AI into their processes. The most scalable way to help SMEs create the required datasets without additional operational disruptions and up-front investment is incremental digitization, which means providing modular digital tools that can be adopted step by step, for example, by moving to cloud-based accounting systems, CRM platforms, and IoT devices.

TRUMPF is an example of a German SME, which, with the help of Siemens' MindSphere platform, was able to digitize real-time equipment data, including vibration, temperature, and gas pressure, in order to create an AI-ready product (TRUMPF & Siemens, 2016). The main objective was not to deploy AI, but to collect structured and machine-level data, which could be used for future analytics. As a result, the company was able to reduce its unplanned downtime by 35-45% and accelerate the diagnostic process several times (eoda, 2022).

Club Factory, a Chinese SME cross-border e-commerce platform with over 40 million users, which is also headquartered in Hangzhou like Alibaba, has also digitized its operations for the same purpose. Prior to the digitization, the

company was using static product descriptions, traditional rule-based recommendation systems, and A/B testing on a biweekly basis, which resulted in CTR of only 9.5% and CVR of 2.3% (Chen, 2024).

To solve this problem, the company, with the help of its CRM tools and product tagging system, has built a digital infrastructure that has allowed it to use AI-powered product knowledge graph to index over 40 million SKUs, personalized recommendations engines, and NLP-based content generation system. The resulting CTR has increased to 13.7%, the CVR to 5.9%, and the repurchase rate from 12% to 19% (Ronchini et al., 2024). In addition to that, dynamic pricing algorithms resulted in up to 12% revenue uplift for fast-moving SKUs.

The two given examples show that the performance of AI in SMEs also depends on their digital readiness. Incremental digitization can help SMEs create a strong foundation of data necessary for future AI success.

Table 1. Club Factory's Key Metrics Before and After AI Deployment

Club Factory'sKey Metrics Before and After Al Deployment			
KPI	Before Al	After Al	Changel
	%	%	%
Click-Through Rate (CTR)	9.5	13.7	↑ 4.2
Conversion Rate (CVR)	2.3	5.9	↑ 3.6
Repeat Purchase Rate	12	19	↑ 7
Revenue Growth (Fast skUs)	0	12	↑ 12

4.2. Tackling Technical Talent Gaps with AI Ecosystems and Partnerships

Small to medium-sized enterprises (SMEs) often do not have the technical talent in-house to build or run their own AI systems. They may not have existing teams of data scientists or machine learning engineers with the right skillsets. It may also be difficult or expensive to hire these specialists, or train internal staff to fill skill gaps. Instead of investing in the talent and resources needed for full in-house AI development, SMEs can more feasibly tap into external ecosystems of public cloud platforms, open-source software, API-driven AI-as-a-service tools, and academic partnerships. External ecosystems can help SMEs leverage mature AI technologies and implementation capabilities.

UK online grocery retailer Ocado started as a mid-sized SME and now co-develops advanced automation and routing systems with NVIDIA, Intel, and academic research labs. Ocado itself does not build every element of end-to-end AI systems for warehouse and delivery automation. Rather, the company embeds plug-and-play AI technology modules from external suppliers into its operations. Ocado integrates AI-powered inventory management, robotic process automation, and algorithmic route planning modules from NVIDIA and other AI technology partners (NVIDIA, 2024).

Deployed systems enabled Ocado to reach 99.9% order fulfillment accuracy, double warehouse throughput and operate 24/7 with minimal manual oversight (Ocado Group, 2025). By tapping into external ecosystems, Ocado realized competitive performance gains without having to recruit deep technical teams of its own.

Chinese SME JUSDA is the warehousing and logistics arm of Foxconn, serving thousands of SME manufacturers. JUSDA runs shared warehousing and transportation services for SME manufacturing and logistics providers in China. Warehouse operations prior to AI adoption included manual demand forecasting, static picking routes, and siloed inventory information (JUSDA Global, 2025). Warehouse picking required paper-based order picking documents and was highly labor-intensive. Operators did not have real-time or dynamic information on SKUs, resulting in stockouts, poor allocation of staff and equipment, and slow response to quality issues.

When reporting commenced, stockout rate was more than 12%, the time for an average picking order was greater than 3.2 minutes per item, and inventory information had an access rate of less than 80% because data was not connected between individual warehouses, (JUSDA Global, 2025). It was unclear which suppliers or SKUs were responsible for these problems and why.

