



# **DETERMINANTS OF AI ADOPTION FOR SMALL AND MEDIUM-SIZED ENTERPRISES (SMEs): EVIDENCE FROM CHINA**

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Abstract

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Artificial intelligence has developed rapidly in recent years and is widely used in many fields. This thesis describes the current situation, challenges, and potential opportunities for artificial intelligence in Chinese small and medium-sized enterprises. This thesis aims to explore issues related to Chinese small and medium-sized enterprises and analysis the characteristics of this particular business environment more broadly. Moreover, the aim is to provide an overview of the development of artificial intelligence and its application in various industries, and particular to research its popularity, application methods, and technological progress among small and medium-sized enterprises in China. This thesis uses the TOE Framework to explore factors influencing AI adoption in Chinese SMEs, highlighting technology, organization, and external pressures. Qualitative methods, including interviews and thematic analysis, uncover key challenges, benefits, and policy implications. Subsequently, it provides solutions to the challenges businesses face when implementing AI, including insufficient data, limited technical complexity, and a shortage of skilled professionals. The study explored that AI adoption in Chinese SMEs boosts operational efficiency and decision-making, but faces barriers like technological limitations, financial constraints, and skills gaps. Recommendations include infrastructure improvement, employee training, and government support. Finally, the paper explores the future of artificial intelligence in Chinese small and medium-sized enterprises from the perspectives of policy, technology, and the market. Then, the potential impact of artificial intelligence on the development of Chinese small and medium-sized enterprises is explored from the perspectives of policy, technology, and the market. The thesis concludes that AI offers efficiency gains for Chinese SMEs but faces financial, technical, and talent hurdles. It recommends enhancing infrastructure, providing employee training, and utilizing government support to optimize AI adoption. This thesis aims to provide theoretical guidance and practical reference for small and medium-sized enterprises to achieve transformation and upgrading with the help of artificial intelligence technology.

Keywords Artificial intelligence; Small and medium-sized enterprises; Application status; Challenges; Opportunities; Adoption

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# 1 Introduction:

## 1.1 Background of the Study

According to Ziemnowicz (2020), economic growth is attainable only through transformative innovation. In a dynamic and uncertain business environment, companies are continuously working to enhance innovative strategies and approaches to maintain their competitive advantage and promote long-term growth (Hsiang et al., 2023).

The integration of artificial intelligence (AI) with Industry 4.0 and the digital age is bringing significant transformations across various sectors. This convergence is speeding up digitalization and promoting the creation of innovative business models, particularly within the manufacturing and service industries (George, 2024; Chen et al., 2023). AI improves Industry 4.0 technologies such as the Internet of Things (IoT), big data analytics, and cyber-physical systems by enabling real-time data processing, predictive maintenance, and informed decision-making (Soori, 2022). These advances help organizations optimize production processes, reduce downtime and develop more efficient business models (Gutiérrez, 2023).

In addition, AI-driven automation is greatly facilitating the implementation of China's "Made in China 2025" strategy, which aims to modernize industry (Lee et al., 2022). Applications of AI in robotics and machine learning can assist companies in enhancing personalized, intelligent production and optimizing supply chain management. The ability of AI to learn from data and adapt enables production systems to develop in line with Industry 4.0 objectives (Dash et al., 2022).

Currently, management models are constantly being updated due to the enormous impact of economic globalization, major technological changes in production processes, business development, productivity improvements, and the management and control of business activities (Gutiérrez, 2023). Artificial intelligence (AI) plays a crucial role in strategic planning and has been used by companies to gain a competitive advantage (Varian, 2018). In the current fast-paced economic landscape, it is seen as the most significant business opportunity. By 2030, global GDP is projected to increase by 15.7 trillion US dollars (Rao & Verweij, 2017). In addition, currently available IoT deployments are largely closed and tailored to specific application domains with vertically integrated solutions (Soori, 2022) and have transitioned from an "old" but emerging technology to a controlled reality (Alsheibani, Cheung, & Messom, 2018).

Small and medium-sized enterprises (SMEs) are crucial to the economies of most nations, especially in developing regions. SMEs dominate the global business landscape and play a vital role in job creation and driving global economic growth (Gutiérrez, 2023). According to Rao & Verweij (2017), if the enterprise is in an industry with a low likelihood of disruption and therefore slow to adopt new technologies, it will face significant challenges: no industry or enterprise is immune to disruption.

According to Correa (2017), leading AI users are beginning to stand out from other users. While many organizations struggle to scale AI and derive value, leading AI organizations (such as Google, Amazon, Tencent and Alibaba) have successfully completed the daunting task of scaling AI projects and producing valuable results. It further illustrates that the genuine capability to harness AI technology for customer service is with a select group of major entities.

The sustainability of both huge multinationals and small enterprises will be scrutinized in the absence of new technology (Gutiérrez, 2023). To make such a judgement, companies must understand the various factors affecting the application of artificial intelligence, assess their impact on enterprise operations and decision-making processes, and identify the obstacles hindering the implementation of artificial intelligence (Rikap, 2023). In addition, governments and technology providers should engage external stakeholders to support AI adoption and provide practical advice to optimize AI integration, thereby improving the competitiveness and sustainability of Chinese SMEs.

## **1.2 Research Objective**

However, although Chinese SMEs have great potential for applying artificial intelligence technology, related applications are still in their early stages. Small and medium-sized enterprises have limited knowledge of artificial intelligence technology, insufficient application capabilities, and relatively few resources invested (George, 2024).

On the other hand, the degree of match between artificial intelligence technology and the actual needs of enterprises needs to be improved. The Chinese government places significant emphasis on artificial intelligence within its policies. Over recent years, it has introduced various bills aimed primarily at advancing the artificial intelligence sector. Such as "Guiding Opinions on Accelerating Scenario Innovation to Promote High-Quality Economic Development through High-Level Artificial Intelligence Applications" These policies have

created beneficial policy conditions for developing artificial intelligence among small and medium-sized enterprises in China. However, when companies use artificial intelligence technology, many challenges such as technical difficulties, lack of talent, and data security issues still exist. How can small and medium-sized enterprises use artificial intelligence technology to maximize their advantages? (Gutiérrez, 2023). Addressing this issue is crucial for boosting the core competitiveness of enterprises.

This study aimed to deliver a comprehensive, enterprise-level examination of AI adoption among Chinese SMEs by employing this methodology. It's aimed to identify the sectors within Chinese SMEs that adopt Artificial Intelligence, evaluate its impact on business operations and decision-making, and pinpoint the obstacles hindering AI implementation. Moreover, examine the influence of external stakeholders and the government and technology providers on the adoption of Artificial Intelligence. With the focus on provide practical advice on Artificial Intelligence integration to improve competitiveness and promote sustainable development in Chinese SMEs.

### **1.3 Research Question**

To accomplish the primary goal of the study, the author developed two key research questions.

*Question: How AI technology evolved over time and what is its significant in the Business context?*

*Question: What are the factors which SMEs should consider while adopting AI technology?*

### **1.4 Research Contents**

This research seeks to examine the present state, obstacles, and potential opportunities for small and medium-sized enterprises (SMEs) in China regarding the application of artificial intelligence (AI). Therefore, this paper sorts out and discusses relevant literature, cases and statistics, sorts out the development of artificial intelligence in Chinese small and medium-sized enterprises, and uses the TOE theory for analysis. Secondly, the promotion and application of artificial intelligence in the field of small and medium-sized enterprises: the government, enterprises and all sectors of society are working hard to promote the application of artificial intelligence technology. Next, the study discusses how artificial

intelligence can be applied to small and medium-sized enterprises. It describes various areas to be explored, including production and manufacturing, sales and marketing, customer service and human resources management. The article also explores how artificial intelligence technology can help small and medium-sized enterprises improve efficiency and ultimately reduce costs, thereby maintaining a better market position.

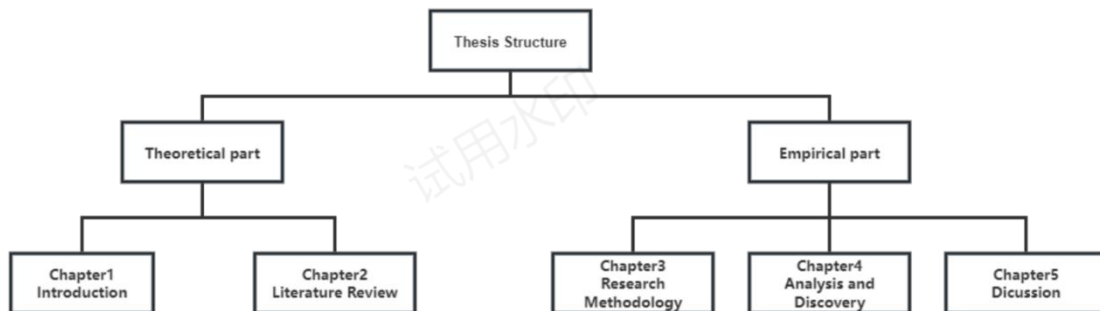
Small and medium-sized enterprises (SMEs) face technical barriers, high investment, talent shortages and data security issues when applying artificial intelligence. Based on these problems and difficulties, this paper uses the Technology-Organization-Environment (TOE) theory to analyze the advantages and disadvantages of current policies, measures and solutions, providing a reference for SMEs to solve current problems. The last suggestion is for the study of artificial intelligence for SME development. Governments should sponsor more in research and development or applying artificial intelligence technology to SMEs with supporting tax incentives, loans, etc. (Colvin, 2022). Enterprises should actively embrace artificial intelligence, vigorously promote technological innovation and talent cultivation, and work together with large enterprises for common progress.

Meanwhile, reshape the path of industry collaboration and win-win, promote seamless connections in AI capability and the actual needs of the enterprise, and promote SMEs to realize sustainable, high-quality development (Yang, 2024). In short, this study systematically examines the implementation context, application fields, challenges and coping strategies of artificial intelligence in Chinese small and medium-sized enterprises, with a view to providing a useful reference for policy formulation, enterprise development and industrial transformation.

## **1.5 Thesis Structure**

This bachelor's thesis begins with an introduction that covers the background, research objectives, and an overview of the problem. The literature review section explores the main concepts of artificial intelligence, digital transformation and the specific challenges faced by small and medium-sized enterprises (SMEs). The following section outlines the research methods employed, including qualitative techniques such as interviews, case studies and data analysis. These approaches are employed to enable a thorough analysis of the role of artificial intelligence in Chinese SMEs. The case studies analyze three cases of Chinese SMEs, demonstrating the practical applications, operational impacts and challenges of using artificial intelligence in different business environments. The final section provides discussion, conclusions, limitations of the research and suggests future research opportunities.

Figure 1 Thesis Structure



## 2 Literature Review

This chapter explores the development, applications and challenges of artificial intelligence (AI), emphasizing its role in the digital transformation, business efficiency and innovation of small and medium-sized enterprises (SMEs), and focuses on the application and integration strategies of AI in China.

### 2.1 Artificial Intelligence

This section will explore the concept of artificial intelligence (AI), including its origins as the brainchild of human ingenuity, and how it is revolutionizing the way industries operate (Fetzer, 1990; Dobrev, 2012; Rashid & Kausik, 2024). Artificial intelligence is defined as a system capable of learning, reasoning, and problem-solving, and its historical roots can be traced back to the seminal work of Turing and McCulloch-Pitts (Hendryck, 2024). The development of artificial intelligence began with early neuron simulation models

## 2.1.1 Artificial Intelligence development

### Definition of artificial intelligence:

One of the fascinating things about the field of artificial intelligence (A.I.) is that the precise nature of its subject is surprisingly difficult to define (Fetzer, 1990). Artificial intelligence is considered "artificial" because of its origin and the way it was created. It is the product of human invention and creativity, rather than the result of natural (especially biological or evolutionary) influences (Fetzer, 1990). An information processing system capable of generating information related to information objects at a lower level (Suleimenov, 2020).

