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Cost-Efficiency Trade-Offs in SMEs Digital Transformation: A Pathway Analysis

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Abstract
Against the backdrop of digital technologies accelerating their penetration into all industrial sectors and the global industrial landscape undergoing profound restructuring, small and medium-sized enterprises (SMEs), as a vital component of the economic fabric, commonly face the dual pressures of technological iteration and cost constraints.SMEs often face difficulties in terms of transformation costs and efficiency. This article focuses on the vigorous development of the digital economy and deeply explores the digital transformation path of small and medium - sized enterprises (SMEs). By analyzing the cost difficulties faced by SMEs in the process of digital transformation and how to improve efficiency, combined with practical cases and literature research, it reveals the key factors affecting the transformation and proposes strategies to optimize the digital transformation of SMEs. The aim is to provide theoretical and practical guidance for SMEs to achieve sustainable development in the wave of the digital economy.
Keywords: Digital economy; Small and medium - sized enterprises(SMEs); Digital transformation; Cost; Efficiency
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1. Introduction

In recent years, the digital economy has developed rapidly and has become a new engine of global economic growth. According to the China Academy of Information and Communications Technology (CAICT), China's digital economy is projected to exceed 60 trillion yuan in 2025, accounting for over 42.8% of GDP (CAICT, 2023; Chinese Academy of Social Sciences, 2021). This estimation aligns with the goal set in the 14th Five-Year Plan for Digital Economy Development, which targets the value-added of core digital industries to reach 10% of GDP by the end of 2025 (State Council, 2022). The growth is driven by dual engines: digital industrialization (valued at 10.09 trillion yuan) and industrial digitalization (43.84 trillion yuan), reflecting an 81.3:18.7 ratio of industry-specific digital transformation to technology-driven development (China Industry Research Institute, 2025). By sector, cloud computing (1.2 trillion yuan), artificial intelligence (500 billion yuan), and industrial internet (1.5 trillion yuan) are expected to lead growth, with an average annual compound growth rate exceeding 25% (ibid.). This expansion is supported by infrastructure advancements. As of 2024 Q3, China's computing power reached 268 EFLOPS, with plans to surpass 300 EFLOPS by 2025 (Ministry of Industry and Information Technology, 2024). Additionally, the number of 5G base stations has exceeded 4.395 million, ranking second globally (China Industry Research Institute, 2025). In this context, digital transformation has become an inevitable choice for enterprises to adapt to the development of the times and enhance their competitiveness. Compared with large enterprises, SMEs have limited resources and weak risk - resistance capabilities, but they are numerous and an important part of the national economy(World Bank, 2025; IMF, 2025). However, SMEs face many challenges during the digital transformation process. How to control costs while improving transformation efficiency and explore a transformation path suitable for themselves has become an urgent problem to be solved.