JUSDA responded by partnering with Alibaba Cloud to launch an AI-enabled logistics initiative in 2023. The company did not build its AI systems internally. Instead, JUSDA integrated JUSDA leveraged pre-trained models, and APIs for demand forecasting, picking route optimization, and other AI use cases from Alibaba Cloud. This ecosystem approach helped JUSDA scale up AI adoption without building its own internal technical team or making large infrastructure investments.

AI systems were deployed to ingest and analyze real-time SKU movement, supplier lead times, historical sales, and other sources to power dynamic decisions within JUSDA's warehouses. Stockout rate fell by 30%, and picking efficiency improved by 18% so that average picking time was reduced to less than 2.7 minutes. Inventory access and transparency improved to 99%. Warehouse managers could also view status and abnormalities of goods and personnel in real-time.

Warehouse response time to quality issues improved by 40% through automated alert systems rather than using a spreadsheet manual report-and-escalation process (JUSDA Global, 2025). AI-powered slotting optimization also contributed significantly to these improvements. Slotting decisions were previously based on fixed shelf classification criteria such as SKU category. The new system used AI to dynamically optimize shelf layout based on picking velocity and order frequency. This reconfiguration improved warehouse throughput by 12% and allowed better space and labor allocation for fast-moving products during high-demand periods (JUSDA Global, 2025).

JUSDA's case shows how ecosystem collaboration can help Chinese SMEs overcome internal resource and technical talent constraints to apply AI. By integrating pre-trained external AI platforms and technologies into SME workflows, complex or cross-functional use cases such as logistics operations can achieve high impact.

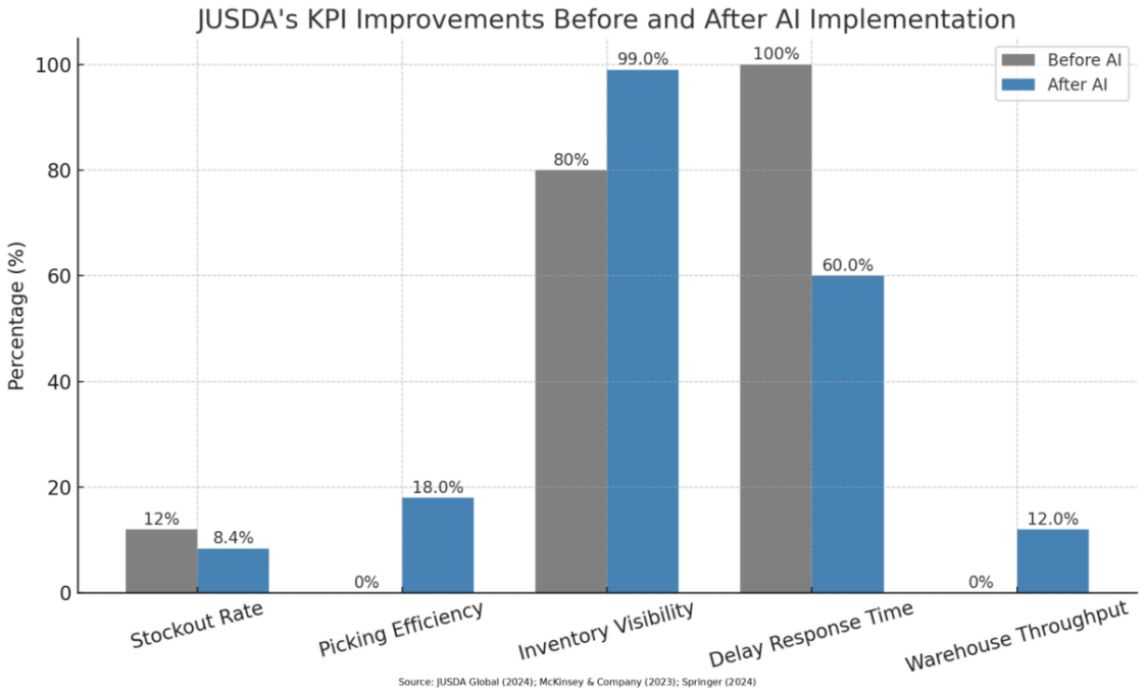


Figure 2. JUSDA's KPI Improvements Before and After AI Implementation

4.3. Scenario-driven MVP Pilots to Minimize AI Costs and Uncertain ROI

Limited financial resources and uncertainty over return on investment (ROI) are often cited by Chinese SMEs as the top barriers to AI adoption. High implementation costs and unclear or delayed payback timeframes present high risk to SME budgeting and financial planning. SMEs can reduce upfront capital outlays, risk exposure, and financial uncertainty over AI by adopting a scenario-driven Minimum Viable Product (MVP) approach. In this strategy, SMEs scope out well-defined use cases in areas with the highest expected impact, then carry out scenario-driven or pilot-level deployments in live production environments. This approach to MVP piloting makes AI deployment more manageable for SMEs.