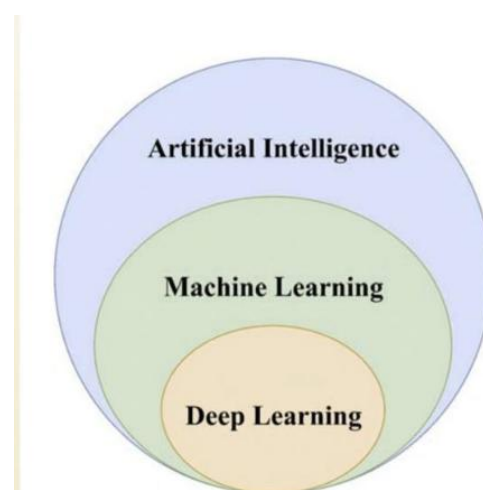
For example, the New World Dictionary (1988) defines "intelligence" as a) the ability to learn or understand from experience; the ability to acquire and maintain an advantage in knowledge; mental capacity; b) the ability to deal with new situations quickly and successfully; to solve problems using reason, to direct behavior effectively, etc.; c) in psychology, a measure of the success with which these abilities are used to accomplish specific tasks" (Fetzer, 1990).

Artificial intelligence can now be defined informally as a process that is not inferior to humans in its ability to deal with a random world (Dobrev, 2012).

### Development of artificial intelligence:

Artificial intelligence has shown great potential over the past 70 years but has never lived up to the high expectations placed on it. Currently, artificial intelligence is transforming many industries by performing tasks that require human intelligence to solve problems and enhancing the application of artificial intelligence in an efficient and precise manner (Rashid & Kausik, 2024). Artificial intelligence starts with machine learning, which centers on algorithms capable of learning intricate tasks and creating predictive models from sample data.

Figure 2 Artificial intelligence – Machine Learning – Deep Learning (Adopted from Dobrev 2012, p. 394)



The figure 2 shows: The main aim of artificial intelligence is to simulate humans. Machine learning is a sub-field of artificial intelligence that uses data to learn complex associations.

Recent achievements in machine learning applications are largely due to progress and breakthroughs in Deep Learning (DL), a specialized area within the broader field of machine learning. Deep learning refers to methods that rely on deep neural networks (Rane, et al., 2024). Deep Learning (DL) techniques identify the best feature set directly from the data, removing the necessity for manual feature engineering. Originally, neural networks were designed to replicate the neural activities of the human brain. As this domain progresses, its popularity increases, making it crucial to comprehend its history and recognize possible challenges (Groumpos, 2023).

### **Development history:**

The earliest artificial intelligence models attempted to simulate individual neurons, starting with the simplest models based on feed-forward and simple input-output functions. The earliest artificial intelligence models attempted to simulate individual neurons, starting with the simplest models from feed-forward and simple input-output functions. This eventually developed into the building blocks of modern deep neural networks or deep learning (DL) (Hendryck, 2024). Alan Turing opened the door to the field of artificial intelligence in October 1950 with his publication "Computing Machinery and Intelligence". In 1943, McCulloch and Pitts described in a paper a computer model for learning, whose processing is similar to neurons in the human brain. (They described this model as the McCulloch-Pitts (MCP) neuron). In 1958, Rosenblatt published a more complex McCulloch-Pitts (MCP) neuron called a perceptron and used this neuron to first realize the development of "artificial intelligence"(Zohuri & Moghaddam, 2018). In 1985, Rumelhart, Hinton and Williams solved the problems raised by Minsky and Papert and introduced the gradient descent optimization method to reduce network errors. This marked the second development of "artificial intelligence". The third development of "artificial intelligence" came in the mid-1990s. Computers underwent rapid development during this decade. In 1997, IBM developed the chess supercomputer "Deep Blue", which defeated the chess champion Garry Kasparov,

proving the combination of artificial intelligence and sufficient computer power. Since then, artificial intelligence has attracted attention and developed rapidly (Dobrev, 2012).

In China, the development of artificial intelligence technology has received great attention from the government and enterprises. In recent years, the state has introduced a series of policies to support the development of the artificial intelligence industry. Small and medium-sized enterprises are actively investing in the use of artificial intelligence to increase output value, reduce expenses, and strengthen their market position (Xiao, 2024). Chinese SMEs widely use artificial intelligence technology in many industries, including smart manufacturing, financial technology, and education and training. The continued advancement of artificial intelligence will help Chinese SMEs reach new heights.

Artificial intelligence has already gone through the stages of infancy, growth and maturity. In China, numerous large corporations have already integrated artificial intelligence technology extensively, and small to medium-sized businesses are beginning to adopt it as well.

## **2.2 Digital Transformation and Artificial Intelligence**

This section explores the role of digital transformation and artificial intelligence (AI) in improving business efficiency and innovation. Digitalization is the basis of this transformation, and by using tools such as artificial intelligence, cloud computing, and big data analytics, SMEs are able to streamline its operations, reduce costs, and drive innovation (Neugebauer, 2019; Huang & Kumarasinghe, 2024). Focus on the infrastructure and expertise needed to use AI. Alibaba and Tencent have made advances in digital infrastructure and affordable cloud solutions in China, supporting SMEs and enabling them to better utilize AI technologies (Hussain & Rizwan, 2024; Wu, 2024).

### **2.2.1 Digital Transformation**

The foundation of digital transformation is digitization, which involves converting raw data like audio, images, and text into a digital format. This enables cost-effective and storage convenient, duplication, transmission and processing (Neugebauer, 2019). Digitization refers to the using digital technology to completely transform business models and open up a new way of creating value and income (Hu et al., 2023). In China, Small and medium-sized enterprises are increasingly adopting cloud computing, artificial intelligence and big data analysis to optimize operations. Research has shown that these technologies can streamline

business processes, reduce operating costs and improve production efficiency (Huang & Kumarasinghe, 2024). Digital transformation enables small and medium-sized enterprises tap-into global knowledge and innovation networks. Research shows that digital tools use can help enterprises to collaborate external stakeholders, access real-time market data, and promote product and service innovation (Neugebauer, 2022). Digital transformation usually focuses on business operations: enterprise automation, supply chain management and logistics optimization, digital sales/marketing and e-commerce (Mariia et al., 2020)

### **2.2.2 Adoption**

The successful application of artificial intelligence in enterprises requires a basic technical architecture, including computing power, storage capacity and network facilities, to support artificial intelligence applications (Li et al., 2017). In addition, adaptability is crucial. Enterprises need talent and AI experts who can not only adapt to evolving technologies, but also put them to use (Jöhnk et al., 2021). Small and medium-sized enterprises generally recognize the potential advantages of artificial intelligence. Research shows: many enterprises consider artificial intelligence to be a strategic driver in future competitiveness, especially in industries such as retail, manufacturing and finance (Wang, 2023). China's digital infrastructure has improved significantly, especially in urban areas, the cloud computing services, and high-speed internet are widely available. This will lower the threshold applying artificial intelligence, making it easy for small and medium-sized enterprises to try out artificial intelligence tools without having to make large upfront investments in the technology (Hussain& Rizwan, 2024).

Lowering the threshold for the application of artificial intelligence can enable small and medium-sized enterprises to easily try out artificial intelligence tools without having to make large upfront investments in the technology (Wu, 2024). Major Chinese technology companies such as Alibaba, Tencent and Huawei provide cloud-based AI solutions for small and medium-sized enterprises, enabling businesses to use AI tools without having to build complex in-house systems. These services usually use a pay-as-you-go model, which makes them more affordable for small businesses (Zhou & Wang, 2021).

## **2.3 Artificial Intelligence and Businesses**

In implementing AI, relatively to the traditional process, it only needs a few changes for increasing efficiency, such as Alibaba's AliCloud service, which allows users to build a virtual

host from their mobile devices; this enables them to access things that cannot be done on their mobile phones or tablets. The newly developed AI by Jitterbug is an interactive intelligent assistant that increases convenience by interacting with AI character beans through talking.

### **2.3.1. Tencent Holdings Limited**

The 2024 Tencent Global Digital Ecosystem Conference officially kicked off at the Shenzhen International Convention and Exhibition Centre in Shenzhen, China, on the 5th-6th of September. During the conference, Tang Daosheng, Senior Executive Vice President and CEO of Tencent's Cloud and Intelligent Industry Business Group said: "New tools are designed to promote digital efficacy, allow enterprises to achieve new growth, understand new trends, and enter global markets." Tencent upgraded many of its product lines to help their partners and enterprise customers reach their AI and digitization goals.

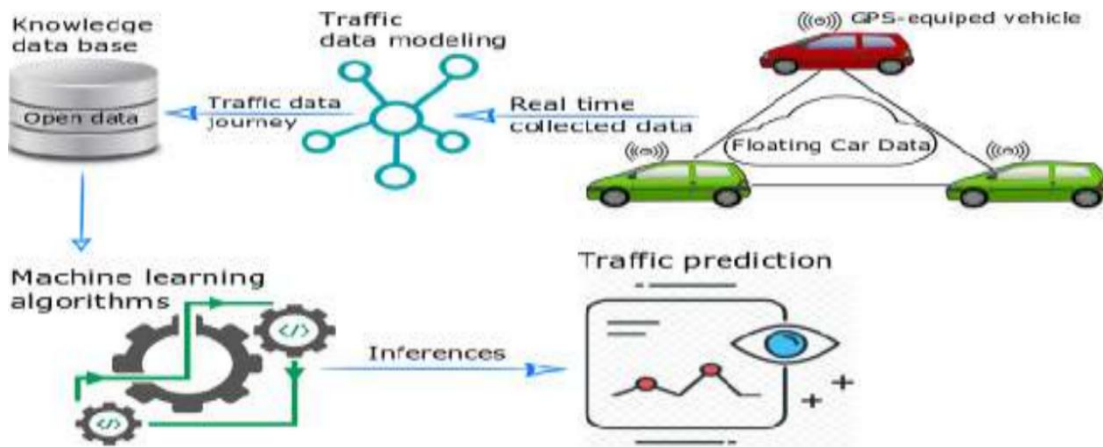
Tencent Cloud Intelligent Computing is an all-new brand launched under AI Infra, providing a suite of computing, storage, and networking technologies aimed at helping the organization effectively fast-track the development and training of large models by optimizing infrastructure. Tencent also released the first "Tencent hybrid Turbo" model, based on Mixture of Experts (MoE), which had an improvement in inference efficiency twice that of the previous generation, while the inference cost was only 50% of the previous generation. Tencent Cloud AI leverages the hybrid paradigm in this code assistant and now serves more than half of the programmers in Tencent Group, helping reduce coding time by an average of up to 40%. Intelligent recording, AI assistant, and multilingual translation, overall, Tencent Conference now serves more than 15 million MAUs (Tencent, 2024).