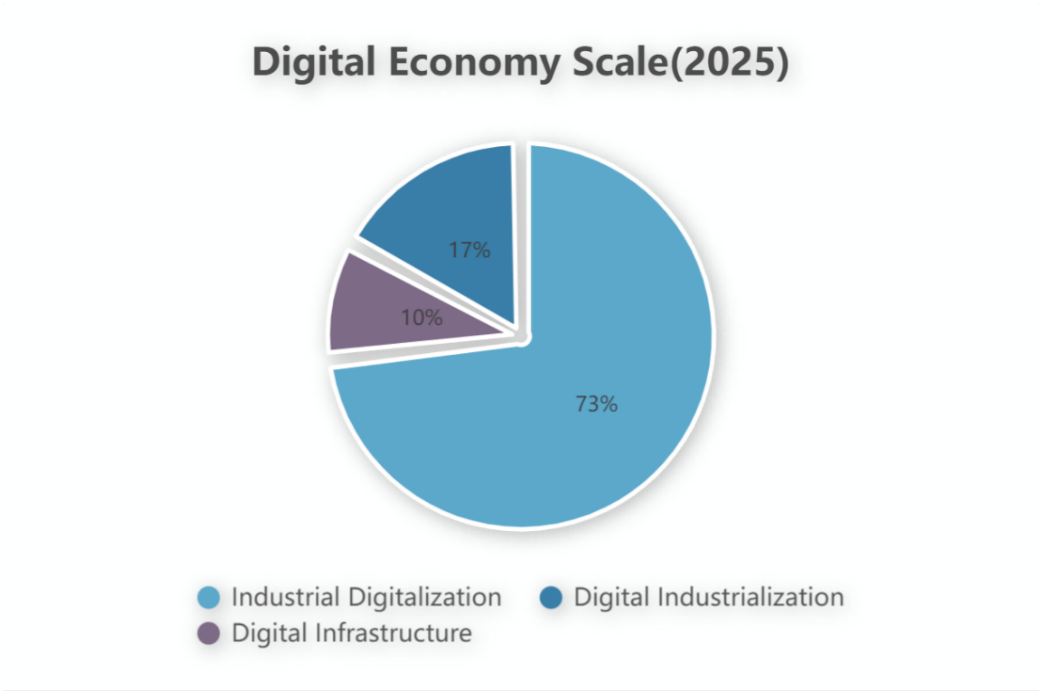

Fig1. digital economy scale (2025)

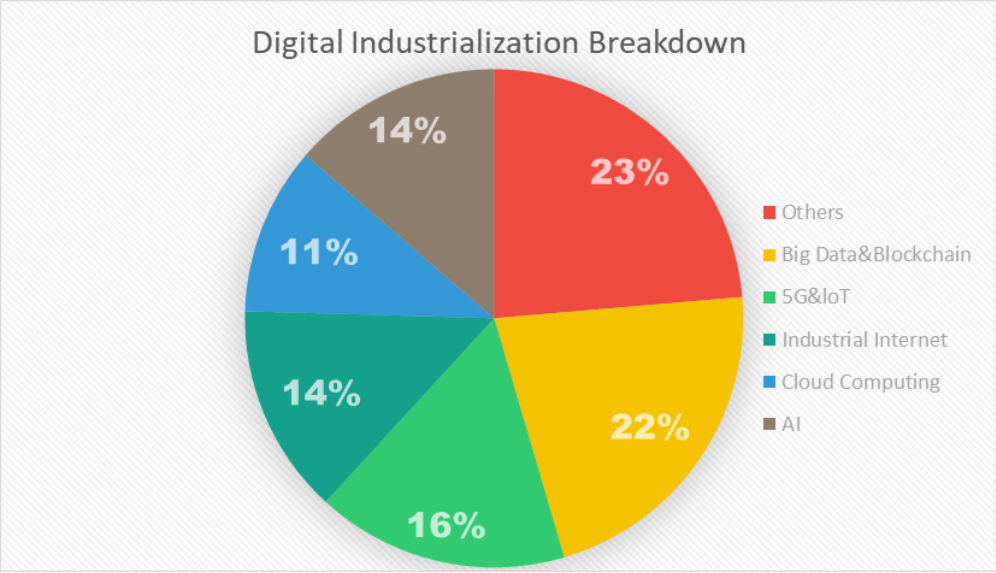

Fig.2.DIGITAL INDUSTRIALIZATION BREAKDOWN

2.LITERATURE REVIEW

In the field of enterprise digital transformation, existing research has explored various aspects of digital transformation in SMEs, yet significant gaps remain, particularly regarding the dynamic relationship between cost and efficiency and the identification of practical transformation paths.