German industrial machinery firm TRUMPF implemented AI through a phased MVP approach. Instead of digitizing the entire company at once, TRUMPF first targeted predictive maintenance on high-value machinery sets. Sensor data collection was done first using IoT sensors that were connected to the Siemens MindSphere platform. Only after a foundational data layer had been built up were AI-powered analytics tools introduced into TRUMPF's machinery maintenance workflow. The first phase of predictive maintenance proved the value case by delivering a 35–45% decrease in unplanned production downtime, which justified further expansion of the program (eoda, 2022). The staged approach allowed TRUMPF to evaluate short- and long-term cost-benefit tradeoffs before committing resources.

In China, Inceptio Technology, a logistics technology company providing AI solutions, adopted an MVP-first approach to pilot and deploy its AI tools. The company first rolled out its proprietary Level 3 autonomous driving system Navigate-on-Autopilot on a small subset of long-haul routes within its delivery fleet. Inceptio Technology tested specific AI functions for autonomous driving on highways, fuel monitoring and management, and route optimization in the course of actual deliveries, rather than doing these trials in a simulated environment (Inceptio, 2023).

The results of this trial deployment were compelling: monthly costs per driver fell from ¥30,000 to ¥15,000-¥24,000, a 20–50% reduction, while fuel consumption fell by 2–6%, and average delivery time decreased by 5–10%. Safety performance also improved, with zero accidents reported and a 35% decrease in driver fatigue. These empirical results gave Inceptio Technology the proof points it needed to secure financing to expand and scale AI modules to be used on national logistics corridors (WJARR, 2024).

Large corporations may have the luxury of long-term R&D budgets or internal AI labs, but SMEs typically cannot afford to invest in AI across all functions without clear KPIs that are able to generate quantifiable benefits in a short time frame. Scenario-driven MVP piloting is a risk-manageable approach that also serves as a necessary learning process to scale AI. SMEs can apply MVP piloting in a process of experimentation under real-world constraints and with limited technical overhead.