### **2.3.2 Google Maps**

Google Maps, a service offered by Google, caters to a diverse audience by providing commuter and tourist traffic data. It aims to predict traffic patterns with high accuracy and determine the optimal routes to various destinations. It has collected several billions of photos from highways, landscapes, facilities, and monuments on every corner of the globe to guide users through the integration of data and satellite imagery. According to a blog post by Johann Lau, Product Manager at Google Maps, it is now set to enhance the traffic predictions with more detailed data picked up from multiple locations. This process uses

Machine Learning (ML)—a part of Artificial Intelligence—to scan stored data and use it in an algorithm to provide improved service for customers.

Figure 3 Traffic Prediction Model in Google Maps. (Adopted from Pulluparambil et al., 2021, p29)



DeepMind, the AI subsidiary of Google Alphabet Inc., has teamed up with Card to enhance traffic prediction skills. The use of a Graph Neural Network (GNN) reduces such inaccuracies in estimated time arrival (ETAs). It is created by combining a Graph Neural Network (GNN) model with a route analyzer. A route analyzer decides upon the "best route" depending on accessible traffic information and geographical data, while the Graph Neural Network (GNN) model predicts the time ahead (Garun, 2020).

### 2.3.3 Alibaba

Its main competitor is Amazon, which for its part did develop a plan regarding AI, led by the Institute for Data Science and Technology (iDST) (Salah & Ayyash, 2023).

Alibaba, meanwhile, took this research unit and built its cloud service off of it, then later transitioned it into ET Brain, which, according to the enterprise, democratizes 'Artificial Intelligence' for enterprises, making AI technology more practical in real life under many facets. In 2016, Alibaba established its Artificial Intelligence Laboratory, while in 2017, the enterprise announced Aligenie, an interactive assistant that would contribute to customer service and enhance the operational functions of the enterprise by using voice recognition and other capabilities provided by artificial intelligence. According to Jia et al. (2018),

currently, Alibaba is trying to seek vertical integration with its alliance with the hardware makers of AI, besides also collaborating with the developers of AI software.

In contrast, Alibaba has designed an intelligent customer support robot called 'AliXiaomi' for automating its services. It manages a large volume of queries, complaints, and referrals, thereby increasing overall productivity and reducing the time required for manual customer service. Intelligent logistics integrated with the system optimize delivery routes and manage warehouses in real-time, hence improving supply chain efficiency and reducing delivery costs (Wu, 2024)

With the advent of the Internet era, smart devices have appeared all around us. Company can better automate marketing and e-commerce based on artificial intelligence technology (Drydakis, 2022). By combining customer usage habits with internet information such as social media, personal data, internet activity and transactions, customers can be targeted more accurately and better services can be provided (Campbell et al., 2022). Company can use artificial intelligence to analyze customer preferences, to meet customer needs in a targeted manner, provide potential customer with content that matches their preferences, and increase the purchase chances. This method also considers the customer's consumption level and interacts with the customer in person manner through various channels and devices (Jadhav, 2021). In addition, digital advertising can use artificial intelligence to analyze each touch-point, that accumulating large amount of high-quality data that will enables enterprises to predict customer needs in real time and recommend specific promotional activity. According to the research of Hu et al. (2023) and Mariia et al. (2020), these data can be used to gain insight into customers' behavior patterns, create personalized advertising and evaluate impact. Artificial intelligence can use data to improve conversion rates and customer service levels, thereby enhancing customer experience and satisfaction.

## **2.4 Small and Medium-sized Enterprise**

### **2.4.1 Definition**

The definitions of SME is usually based on either qualitative characteristic, quantitative thresholds or both combinations (Arentz et al., 2013). The Bonn Federation of Small and Medium-sized Enterprises (IFM Bonn) and the European Commission (CEC) have established a clear threshold: according to the IFM Bonn definition, small and medium-sized enterprises (SMEs) are those with fewer than 500 employees and a turnover of less than 50

million euros (IFM Bonn, 2016). The quantitative threshold in the Commission of the European Communities (2013) definition are 250 employees, EUR 43 million in total balance sheet amount, or EUR 50 million in sales.

### **2.4.2 Importance**

In global, the small and medium-size enterprises (SMEs) role and importance cannot be ignored. They are the epitome of large enterprises and to some extent also reflect the characteristics of large companies. Small and medium-sized enterprises play a vital role in the economy of a country. They are a source of entrepreneurial capacity, innovation and the creation of new jobs. They are also unique in their ability to adopt, adapt and diffuse new technologies (Neagu, 2016).

Small and medium-sized enterprises can create more new jobs at lower cost in the market and are an important part of the solution to the unemployment problem. Small and medium-sized enterprises (SMEs) account for more than 99% of all businesses in most economies around the world (McKinsey, 2022). Data from the European Commission in 2018 indicates that 99.8% of business entities are SMEs, which employ 66.6% of the EU's workforce. From 2016 to 2021, small and medium-sized enterprises (SMEs) in Europe were responsible for creating 85% of new jobs and contributed 56.4% to the EU's added value in the non-financial business sector (Commission of the European Communities, 2020). In Romania, this proportion is as high as 99.6% (Neagu, 2021), While in Asia, SMEs account for more than 96% of all businesses and provide two-thirds of employment in the Asian private sector (Yoshino & Taghizadeh-Hesary, 2018). Between 2007 and 2012, small and medium-sized enterprises (SMEs) made up 98% of all businesses in the country, contributed an average of 38% to the gross domestic product (GDP), and employed 66% of the national workforce (Asian Development Bank (ADB), 2014). In terms of trade, Asian SMEs account for an average of 30% of total exports. In China, SMEs accounted for 41.5% of total exports in 2012, an increase of 6.8% year-on-year; in Thailand, SMEs accounted for 28.8% of total exports, an increase of 3.7% year-on-year (Yoshino & Taghizadeh-Hesary, 2018).

### **2.4.3 Chinese Industrial Enterprises Above/Below Designated size**

The Provisional Standard for the Classification of Small and Medium-sized Enterprises, issued in 2003 in accordance with the Small and Medium-sized Enterprise Promotion Law,

provides guidance on the classification of small and medium-sized enterprises. This policy replaced the old guidelines issued in 1988 (supplemented in 1992).

Figure 4 Provisional Standard for the Classification of Small and Medium-sized Enterprises (Adopted from Central People's Government of the People's Republic of China, 2003.).

Size Category	Industries	Employment-based	Total assets	Business revenue
Small	Industry	< 300	<¥ 40million	< ¥ 30million
	Construction	< 600	<¥ 40million	<¥ 30million
	Wholesale	<100		<¥ 30million
	Retail	<100		<¥ 10million
	Transport	<500		<¥ 30million
	Post	<400		<¥ 30million
	Hotel & restaurant	<400		<¥ 30million
Medium	Industry	300- 2000	¥ 40million-400million	¥ 30million-300million
	Construction	600-3000	¥ 40million-400million	¥ 30million-300million
	Wholesale	100-200		¥ 30million-300million
	Retail	100-500		¥ 10million-150million
	Transport	500-3000		¥ 30million-300million
	Post	400-1000		¥ 30million-300million
	Hotel & restaurant	400-800		¥ 30million-150million

*Note:* SME meet one or more of the conditions. ME should meet three conditions, the others are SE.

The guidelines primarily address wages, income, and overall enterprise assets (refer to the graph above) and pertain to industries including manufacturing, construction, transportation, wholesale and retail trade, as well as hospitality and catering sectors. The Industrial Guidance outlines specific criteria for defining small and medium-sized enterprises (SMEs). SMEs must have no more than 2,000 employees, annual revenue up to 300 million yuan, and total assets not exceeding 400 million yuan. Medium-sized enterprises should employ at least 300 people, with annual revenue capped at 30 million yuan and total assets limited to 40 million yuan. Companies that do not meet these thresholds are classified as small enterprises.

In China, the definition of small and medium-sized enterprises (SMEs) differs across provinces, cities, and counties. The primary criterion is typically workforce size: SMEs generally employ between 100 and 500 people. However, given the country's significant population and the large scale of many enterprises, a substantial proportion of SMEs (approximately 70%) consists of businesses with fewer than 10 employees or individual

proprietorships (Liu, 2008). Additionally, SMEs are classified based on factors such as industry sector, workforce size, annual income, tax contributions, and total assets.

Due to the size of China's small and medium-sized enterprises and market, they may be quite large compared to other countries. In order to further cultivate and expand the market entities, China formulated the standard of "Industrial Enterprises Above Designated size" in 1998. In general, the scale of an enterprise is determined by its annual output, with China establishing specific scale requirements for various industries. Enterprises that meet these criteria are referred to as above-designated enterprises, while those that do not are called below-designated enterprises. Both above-designated and below-designated enterprises are further categorized into very large, large, medium-sized, and small enterprises (National Bureau of Statistics of China (NBSC), 2024).

The most important difference between enterprises above a certain size and those below is their annual main business income, and different provinces, cities, counties and towns have different standards for this. According to information from the State Council of the People's Republic of China (Government of the People's Republic of China, 2024), 1998 - 2006 Standard of "Industrial Enterprises Above Designated size" : All state-owned or non-state-owned industrial legal entities with annual revenue of more than 5 million yuan from their main business 2007-2010 Standard of "Industrial Enterprises Above Designated size": industrial legal entities with annual revenue of 5 million yuan or more from their main business. 2011 - present Standard of "Industrial Enterprises Above Designated size": industrial legal entities with annual revenue of 20 million yuan or more from their main business.

For example, if enterprise A's main business income in 2022 exceeds 20 million yuan, the enterprise will be included in the "industrial enterprises above designated size" in 2023. If the enterprise's main business income is less than 20 million yuan in 2023 due to poor management, it should be classified as an "enterprise below designated size" in 2024. Enterprises should declare to the local statistics bureau, and after the National Bureau of Statistics has approved the financial statements, tax returns, business licenses and other relevant materials, the enterprise can be entered into the enterprise directory and data can be reported.

Figure 5 Basic data on registered SMEs (by region) (Adopted from National Bureau of Statistics of the People's Republic of China)

Item Grouping	Unit¥ Legal Entity	Employment¥ person	Business Revenue of Whole Year¥ thousand	Total Assets¥thousand yuan
Total	2,327,969	58,947,778	6,535,425,319	7,229,524,125
Beijing	98,674	1,470,505	207,285,861	657,757,029
Tianjin	55,807	1,024,926	127,213,911	183,215,064
Hebei	87,605	2,696,972	278,018,746	260,643,092
Shanxi	49,637	1,477,966	117,159,956	161,678,971
Inner Mongolia	22,053	606,530	67,269,521	71,756,861
Liaoning	110,081	2,323,698	231,823,792	323,912,284
Jinlin	32,418	816,716	85,096,910	105,668,596
Heilongjiang	40,790	1,027,397	86,283,651	134,806,517
Shanghai	207,535	2,892,309	490,727,489	520,598,329
Jiangsu	270,669	6,563,781	885,977,068	741,983,051
Zhejiang	241,220	5,705,517	807,014,644	712,725,889
Anhui	59,902	1,758,246	151,277,230	148,582,691
Fujian	77,230	2,151,462	234,096,548	244,422,928
Jiangxi	43,605	1,424,390	110,038,669	108,360,418
Shandong	177,407	5,001,380	576,783,722	477,638,376
Henan	110,182	3,566,630	337,158,734	265,175,536
Hubei	51,682	1,621,358	139,841,497	175,295,610
Hunan	57,720	2,004,921	173,679,267	154,595,563
Guangdong	230,474	6,376,904	666,692,455	803,158,592
Guangxi	33,473	957,281	81,077,721	103,616,338
Hainan	7,836	147,402	15,204,345	33,739,621
Chongqing	34,683	1,143,975	105,127,683	97,136,789
Sichuan	75,330	2,138,436	200,793,576	271,805,434
Guizhou	19,134	647,977	47,661,656	62,891,774
Yunnan	29,160	837,651	72,241,664	108,011,660
Tibet	851	37,834	2,587,052	6,585,768
Shanxi	45,906	1,173,463	109,487,046	116,132,571
Gansu	23,879	677,594	50,300,257	66,582,624
Qinghai	4,693	141,599	9,363,128	16,833,170
Ningxia	4,693	141,599	9,363,128	16,833,170
Xinjiang	18,648	340,509	46,743,236	66,910,179

#### 2.4.4 Development Status of Small and Medium-sized Enterprises in China

The adoption of new technologies entails uncertainty for companies, since most of the time, they do not know how the introduction of technology in their processes will improve or worsen (Gutiérrez, 2023). These are crucial decisions, and they must be the smartest, since they can be the door to digital transformation, a new business model, process reconfiguration,

the ability to make all areas more efficient, cost reduction, among many other things (Gutiérrez, 2023).