Benefits of Digital Transformation: Smith (2021) conducted a comprehensive study of 200 large - scale enterprises across multiple industries, including manufacturing, finance, and retail. Using a combination of quantitative analysis and case studies, the research revealed that enterprises that completed digital transformation achieved an average of 30% reduction in production costs and a 25% increase in operational efficiency. For example, a leading manufacturing company optimized its supply chain management through digital platforms,

reducing inventory turnover time by 40% and enhancing its market responsiveness. These findings underscore the potential of digital transformation to enhance competitiveness by streamlining operations and improving resource allocation. Challenges Faced by SMEs: Johnson (2022) surveyed 500 SMEs in the United States, Europe, and Asia, focusing on the barriers to digital transformation. The study indicated that 72% of respondents cited capital shortages as a major obstacle, with the high costs of technology adoption, software licenses, and infrastructure upgrades being the primary concerns. Additionally, 65% of SMEs reported a severe shortage of technical talent, lacking professionals with expertise in digital technologies such as artificial intelligence, big data, and cloud computing. These challenges are further compounded by SMEs' limited financial resources and risk - taking ability, making digital transformation a daunting task. Driving Forces for Transformation: Li (2023) carried out an empirical analysis of 300 SMEs in China, using regression models to examine the impact of government policies and inter - enterprise cooperation on digital transformation. The results showed that government subsidies and tax incentives significantly reduced the financial burden on SMEs, increasing their likelihood of initiating digital transformation by 35%. Inter - enterprise cooperation, such as joint R & D projects and shared digital platforms, also played a crucial role. For instance, A cluster of SMEs in the electronics industry in Shenzhen collectively invested in a cloud - based manufacturing platform, reducing individual investment costs by 60% and improving overall productivity; Strategies for SMEs: Wang Hua (2022) analyzed 100 successful cases of SME digital transformation in China, proposing a phased approach. The research emphasized that SMEs should start with low - cost, high - impact areas such as customer relationship management (CRM) digitization and process automation. By gradually expanding digital applications based on business needs, SMEs can avoid over - investment and ensure sustainable development. For example, a local service - oriented SME achieved a 20% increase in customer satisfaction by implementing a digital CRM system.

Research Gaps and Significance: Despite these valuable insights, existing studies often treat cost and efficiency as static factors, neglecting their dynamic interactions during the digital transformation process. Moreover, the lack of industry - specific transformation paths hinders SMEs from formulating targeted strategies. This study aims to fill these gaps by: constructing a dynamic cost - efficiency model that captures the evolving relationship between costs and benefits during digital transformation; identifying practical transformation paths tailored to different industries and scales of SMEs; providing actionable recommendations for SMEs, policymakers, and technology providers. By addressing these issues, this research can contribute to more effective and sustainable digital transformation strategies for SMEs, enhancing their resilience and competitiveness in the digital economy.

3. Current Situation and Problems of Digital Transformation of SMEs

At present, some SMEs have started to try digital transformation and introduced digital technologies in production, marketing, financial management, and other aspects. For example, some enterprises use e - commerce platforms to expand sales channels and improve financial accounting efficiency through financial management software. However, overall, the digital transformation of SMEs is still at a relatively low level. According to the investigation, there are the following issues:

Enhanced awareness of transformation but overall low level: Most small and medium-sized enterprises have realized the importance of digitization, and 70.9% of them actively plan for transformation. However, over 70% of enterprises are still in the basic exploration and simple operation stage of digital transformation, and only 3% are in the deep application stage; There are differences in the transformation process of different industries: the digitalization process of manufacturing is relatively slow, and the digitalization of production processes lags behind significantly, while the digitalization application of human efficiency and other aspects is relatively more prevalent in the service industry; The transformation has shown initial results, and the willingness to invest has increased: nearly 80% of small and medium-sized enterprises that adopt subscription-based services and industrial internet platform applications have achieved positive results. In 2022, 53% of small and medium-sized enterprises invested more than 500000 yuan in digitalization, and over 70% of small and medium-sized enterprises plan to continue increasing their IT investment. According to relevant surveys, only about 30% of SMEs have carried out relatively systematic digital transformation work, and most enterprises still remain in the initial stage of digital application.