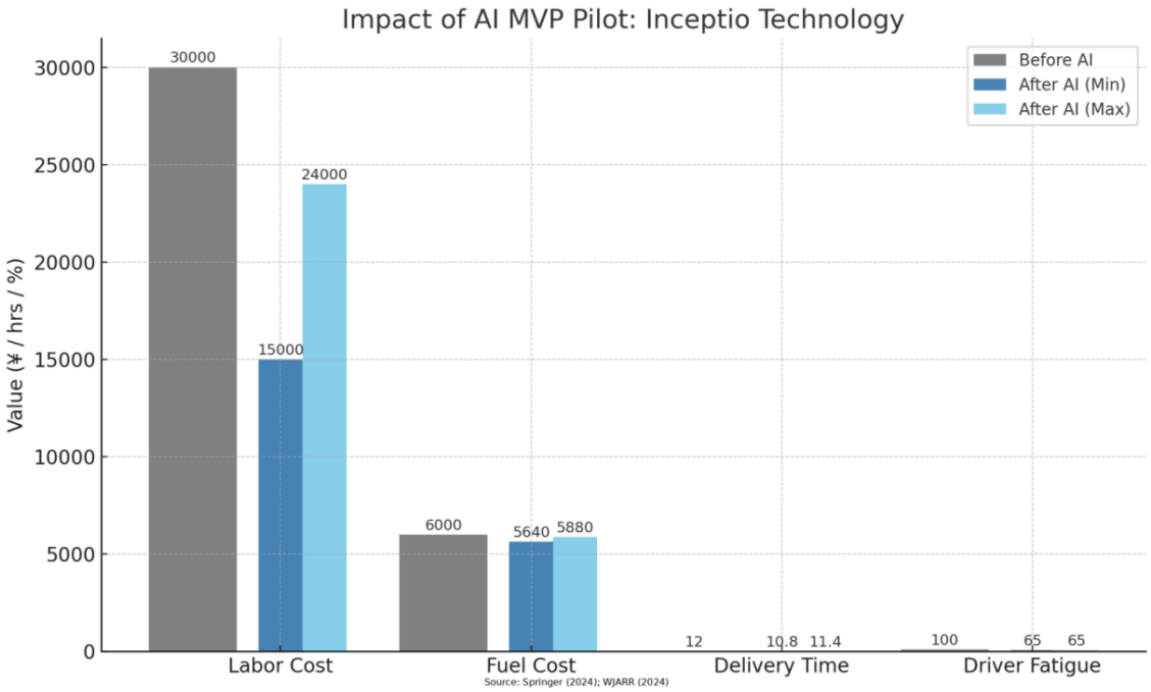


Figure 3. Impact Of AI MVP Pilot: Inceptio Technology

4.4. Privacy-First Design for Legal Compliance and Ethical Use of AI

With the 2021 rollout of China's Personal Information Protection Law (PIPL), businesses are now under more regulatory pressure when it comes to collection, storage, processing and use of individual information. PIPL enshrines many user consent, data minimization and accountability rules, including those related to cross-border data transfers and explicit accountability for algorithmic decision-making. Compliance with PIPL and related standards can be daunting for SMEs that lack legal or compliance resources. Profiling or collecting data from users for AI models, and systems that perform automated decision-making or behavioral analysis, may also trigger closer regulatory and public scrutiny for SMEs.

One solution is a "privacy by design" approach to AI tool development and deployment. That means taking legal and ethical use cases into account in the very design of the technology—from the architecture of the system (e.g. by defaulting to anonymized datasets, scrubbing personally identifiable information (PII) where possible, or building opt-in, transparent user consent collection at the front end) through to the AI testing and release processes (transparent documentation of the input training data and the decision thresholds for automated outputs). In other words, build in privacy and ethical practices from the start to minimize compliance risk, but also to set the foundation for long-term trust from users and partners.

GDPR-enforced markets in Europe have led the way in privacy-first design for AI. Finnish SME HappySignals, which provides employee experience analytics, uses aggregated and anonymized data, as well as full customer control over consent-based metrics collection. Human review loops have been built into every automated recommendation to the customer. This human-in-the-loop architecture, privacy-first approach to data collection and use, and robust compliance with GDPR not only kept HappySignals out of hot water, but also enabled rapid growth in its AI-augmented service offerings (HappySignals, 2022).

For Chinese SMEs, Ping An Smart Healthcare, a healthcare tech subsidiary of Ping An Group, has already put AI into a range of use cases for healthcare, from hospital triage and diagnostics to health insurance claim fraud detection, in ways that embed privacy as a non-negotiable. For example, in its AI-assisted triage product that's been adopted by several provincial health systems, all patient information is tokenized and encrypted and any AI output is subject to human, licensed physician review before action is taken. Ping An Smart Healthcare also set up a data compliance committee to vet all operations for alignment with PIPL and related healthcare-specific guidelines on data use (Ping An Healthcare Technology Research, 2023).