By the close of 2022, China had more than 52 million small and medium-sized enterprises (SMEs) (China IP News, 2023). The large number of SMEs, characterized by their adaptable business models, sharp market awareness, and specialized advantages, have become the driving force behind the emergence of new industries, business forms, and operational modes. They possess significant competitive strengths and growth potential, making them a crucial engine for advancing the high-quality development of China's economy (National Bureau of Statistics of China, 2023). By the end of 2021, small and medium-sized enterprises (SMEs) will have contributed over 50% of China's tax revenue and generated more than 60% of its gross national product, fixed asset investment, and outward investment. These contributions significantly support the sustainable development of China's economy (National Bureau of Statistics of China, 2023). However, these figures have obvious importance for the Chinese market, where there is still more flux in the development and creation of SMEs due to the decentralization and diversity of these companies. The 'SME Development Environment Assessment Report 2023' (China) indicates that the number of SMEs in the 50 participating cities rose from 26,793,000 in 2021 to 29,114,000 in 2022, reflecting an 8.7% growth rate. This steady increase in the number of SMEs highlights their consistent growth. According to Mariia et al. (2020), digitization transforms companies.

#### **2.4.5 Artificial Intelligence in Chinese SMEs**

According to 2022 survey by McKinsey & enterprise (China), the domains of AI applications in SMEs can be identified as: Intelligent Manufacturing, The adoption of automated production lines, robotics, and many other technologies for betterment in the production rate and to lower the cost for enterprise

On the other hand, AI technology can further accelerate production and cut operational costs for organizations, enhancing their competitive advantage. It also fosters innovation and the development of new business models, facilitating further market expansion. What's more, AI technology can enable companies to move towards ecologically friendly development by reducing energy consumption and environmental degradation. However, the practice of artificial intelligence in Chinese small and medium-sized enterprises has encountered some problems in their implementation. The investments in AI research, development, and implementation is high, while small to medium-scale enterprises may experience limitations for finance, technology, and management. The understanding and application of AI

technology have seriously been needed inside organizations, while the urgent need of forming a team knowledgeable and skilled in artificial intelligence is quite prominent.

The policy supports the Chinese government and relevant departments in developing the AI industry, supporting small- and medium-sized enterprises to take part in funding with financial subsidies and enjoy tax benefits. Meanwhile, they support enterprises to strengthen cooperation with colleges, universities, and research institutes to enhance their technology innovation capabilities and cultivate more professionals

## **2.5 Compatibility**

Prior to the era of Industry 4.0, industries faced challenges in continuing to operate with existing technologies (Chatterjee et al., 2022). These limitations are preventing organizations from adopting AI. And SMEs face multiple organizational, environmental, technological and personal barriers to using AI (Chaudhuri & Vrontis, 2021). DOI theory states. The application of an innovation correlates well with its applicability to a given context and experience. And compatibility has a favorable impact on the expected implementation of error profiles in SMEs (Kumar et al., 2021). Compatibility describes how well an innovation matches existing values, previous experiences, and the needs of potential users (Chatterjee, 2019). This means that the higher the compatibility, the more efficient the adoption of AI by SMEs. Successful adoption of AI technology leads to higher productivity and shorter manual work hours. Incompatibility usually requires major process adjustments, which can be difficult to adopt and requires a lot of learning (Usmani et al., 2023). AI technology requires a lot of data, especially machine learning (Huang & Kumarasinghe, 2024). At the same time AI techniques coordinate data, networks and software hardware better than existing techniques. Therefore, if SMEs want to apply AI better, then they need to get higher compatibility.

## **2.6 Factors influencing the adoption of artificial intelligence**

The use of artificial intelligence (AI) in small and medium-sized enterprises is seen as an important driver for improving operational efficiency and competitive advantage (López et al., 2024). The biggest barrier to the AI widespread adoption is the lack of skilled AI professionals (López et al., 2024). Many small and medium-sized enterprises lack the expertise needed to effectively use artificial intelligence technology, and some region lack

digital literacy and technical expertise, resulting the high recruitment costs, especially in small cities and less developed regions (Huang & Li, 2021). Technical skills are crucial to the AI solutions implementation. Small and medium-sized enterprises can invest in staff training are more likely to be able to realize the full potential of AI technology, thereby improving operational efficiency and decision-making capabilities (Davis et al., 2023).

The artificial intelligence use in SMEs is still gradually increasing. Many companies have recognized the AI potential to improve operational efficiency and customer experience (Davis et al., 2023). Overcoming multiple barriers, such as data quality issues and funding constraints, is required to achieve full AI integration, these factor may affect the effectiveness AI algorithms and the company's ability to allocate resources to AI projects (Hu et al., 2023). To effectively adopt AI, SMEs would need to comprehensively assess their organizational culture, data quality, business models and strategic approaches (Hu et al., 2023). Fostering an organizational culture that encourages innovation and enhancing data management practices are essential for the effective implementation of AI.

Moreover, the regulatory environments and market dynamics significantly influence the artificial intelligence future in small and medium-sized enterprises. Understanding and complying with compliance requirements is key to the successful adoption of AI by small and medium-sized enterprises, while supportive regulations can stimulate innovation (Schwaeke et al., 2024). In the industry, competitive pressures is driving small and medium-sized enterprises to adopt artificial intelligence to remain competitive and meet customer needs (Hussain & Rizwan., 2024). In this fast-evolving landscape, small and medium-sized enterprises should consider artificial intelligence as a key strategy for enhancing efficiency and achieving sustainable growth.

### **2.6.1 Technical aspects**

Technical barriers are major factors preventing small and medium-sized enterprises from adopting artificial intelligence (DENG, 2024). Technical capabilities refer to the physical resources needed to implement innovative data, networks, computer hardware, etc. (Aboelimged, 2014). Recent research shows, the artificial intelligence technology immaturity and instability are the main challenges in small and medium-sized enterprises in adopting artificial intelligence technology (DENG, 2024). Despite impressive achievements in recent years, the artificial intelligence in practical applications reliability and accuracy still needs to be improved, as evidenced by the persistent technological gap between large enterprises and small and medium-sized enterprises (Sharma et al., 2023). More than 80% of small and

medium-sized enterprises senior managers in Latin America believe information technology is a key factor in improving competitiveness (Gutiérrez, 2023). This underscores the crucial role of technology in establishing competitive advantages and the challenges small and medium-sized enterprises encounter in effectively adopting it.

In addition, the relatively rapid iterative updates in the artificial intelligence field have created challenges for small and medium-sized enterprises in technological catch-up and adaptation terms. For small and medium-sized enterprises, maintaining competitiveness while adopting new technologies is a complex issue (DENG, 2024). Research shows that these companies should focus on balancing technological development and maintaining existing competitiveness (Sharma et al., 2023).

Data is the cornerstone of artificial intelligence technology, but there are serious challenges in terms of data accumulation and quality. As Sharma et al. (2023) and Deng (2024) point out, high-quality data is crucial for effective AI model training for small and medium-sized enterprises, but obtaining high-quality data is often very difficult. In addition, the uncertainty of data quality in small and medium-sized enterprises can lead to errors in the AI learning process, which can adversely affect the application results.

Support from hardware and software platforms is a major factor in the implementation of artificial intelligence technology (Parunak, 1996). Nevertheless, small and medium-sized enterprises frequently exhibit constrained investment in technical equipment and talent development, which gives rise to considerable resource limitations in the deployment of artificial intelligence technology (Zhou & Wang, 2021). The integration and application of artificial intelligence technology also relies on a high-quality talent pool. The relatively insufficient talent pool in small and medium-sized enterprises is a key factor affecting the development of artificial intelligence in small and medium-sized enterprises.

### **2.6.2 Top management and business operations**

Enterprises often encounter various difficulties in their operations and management, especially in the field of artificial intelligence. For small and medium-sized enterprises (SMEs) in China, the term "optimal management support" is used to describe the use of high-level FWD involvement. Senior management commitment can have a positive impact on the allocation of underutilized innovation when it comes to strategy formulation, capital reserve allocation and resource allocation (Praveen et al., 2020). Artificial intelligence has the potential to transform organizations by improving operational efficiency and promoting

sustainable growth. For small and medium-sized enterprises, the successful adoption of AI largely depends on the active support and dedication of top management.

According to Sharma et al (2023), for a project to be successful, management needs to provide continuous support during implementation. If top management does not facilitate AI training for current employees, it will be challenging for them to learn new technologies, ultimately hindering the enterprise's overall operational efficiency. This also shows that senior managers of small and medium-sized enterprises can seize the right opportunities, supervise specific projects, and provide sufficient funding and resources, and the projects are likely to succeed (Usmani et al., 2023).

### **2.6.3 Costs**

Resources, assets and supply are crucial when it comes to the application and adoption of artificial intelligence in small and medium-sized enterprises (SMEs). Resource scarcity refers to the assets and supply that a business has at its disposal at this stage. Compared to large enterprises, SMEs usually have less funding for research and development, technical talent and investment (Sharma et al., 2023). SMEs must therefore carefully evaluate the costs and benefits of adopting new technologies. Resource scarcity can certainly become a major problem if new technologies are invested in the wrong asset areas.

According to Jöhnk et al. (2021), the definition of costs as those associated with documented benefits, i.e. the using modern technology outweigh the costs advantages. This concept is particularly important in the adoption of artificial intelligence context (Zhou & Wang, 2021). Small and medium-sized enterprises need to weigh the potential benefits against the financial and operational costs (Jöhnk et al., 2021). Recent research has shown that the artificial intelligence implementation financial burden including training, infrastructure and maintenance cost, may be too much for small and medium-sized enterprises (Sharma et al., 2023). The large-scale AI projects adoption by SMEs is a long-term process, to successfully transition to smart operations, companies transitioning to AI should implement a reliable security strategies (Gutiérrez, 2023). Small and medium-sized enterprises often face higher cyber security risk when during the digital transformation process (Zhou & Wang, 2021). The financial impact is not limited to the initial investment, but also include recurring cost related to security protocol and regulatory compliance.

The demand for skilled labor increases small and medium-sized enterprises costs. Lack of qualified personnel may lead to increased training cost or reliance on external consultants, further depleting limited resources (Hansen & Bøgh, 2021).