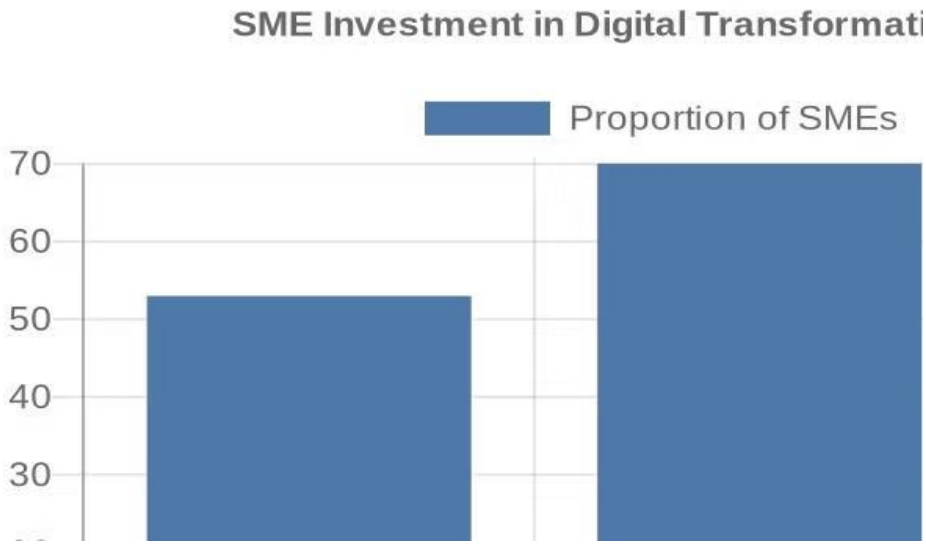

Fig.3.SME INVESTMENT IN DIGITAL TRANSFORMATION (2022)