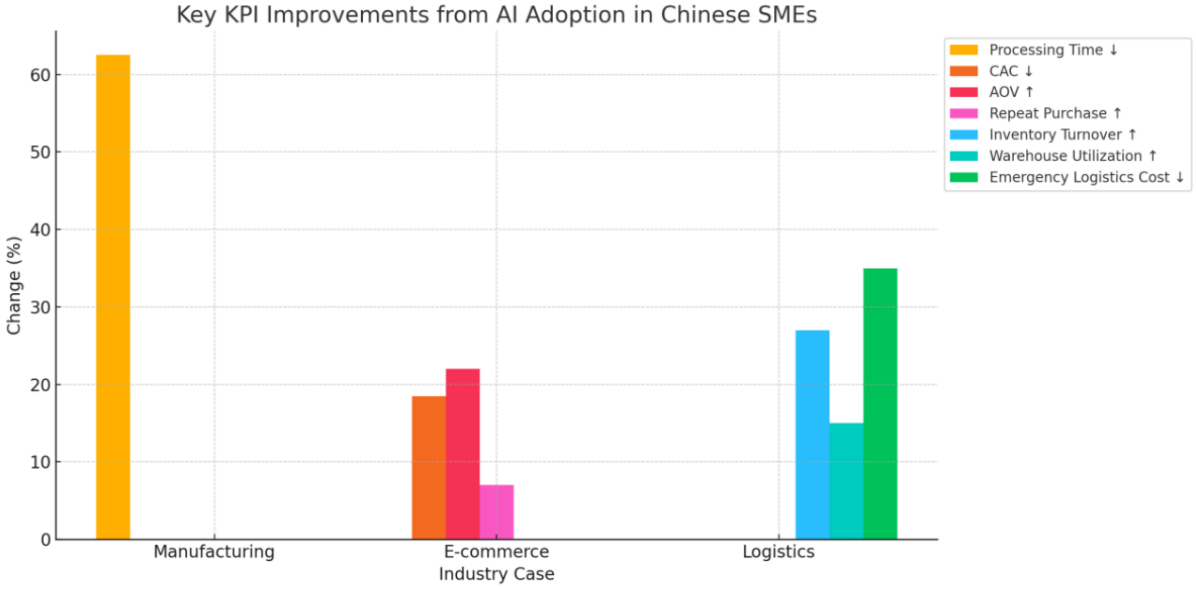
Smaller SMEs without the resources of Ping An can adopt similar strategies. The AI should default to using as little data as possible, select pseudonymized or non-sensitive user attributes for processing, and incorporate simple opt-in/opt-out mechanisms that are easy for end-users to understand. If contracting with cloud vendors, SMEs should look for providers that offer compliance capabilities baked in for data logging, access control, auditing, and cross-border data transfers. Cloud and AI platform providers like Tencent Cloud, Baidu AI, and Huawei Cloud have been creating PIPL-aligned templates and API wrappers for these use cases. The upshot is that SMEs can see legal and ethical compliance not as a barrier but as a product design opportunity. Privacy by design is now also a selling point and a strategic advantage that will build the long-term trust needed for responsible innovation.

5. Conclusion and Future Outlook

This paper has investigated the challenges and opportunities for Chinese small and medium enterprises (SMEs) to adopt artificial intelligence (AI) in a modular, phased, and collaborative way to improve their economic management capabilities. It has analyzed the main barriers to adoption, such as data infrastructure, talent, cost, and regulation; it has suggested five innovation approaches, including gradual digitization, platform ecosystem, scenario-based MVP piloting, human-AI collaboration, and privacy

protection. It has also conducted case comparison across different industry domains such as manufacturing, e-commerce, and logistics to validate the effectiveness and feasibility of the proposed innovation approaches. The paper has found that with the modular, phased, and collaborative adoption of AI, SMEs can achieve tangible benefits in efficiency, accuracy, and customer satisfaction, even with limited resources and technical capabilities. Furthermore, by leveraging external resources and platforms such as cloud computing, open source, and public policy support, SMEs can overcome many of the entry barriers and technical challenges associated with AI adoption.

The paper's key findings on the principal KPl gains from the AI adoption can be seen in Figure 4, and the key finding and research contributions have been listed in Table 4.



Source: Panwar (2024); Chen (2024); Ministry of Industry and Information Technology (2023); EU SME Centre (2023)

Figure 4. Key KPl lmprovements from Al Adoption in Chinese SMES

In terms of future outlook, the long-term AI adoption and innovation of Chinese SMEs will require three major enablers. The first is the continued innovation and refinement of modular, SaaS-style AI tools that can lower the technical threshold for SMEs. The second is policy alignment and regulatory clarity that can provide fair competition and accountability rules for SMEs without stifling their innovation potential. The specific laws and regulations include “PRC Network Security Law” and “The Personal Information Protection Law (PIPL)”. The third is capacity building and empowerment of SMEs through cross-sector training, knowledge sharing, and digital infrastructure support that are tailored to their specific needs and contexts. Of course, as one can see, our paper only validates our hypothesis using real cases rather than investigating the topics in more depth. The future research can build upon this work to further explore how different SMEs can adopt AI differently according to their sectors, sizes, goals, and resources, how AI adoption can have long-term impacts on SME performance, competitiveness, and social impact, and how emerging technologies and trends can shape the future of SME-AI innovation in China and beyond. Empowering SMEs with AI is not only a technical challenge, but also an economic imperative for inclusive and innovation-led growth in China.

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