#### **2.6.4 Policy and regulatory barriers**

In developing country, small and medium-sized enterprises face significant policy and regulatory barriers to artificial intelligence adoption (Marios & Tulus, 2021). These barriers are reflected in the lack of a supportive regulatory framework, insufficient financial access, and limited government resource. This is particularly evident in the researched country, where large enterprises are often able to take policy support advantage and resource allocation, while small and medium-sized enterprises are the relative disadvantage (Zhang et al., 2022). This discrimination limited small and medium-sized enterprises develops potential in the artificial intelligence field and exacerbates imbalances in market competition. Current literature suggests the AI technology regulations uncertainty may deter small and medium-sized enterprises in considering investing in new technologies (Hansen & Bøgh, 2021). The artificial intelligence accelerating development have raised concerns about compliance and the possibility in regulatory change, which poses a challenge for small and medium-sized enterprises to formulate effective long-term strategy (López et al., 2023).

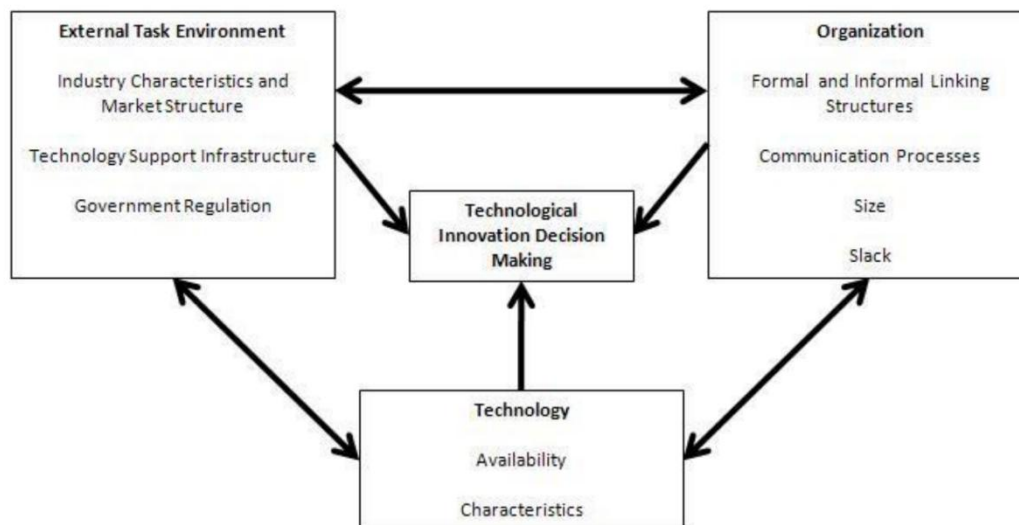
Moreover, in many developing country, existing policies will not adequately address the unique challenges faced by small and medium-sized enterprises, resulting in a lack of targeted assistance to these enterprises (Sharma et al., 2023). For example, the regulatory environment may provide preferential treatment for the large enterprises through tax incentives and subsidies, while small and medium-sized enterprises are unable to obtain similar supports (Liu, 2008).

Small and medium-sized enterprises (SMEs) will face challenges not only in the financial sector adopting artificial intelligence (AI), but also in dealing with a complex regulatory environment that does not adequately take into account the SMEs needs. Small and medium-sized enterprises are unable to fully participate in the digital economy or compete fairly with large company, which creates barriers to the entry of small and medium-sized enterprises (Zhou & Wang, 2021).

### 2.6.5 Technology-Organization-Environment (TOE)

The research question stems from an organizational theory perspective (Aarstad & Saidl, 2019). To analyze technology adoption at the organizational level and explain behavioral intentions and innovation implementation at the company level, this study draws on the Technology-Organization-Environment (TOE) theory, as it focuses more on understanding the factors that influence adoption policies (Schwaeke et al., 2024). To analyze technology adoption at the organizational level and explain firm, recent literature has confirmed the applicability of the TOE theory in analyzing the dynamics that influence specific innovation in organization, especially in the case of technological innovation (Schwaeke et al., 2024; Aarstad and Saidl, 2019). The TOE framework is part of a typical innovation process and can be used to determine how the business environment affects innovation adoption decisions and implementations. By constructing cluster and integrating them into a theoretical foundation, the framework is very practical in researching the barriers faced by small and medium-sized enterprises (Schwaeke et al., 2024; Aarstad & Saidl, 2019).

Figure 6 The Technology-Organization-Environment framework. (Adopted from Baker, 2011).



## 3 Research Methodology

This thesis uses qualitative research. Qualitative research allow researcher to capture the phenomena underneath the complexity of the study (Flick, 2018). Qualitative research is also crucial to this study because it involves the perspectives participants, provides an understanding of how internal structures and process are established and maintained, gather

information on individual and collective experiences, and how contextual factors such as government policy influence organisational practices. (Bryman, 2012; Corbin & Strauss, 2015; Creswell & Poth, 2018; Patton, 2015).

Qualitative research helps to gain an in-depth understanding of the complex factors affecting the artificial intelligence application and to understand the different stakeholder's perspective such as SME owners, employee and decision-maker (Creswell & Poth, 2018). This qualitative research employ interviews, case studies, and document analysis to investigate decision-making processes, employee perspectives, and governmental involvement in AI adoption within small and medium-sized enterprises (SMEs). The study examines the opportunities and challenges SMEs in China encounter, providing an in-depth analysis of whether and how artificial intelligence can be implemented. It also explores the reason for integration, considering the distinct regulatory, social, and cultural characteristics of China's business environment.

Interviews are crucial in qualitative research and can provide rich and insightful experiences and insights (Corbin & Strauss, 2015). King and Horrocks (2010) emphasize that interview enable researcher to explore participants' "life experiences" and gain deeper understanding of the social and organisational processes shaping behaviour. Interviews are valuable for investigating aspect like organizational culture, leadership styles, and the use of artificial intelligence technologies in small and medium-sized enterprises. Interviews are also a flexible and responsive method; researchers can adjust questions in real time and explore emerging theme (Kvale, 2007). Therefore, it is clearer to research the external factors impact, technological development and government policy on the artificial intelligence adoption by Chinese small and medium-sized enterprises.

This research uses case study on data management, employee adaptation and system integration to help enterprises identify and solve obstacles on technological transformation (Siddique, 2018). Case studies provide strategic support for decision-makers, promoting innovation and operational optimization. By promoting cross-industry knowledge sharing, case studies bridge the gap between theory and practice, helping enterprises achieve efficient operations and maintain a competitive advantage in the era of digital transformation (Hansen & Bøgh, 2021). This research uses case studies to analyze the other enterprise successes and failures and provide a practical framework for the future technology's adoption.

### **3.1 Data collection**

Data collection from qualitative research interviews, including gathering more detailed information from involving participant in discussions. Researchers obtain data from the asking questions and following up on the respondent's answers. The semi-structured interviews followed a flexible interview guide. Building rapport, asking open-ended questions and allowing participants to elaborate on their answers are key techniques in this process (King & Horrocks, 2010).

This paper uses semi-structured interviews to collect qualitative data (Jöhnk et al., 2021)

The flexibility of semi-structured interviews allows researchers to gain insight into participants' perspectives and adapt the approach based on emerging insights. Case studies provide a wealth of background and offer an insight into the practical application of artificial intelligence. This approach helps to gain deeper understanding on the implementation details of artificial intelligence in different environments (King & Horrocks, 2010).

The interview questions in this research are divided into five categories: business environment, technology, organization, artificial intelligence and environment, and are provided Chinese and English. These questions explore various aspects of the artificial intelligence impact on the case company, paving the way for subsequent in-depth investigations. This research involved face-to-face interviews with three managers from different industries, each lasting no more than 60 minutes. Researchers arrive at the location of the target enterprise to conduct on-site investigations to further inform the company case study. Due to the country particularities, the interview was conducted in Chinese and translated into English.

### **3.2 Sampling technique**

Qualitative research often use non-probability sampling techniques to capture different opinion and subtle contextual differences (Creswell & Poth, 2018). Purposeful sampling is one of the most common method researchers select participant and cases that are particularly relevant or unique to the research question, thereby providing valuable insight (Patton, 2015). Other methods include theoretical sampling, participants are selected to

develop or refine a theory based on new findings, and snowball sampling participant network are used to identify other informant (Merriam & Tisdell, 2016).

This study employ stratified sampling to thoroughly explore the application of artificial intelligence in small and medium-sized enterprises across diverse industries. This method is especially useful for examining distinct groups or sub-population (Rao & Verweij, 2023). Gustafsson et al. (2022) emphasize that the stratified sampling used can improve the representative of the sample, which in turn promotes effective comparisons between different groups. Several business and management related studies use these sampling techniques to collect data (Shahzad & Elenurm, 2020; Shahzad et al., 2024; Mousa et al., 2024; Shahzad and Arslan, 2023).

Table 1 Interviewee Information

Number of interviewees	Enterprise Role	Genders	Age	Region	Scale of Enterprise	Main business	Knowledge of Artificial Intelligence	Date of interview
1	Board Chair	Male	52	Towns	small	Baijiu agent	I	7.11.2024
2	CEO	Male	35	Urban	small	Parts supplier	III	11.11.2024
3	Manager	Male	32	Suburb	Medium	E-commerce	III	12.11.2024

I : Basic understanding

II : Know better

III: Basic application of artificial intelligence

IV: Skilled use of artificial intelligence

VI: Innovative Application of Artificial Intelligence

### **3.3 Data analysis**

Methods of qualitative data analysis provide numerous strategy for interpreting non-numerical data and extracting meaning. Among these, "thematic analysis" is a widely adopted technique that focuses on recognizing recurring pattern or theme within the data (Braun & Clarke, 2006). This versatile method is applicable to a broad range of research topics. Another commonly used approach is "theoretical sampling," which seeks to build theory through iterative coding and continuous comparison of data (Charmaz, 2006). This study will use thematic analysis. By collecting and organizing various type of data related to the enterprise, we can understand the background, technical route and implementation process of the enterprise's artificial intelligence application. Through field research, one-on-one interviews were conducted with the enterprise's management and technical teams. Finally, the data collected from the interviews and case studies were analyzed through thematic analysis.

Step 1: The case study following the interview provides a practical context.

Step 2: Data from case studies and interviews were extracted and used for thematic analysis.

### **3.4 Reliability and Authenticity**

This research has taken a number of measures to ensure the data reliability. First, we used semi-structured interviews and designed flexible questions in advance to confirm and ensure that respondents can accurately express their views and experiences. This approach effectively captures respondents' authentic experiences. By repeatedly interviewing senior management and different companies' employees, the consistency and the data verifiability can be improved (King & Horrocks, 2010). In addition, by using the TOE framework, this research systematically analyses the technical, organisational and environmental factors to influence the adoption of artificial intelligence, providing a solid theoretical basis on the research conclusions (Tornatzky & Fleischer, 1990).

The value of this research is truly reflecting the current state of the artificial intelligence application in small and medium-sized enterprises in China. Through semi-structured interviews with case companies, the study can truly understand the feelings and challenges

in technology application, thereby revealing the key factors affecting AI application, such as technology maturity, data quality and the policy environment. This research method, combined with real-world problems, helps ensure the reliability of the results. The company's technological readiness and organisational culture are crucial for the successful application of artificial intelligence (Jöhnk et al., 2021). Moreover, by combining current Chinese government policies with the actual business operating environment, the relevance and feasibility of the conclusions can be ensured. However, due to the rapid development of artificial intelligence technology and policies, the authenticity of the research will decrease over time (Huang & Li, 2021).

## **4 Analysis and discovery**

This chapter will examine the firms using case studies, followed by analyzing the content of the interviews using thematic analysis.

### **4.1 Case 1: Small business enterprises**

The company is a trading enterprise that has been established for 12 years and focuses on cooperation with upstream manufacturers and product sales. As the business expanded, the company also underwent significant changes in terms of business scale and organisational structure, growing from an initial sales volume of over 1 million vehicles to 25 million vehicles. Companies are currently facing dual challenges in market competition and internal management, especially in terms of digital transformation and the application of artificial intelligence. Key issues include the collection of financial data, the management of customer information, and the efficiency of logistics and distribution. Therefore, the enterprise hopes to solve these pain points through artificial intelligence and digital transformation, laying the foundation for future market expansion.

This case study reveals the typical challenges and transformation strategies faced by Chinese small and medium-sized enterprises in the process of artificial intelligence and digital transformation. First, since its establishment, the enterprise has accumulated rich experience in cooperating with upstream manufacturers in the sales of traditional liquor. However, with the changes in market demand and the expansion of its scale, the enterprise has gradually realized the inadequacies of the traditional operating model in terms of data collection, financial statistics and customer management. To address these issues, the enterprise has begun to shift towards artificial intelligence and digital transformation, aiming

to improve the efficiency of financial, warehouse and customer information management, thereby laying the foundation for future market expansion.

Second, the enterprise chairman is deeply involved in technical and strategic decision-making, leading the team to gradually accept new technologies, actively promoting internal training, and helping employees adapt to the transformation of artificial intelligence and digital operations. Although the team has some inertia and knowledge gaps in adapting to technology, the leadership has realized the importance of training and connecting with the upstream winery's artificial intelligence system to achieve end-to-end data sharing and improve management efficiency. The enterprise's current infrastructure is not perfect, but the management is determined to invest resources to optimize the data system and introduce suitable AI technology. To promote this strategy, the enterprise also hopes to receive government support in terms of policy, training and funding, so as to achieve comprehensive digital transformation within the next five years and enhance the competitiveness of the enterprise in the market.

## **4.2 Case 2: Small intelligent manufacturing enterprise**

This is an intelligent manufacturing enterprise located in the urban area of Hebei, China, focusing on the production of intelligent home appliances and electronic products. With the rapid changes in market demand and increasing competition, the enterprise realized that it must rely on digital transformation to improve production efficiency and product quality. In recent years, artificial intelligence (AI) has become one of the enterprise's strategic priorities, especially in terms of optimizing production processes and enhancing the customer experience. However, the implementation of AI also brings new challenges, including the cost of technological transformation, the need to upgrade data systems, and employees' adaptation to new technologies. The enterprise's management attaches great importance to this, and while gradually promoting AI, it also focuses on improving the technological infrastructure and employee training.

The enterprise adopted a gradual implementation strategy when adopting AI technology. First, as an advocate of technological transformation, the general manager was directly involved in decision-making on AI integration and worked closely with the technical team to develop a specific implementation plan. The enterprise gradually improves the team's understanding and application of artificial intelligence through training and industry visits, thereby reducing the barriers to adaptation brought about by technological change. In its initial application, artificial intelligence technology helped the enterprise reduce human error

in the production process, improve production efficiency and product quality. In addition, the enterprise also used internal communication platforms to encourage employees to raise questions and suggestions during the transformation process, thereby effectively alleviating resistance to change.

Despite these results, data management in AI applications remains one of the main challenges companies face. The collection, storage and analysis of high-quality data is critical to the accuracy and efficiency of AI systems, so companies are still investing heavily in data systems (Verhoef et al., 2021). In the future, with the promotion of government policies such as tax incentives and financing support, the enterprise hopes to leverage these supports to accelerate the implementation of artificial intelligence and consolidate the enterprise's competitiveness in the field of intelligent manufacturing. At the same time, the enterprise expects the introduction of industry standards to provide clearer guidelines for technology applications, thereby further reducing transformation risks and ensuring the enterprise's leading position in the industry (Wang, 2023).

### **4.3 Case 3: Integrate e-commerce enterprise**

This is a comprehensive e-commerce enterprise that mainly sells household goods, electronics, clothing and other goods online. In recent years, the enterprise has faced pressure to improve the customer experience and remain competitive in the market and has incorporated artificial intelligence (AI) into its core digital transformation strategy. The enterprise applies artificial intelligence technology to key processes such as product recommendations, inventory management, and logistics and distribution to improve personalized service levels and business efficiency. However, technological transformation also brings significant challenges, including high development costs, the time cost of employees adapting to new technologies, and concerns about data privacy and security. The enterprise's leadership firmly supports the application of artificial intelligence and is committed to the long-term goal of digital transformation by upgrading infrastructure and enhancing training.

In terms of the application of artificial intelligence, the enterprise has provided efficient data support for the artificial intelligence system by optimizing the infrastructure and establishing a data analysis team. Specifically, the enterprise uses artificial intelligence to analyze users' shopping records and browsing habits in its product recommendation system, so as to recommend related products to users, which greatly improves user stickiness and purchase conversion rates. Simultaneously, the enterprise leverages artificial intelligence to forecast

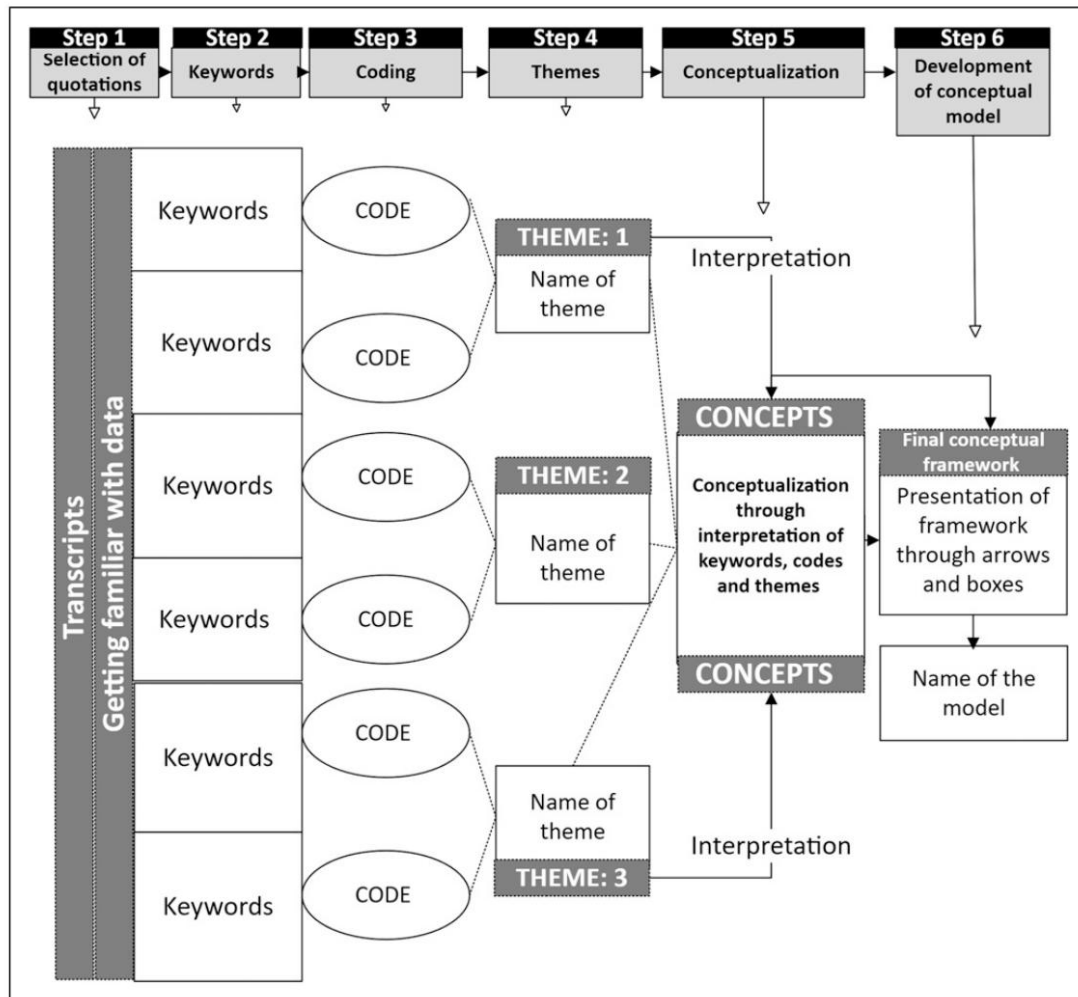
demand variations in inventory management, logistics, and distribution. This real-time allocation of inventory resources not only lowers inventory costs but also enhances response speed. However, the enterprise also found that data silos posed a challenge to integration: the inconsistency of data formats and standards across departments resulted in inefficient data integration, which affected the comprehensiveness and accuracy of the AI system (Hsiang et al., 2023). To this end, the enterprise is evaluating further upgrades to its hardware infrastructure to ensure the effective operation of the AI system.

In addition, enterprises have implemented internal training programs to help employees understand the role of artificial intelligence in their businesses and have established "Artificial Intelligence Application Forums" to promote interaction with industry experts. Enterprises hope that the government will further improve its policies for the development of artificial intelligence and provide more support to small and medium-sized enterprises in terms of funding and technology integration. In the future, companies will achieve sustainable technological development through policy support, technology standardization and the artificial intelligence talent cultivation, strike a balance between compliance and innovation by improving data privacy laws to ensure leading position in a highly competitive market (Wu, 2024).

#### **4.4 Thematic analyses**

Thematic analysis is a common data analysis method that helps researcher identify and extract recurring theme or pattern from large amount of data (Braun & Clarke, 2006). This method is suitable to understanding complex social phenomena and behavior pattern, especially when the research objective involves exploring the experiences and individual or group perception (Naeem et al., 2023). According to Nowell et al. (2017), thematic analysis is popular in a variety of qualitative research due to its systematic and flexible nature, as it allows researchers to both systematically summarize the information on the data and provide in-depth explanation.

Figure 7 A systematic thematic analysis process: A novel six-step process for conceptual model development in qualitative research. (Adopted from Naeem et al., 2023).



Thematic analysis is a powerful and versatile qualitative research method that is popular for its ability to explore and discover insights in interview and focus group data (Naeem et al., 2023). It provides a structured and adaptable way to understand complex human experiences. According to the Braun and Clarke (2006) framework, thematic analysis is conducted through six distinct and purposeful steps, each with specific objectives and methods – guiding the researcher to meaningful patterns and conclusions from the raw data.

The initial step involves thoroughly understanding the data and its transcription. Researchers achieve this by engaging with high-quality audio recordings and producing verbatim transcriptions. This process aims to facilitate an in-depth examination of the data, allowing for the identification of preliminary themes and key elements (Naeem et al., 2023). Simultaneously, researchers select illustrative quotations that effectively represent the data.

and align with the research objectives. These selected excerpts serve as a foundation for subsequent analysis (Braun & Clarke, 2006).

The second step involve the selection of keywords, during which researchers systematically analyze the data to extract key terms, recurring patterns, or significant visual element (Naeem et al., 2023). These keywords encapsulate the participant's experiences and emotions, extending beyond textual data to include multimedia elements, such as photographs and videos (Braun & Clarke, 2019).

The third step involves coding, which Creswell (2015) highlights as essential in qualitative research due to the intricate and dense nature of textual data. By associating specific code or phrases with data segments, researcher can extract key information. This process not only condenses the data but also serves as a foundation for developing themes (Naeem et al., 2023).

The fourth step involves theme development. Researchers categorize the codes into coherent themes and identify patterns within the data. Braun and Clarke (2006) argue that themes are not merely repeated topics, but their significance to the research question is crucial. This phase elevates the analysis from detailed data examination to a more abstract level of interpretation (Naeem et al., 2023).

The fifth step is conceptualization. During this stage, researchers clarify and interpret the concepts derived from the data by analyzing keywords, codes, and themes (Naeem et al., 2023). They employ tools like diagrams or models to illustrate the relationships between these concepts, refining the definition of a social model (Patton, 2015). This process contributes to strengthening the theoretical foundation for the data.

The sixth step involves developing a conceptual model. Researchers design this model using collected data and integrate it with existing theoretical frameworks to address the research questions (Naeem et al., 2023). According to Camp (2001), theoretical models are grounded in the validation of established theories, whereas conceptual models derived from thematic analysis emphasize the novel contributions of the study. In essence, this model integrates the research findings and highlights their importance within the wider academic context.

The following will present the analysis conducted by the researcher. First, the author of this article organized the data based on the content of the interviews and related research questions. Through repeated review of the content of the interviews, the content that

matched the research questions was extracted. It is recommended that the reader become fully familiar with the text by repeatedly reviewing it. Secondly, preliminary code generation was carried out by combining case studies based on interviews, generating 17 codes. The preliminary codes were then reviewed, and similar codes were grouped, after which 10 codes were obtained. In the process, the researchers eliminated some codes that were too different from the research questions. Three themes were eventually identified. Integrating the newly generated code has slightly altered the three themes, and the code has been organized into coherent groups to aid in identifying patterns and relationships.

The following table provides a preliminary summary of the interviews.

Table 2 Factors driving the adoption of AI affecting this business

<b>Interviewee</b>	
Case 1	<p>"The company is facing challenges in its traditional operating model, especially in the management of finance, distribution, inventory and customer information. Therefore, it needs to improve the efficiency of these areas through digital transformation and artificial intelligence. The company hopes to improve sales and management by introducing AI technology, so as to enhance market competitiveness and adapt to the needs of the larger market. Upstream wineries have begun to use AI technology to manage production and marketing, and the company also hopes to take this opportunity to achieve technological integration and collaborative development."</p>

The

Case 2	<p>"The main factors driving companies to adopt AI include changing market demands and competitive pressures. As market competition intensifies, companies recognize the need to rely on digital technology to improve production efficiency and meet challenges. Government policies that offer tax incentives and financing support also play an important role in driving adoption, as these policies alleviate the cost burden of transformation. In addition, as competitors in the same industry gradually begin to adopt AI technology, companies feel the need to accelerate their pace in order to avoid being eliminated from the market."</p>
Case 3	<p>"There are two main drivers for companies to adopt AI. The first is the need to enhance the consumers shopping experience and remain competitive. Company hope to drive business and digital transformation through AI to achieve a more personalized customer experiences and more efficient operation managements. Secondly, the government's police in recent years to encourage the development of AI, especially in terms of financing and tax incentives, have provided company with financial and technical supports and reduced their burden. In addition, as competition in the e-commerce industry intensifies, technology innovation from competitors also motivates company to accelerate the adoption of AI to maintain a competitive advantage in the market."</p>

following table provides a preliminary summary of the interviews.

The table above (Table 2) illustrates: Factor driving AI adoption among SMEs are mainly market competitive pressures, improving operational efficiency, and government policy support. Whether it is Baijiu distribution, smart manufacturing, or e-commerce company, changes in market demand and technological innovation among peer have prompted company to accelerate the adoption of AI. Government policies on tax incentive and

financing support have also played an important role in reducing the cost of transformation and further promoting the application of AI technology. This shows that AI is not only a means to improve productivity, but also a necessary tool for company to adapt to market changes and improve the customers experience.

Table 3 How the application of artificial intelligence affects the efficiency of operations and decision-making in this enterprise

Interviewee	
Case 1	<p>"AI will provide technical support in data collection, financial management, customer information collation and market analysis, helping companies to better manage and optimize resources. AI technology can provide more accurate data analysis, support strategic decision-making, and improve the efficiency and quality of decision-making. Through intelligent computing and data systems, companies hope to optimize sales, inventory and customer management, and improve overall operational efficiency. Although companies are aware of the potential of AI, employees are still not sufficiently adaptable to the new technology. Training is needed to shorten the learning curve and ensure that the technology can be successfully applied to daily work."</p>
Case 2	<p>"AI can significantly improve production efficiency, reduce human error, and thus improve product quality and enhance the customer experience. These changes directly optimize the company's operational efficiency. At the same time, the introduction of artificial intelligence also helps with strategic decision-making, especially in terms of production process improvement and technology selection."</p>

	The integration of AI technology makes decision-making more accurate and helps companies take the lead in the field of intelligent manufacturing."
Case 3	"AI has significantly improved customer experience and business management efficiency, enhanced user stickiness and purchase conversion rates, and has shown significant results, especially in inventory management and logistics. The introduction of AI technology has helped the company improve operational efficiency in key business areas while making decisions more accurate. At the strategic planning and decision-making level, the application of AI enables the company to balance innovation and cost-effectiveness, promote the efficient implementation of projects, and thus support the company in being well-positioned for long-term development."

The table above (Table 3) illustrates: The adoption of Artificial Intelligence has had a profound impact on the operational and decision-making efficiency of different types of businesses. AI has greatly enhanced operational efficiency and decision-making quality across various sectors, including small commerce, smart manufacturing, and e-commerce, by providing precise data analysis, automating processes, and offering intelligent decision support. It enables companies to maintain a competitive edge in their respective fields.

Table 4 Optimising AI implementation strategies

<b>Interviewee</b>	
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Case 1	<p>"The main challenge currently faced by the enterprise is the relatively weak knowledge and adaptability of employees to artificial intelligence. To alleviate this problem, the company plans to strengthen employee training, especially knowledge about digital transformation and AI applications. By improving employees' understanding and application of new technologies, it is expected that barriers to technological adaptation can be overcome. The company also needs to select suitable software and technical solutions to support the implementation of AI and ensure a smooth transition to intelligent operations."</p>
Case 2	<p>"Although the company already had a preliminary data system and computing equipment in place, more investment was needed to fully support AI applications, especially in terms of data analysis and collation. Through training and industry visits, the company gradually improved the team's awareness and understanding of AI, overcoming the initial sense of unfamiliarity. The company also launched a number of training programs to help employees adapt to the changes in working methods brought about by AI, while reducing resistance and difficulties during the transformation process through internal communication platforms. These strategies have provided a solid foundation for the smooth implementation of AI."</p>
Case 3	<p>"The company carried out a systematic upgrade of data storage and computing power before introducing AI technology, including cloud computing and data center construction. In addition, a data analysis team was set up to sort and clean the data to solve the challenges in data management. Although the company has upgraded its data and hardware facilities in many aspects, it still faces the challenges of data format inconsistency and integration. To improve the application effect of AI, the infrastructure will be further upgraded in the future, especially in the application of logistics and customer service. Higher computing power and network support will be the key to implementing AI."</p>

The table above (Table 4) illustrates: Different types of organizations face their own challenges when implementing AI and are responding in targeted ways. Smaller commerce businesses are ensuring a smooth technology implementation by enhancing staff training on digital transformation and AI adoption, and choosing the right software solutions to support intelligent operations; Smart manufacturing companies, on the other hand, are focusing on improving their data analytics capabilities and helping their employees adapt to AI changes through training and industry research, as well as using internal communication platforms to reduce resistance to the transition; E-commerce companies begin by upgrading their infrastructure, including cloud computing and data center development. They also assign teams to handle data cleansing and integration tasks, thereby advancing the use of AI technology within their core operations. Overall, the key to successful AI implementation in enterprises lies in optimizing technology infrastructure, enhancing staff training and adaptation, and addressing data management issues

After identifying and categories the interviews, two of the themes changed significantly. The following table shows the results after recording and categories the themes:

Table 5 Main Themes and Sub-Themes

Main Theme	Sub-Theme	Description
Factors Driving the Adoption of AI	Internal Operational Challenges	Internal inefficiencies in finance, inventory, and customer management necessitate AI adoption to streamline processes and improve data accuracy. Current operations are hindered by fragmented data collection and limited technological support, which restricts growth and agility. AI adoption is viewed as essential to building a more cohesive and efficient organizational structure
	Market and Competitive	Rising competition and changing market demands push the business to innovate and

	Pressures	<p>adopt AI to maintain relevance and attract new customers. While competitors are integrating artificial intelligence to optimize processes and improve the customer experience, the company feels the pressure to adopt similar technologies to avoid losing market share. To remain competitive in this situation, it is essential to keep up with industry developments and use artificial intelligence to meet customer expectations.</p>
	Government Policies and Industry Standards	<p>Governments have played an important role in driving the adoption of AI by promoting digital transformation through tax incentives, funding and industry standards. Policies aimed at reducing the cost of technology adoption make artificial intelligence more accessible to small and medium-sized enterprises, aligning business objectives with national digital efforts. The company sees these policies as key enablers of its AI journey, helping to offset the cost and complexity of technology upgrades.</p>
Impact of AI on Operational Efficiency and Decision-Making	Enhanced Data Collection and Management	<p>Artificial intelligence enhances data collection, organization, and analysis, thereby facilitating improved resource allocation, customer relationship management, and long-term strategic planning. By automating data-intensive processes, AI reduces human error, increases data accessibility, and fosters cross-departmental collaboration. As a result, the company can monitor key performance indicators in real time, optimizing customer</p>

		service and sales strategies.
	Decision-Making Optimization	Artificial intelligence provides accurate, data-driven insights that improve the efficiency and quality of decision-making at both strategic and operational levels, allowing leaders to make informed decisions. Through AI's capabilities in predictive analysis and trend identification, companies can more effectively anticipate market changes and adjust strategies accordingly. This improved decision-making process supports calculated risk-taking and the pursuit of new growth opportunities.
	Employee Adaptability and Training Needs	To fully leverage AI's potential, employees must move beyond traditional work practices and develop the ability to use AI tools effectively, which necessitates a comprehensive training program. Adapting to AI requires closing knowledge gaps, particularly for teams familiar with manual workflows, to build confidence in utilizing digital technologies. These training efforts not only enhance skills but also cultivate a culture that encourages innovation and embraces change.
Optimizing AI implementation strategies	Infrastructure Readiness and Upgrades	The successful implementation of artificial intelligence necessitates a robust infrastructure, encompassing data storage and processing resources, as current systems may be insufficient. This includes investments in

		<p>software, hardware, and cloud solutions to facilitate large-scale data handling and real-time analyze. The company acknowledges that enhancing its infrastructure is a critical step in fully realizing the potential of AI within its operations.</p>
	<p>Employee Training and Adaptation Programs</p>	<p>Training programs enable employees to familiarize themselves with AI technologies, facilitating adaptation to new tools, minimizing resistance, and enhancing productivity. A well-structured training curriculum equips staff with hands-on AI skills, simplifying the integration of AI-driven tasks into routine operations. This theme highlights the crucial role of human capital in AI adoption, emphasizing the importance of ongoing learning and support for successful implementation.</p>
	<p>Data Management and Standardization</p>	<p>Standardized data formats and efficient data integration are critical for AI accuracy and functionality, as inconsistent data can lead to errors and inefficiencies. By unifying data systems and ensuring consistency, the company can optimize AI performance and support accurate, cross-functional data analysis. Effective data management lays the groundwork for reliable AI outputs, which are essential for informed decision-making and strategic alignment.</p>

	<p>Long-term Strategic Vision and Government Support</p>	<p>The company aims to develop a long-term AI strategy that aligns with its growth objectives. It depends on government support for funding, policy guidance, and workforce development. Anticipating shifts in policy and technological progress, the company plans a gradual approach to AI adoption, balancing short-term needs with long-term scalability. Government assistance is viewed as critical in offsetting costs, particularly for training and infrastructure, enabling the business to maximize the potential of AI over time.</p>
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## 5 Discussion and Conclusion

This chapter will outline the conclusions, discuss both theoretical and practical implications, address the research limitations, and explore possibilities for future advancements.

In this study, the authors examine current status, challenges, and potential opportunities of Artificial Intelligence (AI) applications in Chinese small and medium-sized enterprises (SMEs). Through the review and qualitative analysis of existing literature, we draw the following key conclusions: First, AI has already played a significant role in the operations of SMEs in China. With the continuous advancement of technology, more and more SMEs have begun to pay attention to and actively introduce AI technologies with the aim of improving productivity, reducing operational costs, and optimizing products and services (Li, 2020; Gutiérrez, 2023; Hsiang et al., 2023). The application of AI technology in several areas, such as manufacturing, customer service, and marketing, has helped organizations to significantly improve their operational efficiency (George, 2024; Ahmed, 2022).

However, despite the nascent use of AI in SMEs, several challenges remain. Firstly, there are technical difficulties, such as existing algorithms that are not yet fully mature and variable data quality, which limit the effectiveness of AI in practical applications. Secondly, the

enterprise level also faces a number of problems, including a lack of professional talents, insufficient funds, and low management level, which make many SMEs face certain difficulties in accepting and applying AI technology. Policy and environmental issues should not be ignored. Although the Chinese government has invested a lot of resources in the promotion and support of AI technology, many SMEs still face greater pressure in terms of policy implementation and resource allocation (Liu, 2008; Ahmed, 2022).

As the country increases its investment in new infrastructure development, AI technology will penetrate more deeply into all aspects of production and operations of SMEs (Schwaeke, 2024). Enterprises should seize this opportunity, actively embrace change, and accelerate the pace of AI research and practical application. At the same time, the government, industry associations and research institutes need to work closely together to provide SMEs with more resource support and help them achieve higher quality development in the AI era (Wu, 2024; Hsiang et al., 2023).

Chinese SMEs face certain challenges in applying AI, but advances in technology have brought them enormous room for development. While enjoying the convenience of technological innovation, enterprises still need to overcome various difficulties. Only through innovation, enhancing core competitiveness, and improving conditions for industrial development can SMEs stand out in the wave of AI and achieve sustainable and high-quality development (Usmani, 2023).

With the continuous development of AI technology, there is a huge potential for Chinese SMEs to apply in this area (Liu, 2008). In the future, AI will further penetrate all levels of the enterprise, from production to management to sales, and significant economic benefits will be realized at every stage (Ahmed, 2022). This section will explore the development trends and issues faced by Chinese SMEs in AI applications through the previous chapters.

Artificial Intelligence will greatly enhance the productivity of Chinese SMEs by leveraging smart factories, automated production lines and robotics, companies can realize the intelligence of the production chain, reduce costs and accelerate production schedules. In addition, the application of AI in the field of R&D and design is becoming increasingly sophisticated, injecting a strong impetus for innovation in enterprises. This process not only improves production capacity but also brings more market competitiveness to enterprises (Wu, 2024).

Secondly, AI will significantly improve the decision-making efficiency of SMEs. Through in-depth mining and analysis of massive amounts of data, enterprises will be able to accurately grasp market dynamics, thereby improving their competitive advantage. Regarding internal management, AI assists companies in streamlining business processes like human resources and financial management, minimizing human errors, and enhancing overall operational efficiency. For example, intelligent assistants can help managers quickly deal with daily affairs, save time and energy, and focus on strategic decision-making.

In sales, AI is likewise playing an increasingly important role. Through in-depth analysis of customer data, enterprises can achieve precision marketing, thereby increasing sales. AI technology can also improve the quality of customer service, help enterprises to build a good brand image and customer reputation, enhance customer loyalty and market influence.

Despite the great potential of AI, many SMEs still face a number of difficulties in its implementation (Hu, 2023). Due to the high technological threshold, many SMEs have difficulties in technology training and R&D and lack sufficient technological reserves for effective AI applications. On the other hand, the issue of capital remains a major constraint to business development. The investment cost of AI is large, especially for capital-strapped SMEs, which undoubtedly increases their financial pressure. As businesses increasingly depend on data to enhance decision-making and streamline operations, the importance of data security and privacy protection intensifies. Safeguarding organizational data and preventing breaches, leaks, and misuse have become critical and pressing challenges that demand immediate attention.

To address these challenges, collaboration between government, industry association, and business is essential for advancing the application and artificial intelligence (AI) technology development. Government should foster increased investment in AI by enterprises, while strengthening policy frameworks that encourage innovation and research. Industry associations can facilitate technical exchanges and workforce training, enhancing both technical expertise and innovation within companies. Enterprises themselves must proactively embrace AI-driven technological changes, pursue industrial transformation, and drive technological breakthroughs and practical application (Wu, 2024; Liu, 2008).

Artificial intelligence (AI) has presented significant opportunity for small and medium-sized enterprises (SMEs) in China. Through collaborative efforts among the government, industry associations, and businesses, SMEs can leverage AI to foster high-quality development, thereby contributing more effectively to China's economic growth and social advancement.

## 5.1 Theoretical and Practical implications

This study explores the transformative artificial intelligence potential for Chinese small and medium-sized enterprises, highlighting its role in operational efficiency, competitiveness and decision-making. In theory, this study use the Technology-Organization-Environment (TOE) framework to understand the dynamic of AI adoption, gaining insight into the interaction between environmental factor such as technological readiness, organizational culture and regulatory framework. In practical, this study affirms the key role of government policy in promoting the adoption of AI through tax incentives, funding subsidies and industry standards. Internal challenges such as data management and employee adaptability were also addressed. The application of artificial intelligence in optimizing processes, improving the user experience and creating sustainable business models was highlighted, demonstrating its effectiveness in advancing the strategic goal of small and medium-sized enterprises.

## 5.2 Limitations and Future research avenues

The limitations of this research lie mainly in data collection and sample representation. Due to the qualitative research methods, data collection relies on the subjectivity of interviews, and respondents' answers may be influenced by personal backgrounds, experiences and biases, making it difficult to achieve complete objectivity. This type of data relies on subjective experience and may lead to results with limited external validity (Bryman, 2012). Due to the relatively small sample size of the research and China's unique market/economic environment and market size, the research does not represent all Chinese SMEs. This somewhat limits the universality of the research results. In addition, Chinese government policies on artificial intelligence and SMEs are constantly being updated. The rapid development of artificial intelligence also makes it difficult to fully predict and capture the long-term impact or changing trends of artificial intelligence applications (Lichtenthaler, 2020). Finally, since part of the interview content was conducted in Chinese and translated into English, the translation process may have a slight impact on the semantics or meaning, which may affect the accuracy of the data. In addition, time and resource constraints may not cover all regions, industries, or enterprises, which limits the breadth of the research to some extent (Creswell & Poth, 2018).

Although the TOE theoretical framework used in this research is helpful in analyzing the factors affecting technology adoption, its practicality in actual situations is also limited by the

actual situation of the research enterprise. Therefore, future research can further explore the applicability and universality of this analytical framework (Schwaeke et al., 2024).

Future research should focus on longitudinal analysis of AI applications to understand their ongoing impact on SMEs. Research could explore industry-specific challenges and opportunities, particularly in industries where AI applications are nascent or highly dynamic. In addition, studying the role of emerging AI technologies (such as generative AI and edge computing) in SMEs can generate practical insights. Another promising avenue is to assess the effectiveness of government policies and private sector partnerships in promoting AI-driven innovation. In addition, comparative studies between different geographical regions or economies can provide a broader perspective on how cultural and economic factors influence the adoption of AI by SMEs.

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## **Appendix 1. Interview Protocol**

### **English format:**

#### **Enterprise background and objectives**

Could you please briefly introduce your enterprise, its main business and current goals or challenges, especially those related to digital transformation and the application of artificial intelligence?

#### **Role and participation in technology decision-making**

What is your position in the enterprise and to what extent are you involved in strategic decision-making?

#### **A preliminary examination of the nexus between artificial intelligence and digital transformation**

What are your initial thoughts and familiarity with artificial intelligence technology and your team? What are the positive aspects or concerns about its impact on your industry?

#### **Technical preparations and challenges**

Is your enterprise's current technological infrastructure ready to support AI (e.g. data systems, computing power)? What are the main technological challenges you face or foresee when adopting AI?

#### **AI management and cultural approach**

How does your enterprise's leadership view artificial intelligence and digital transformation? Are there specific strategies, such as training programs or internal communication, to help employees adapt to these changes?

#### **External and future influences**

What government policies, industry competition or other external factors will influence your attitude towards AI? Looking ahead, what support or policy changes would help drive AI integration in your enterprise over the next five years?

**Chinese format:**

**公司背景和目标**

您能否简要介绍一下您的公司、其主要业务以及当前的目标或挑战，特别是与数字化转型和人工智能采用相关的目标或挑战？

**在技术决策中的角色和参与**

您在公司中扮演什么角色，您在战略决策中参与程度如何，尤其是有关技术和人工智能集成的决策？

**对人工智能和数字化转型的初步看法**

您和您的团队对人工智能技术的初步看法和熟悉程度如何？它对您的行业的影响有哪些积极方面或担忧？

**技术准备和挑战**

贵公司当前的技术基础设施是否已为支持 AI 做好准备（例如数据系统、计算能力）？在采用 AI 时，您面临或预见的主要技术挑战是什么？

**人工智能的管理和文化方法**

贵公司的领导层如何看待人工智能的采用和数字化转型？是否有具体的策略，如培训计划或内部沟通，来帮助员工适应这些变化？

## 外部和未来影响

哪些政府政策、行业竞争或其他外部因素会影响您对 AI 的态度？展望未来，未来五年内，哪些类型的支持或政策变化将有助于推动贵公司的 AI 整合

**Appendix 2. Data Management Plan.**

All data collected during the dissertation process was saved on a password-protected personal computer with files saved on a local hard drive. Any information shared has been confirmed with the commissioning company and the security of the information shared has been ensured. Semi-structured interviews were conducted with the owners of the commissioning companies and responses from the interviews were transcribed from audio recordings into text format. The case study was confirmed by the owners of the commissioning companies. The authors obtained permission from the respondents to share with them the information most relevant to this study. Interviewees' responses were anonymized throughout the thesis. The authors and interviewees agreed to allow the thesis supervisors and reviewers to view the original transcripts and audio recordings of the interviews and to analyse the internal documents in their original digital format.

Data will be stored and processed on the thesis author's own password-protected computer. Data backups will be kept in a different folder from the analysis files. The research data contains confidential information. No personal data will be collected for the thesis research. The data and results of this thesis are owned by the author, Ningyu Zhang. In addition, ownership of and access to the data has been agreed with the commissioning company as they were the main participants in the research for this thesis. The research data will not be reused once the thesis is completed. The authors of the thesis will keep the data securely for one year from the date of approval of the thesis to ensure that the results can be validated if necessary, and then the data will be securely destroyed.