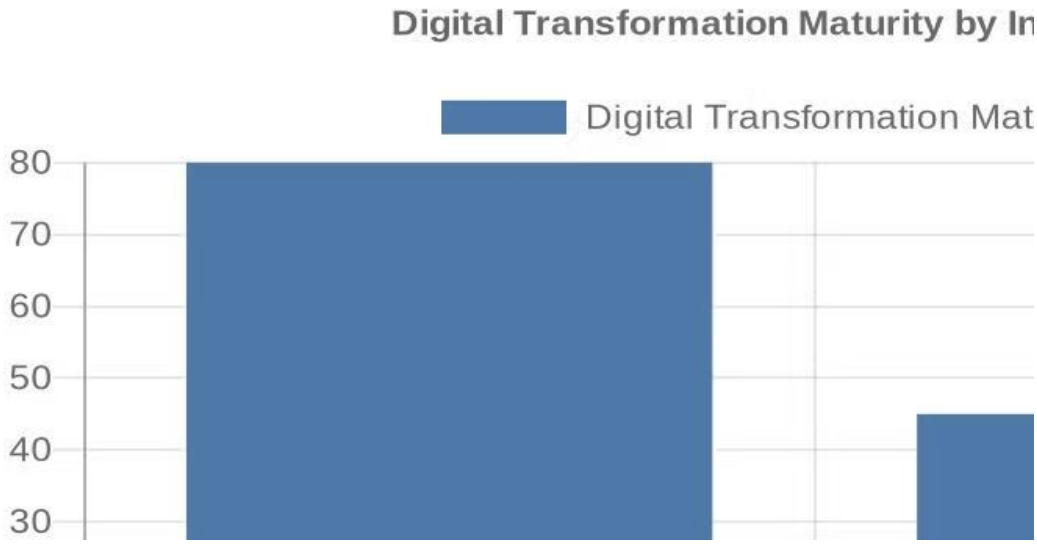

Fig.4.DIGITAL TRANSFORMATION MATURITY BY INDUSTRY

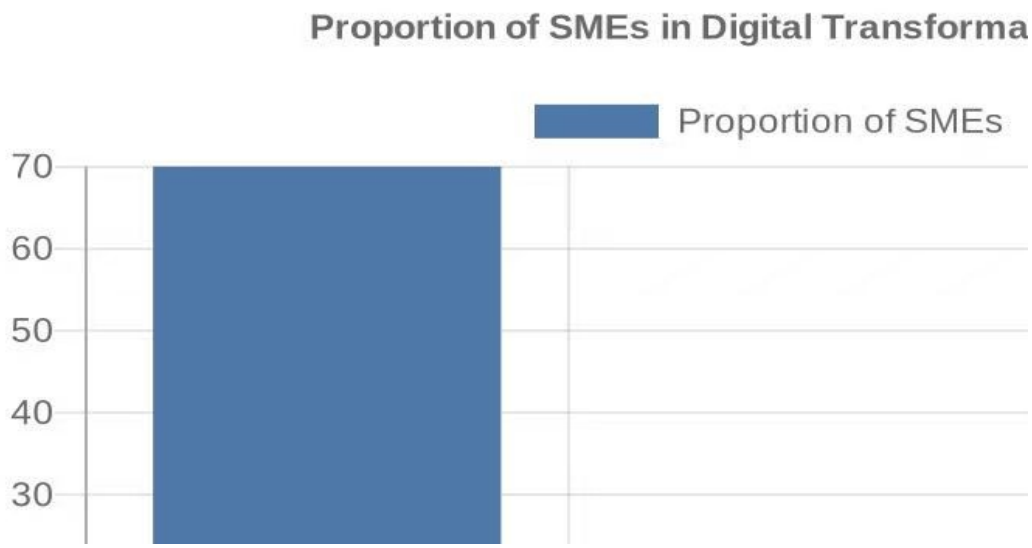

Fig.5.PROPORTION OF SMES IN DIGITAL TRANSFORMATION STAGES

4. Key Challenges Hindering SMEs' Digital Transformation and Their Urgency

4.1 Multifaceted Challenges Faced by SMEs

Financial Constraints

Digital transformation demands substantial upfront investment in infrastructure, software, and hardware upgrades. However, the return on investment often takes time, creating a significant financial burden for SMEs. With limited internal resources and restricted access to external financing, many SMEs struggle to allocate sufficient funds for digital initiatives, severely hampering their transformation progress.

Talent Shortage

The success of digital transformation hinges on the availability of specialized talent proficient in emerging technologies such as artificial intelligence, big data, and cloud computing. SMEs face difficulties in attracting high - end technical talent due to limited salary packages, fewer career development opportunities, and weaker brand appeal compared to large enterprises. Moreover, the lack of internal training systems and insufficient digital knowledge among management further exacerbate the talent gap, impeding innovation and technological adoption.

Technological Mismatch

The digital solutions currently on the market are predominantly tailored for large enterprises, featuring complex architectures and high costs. These tools often fail to align with the diverse and heterogeneous needs of SMEs, which operate across various industries with unique business models. The low adaptability of existing technologies not only increases implementation costs but also reduces the effectiveness of digital transformation efforts.

Data Security Risks

Digital transformation exposes SMEs to heightened data security threats. With limited investment in cybersecurity technologies and a lack of in - house expertise, these enterprises are vulnerable to data breaches, intellectual property theft, and other security incidents. Weak network security awareness among employees further compounds the risks, making data security a critical concern that could undermine the entire digital transformation process.

Strategic Deficiencies

A significant proportion (over 60%) of SME executives lack a comprehensive understanding of the strategic importance of digital transformation. This lack of awareness leads to inadequate strategic planning, insufficient resource allocation, and misguided approaches, such as treating digital transformation as a simple software purchase without considering overall business alignment. As a result, many digital initiatives fail to achieve the expected outcomes.

Inadequate Service Support
Given their weak IT capabilities and unclear transformation pathways, SMEs require extensive support throughout the digital transformation journey, including policy guidance, strategic planning, and technical assistance. However, the current service ecosystem is fragmented and insufficient, leaving SMEs without the necessary guidance and resources to navigate the complexities of digital transformation effectively.

4.2 The Urgency of Addressing These Challenges
The digital transformation of SMEs is not merely a technological upgrade but a strategic imperative for their survival and growth in the digital economy. Failure to overcome these challenges will widen the digital divide between SMEs and large enterprises, reducing the competitiveness of SMEs in the global market. Additionally, as the backbone of many economies, the stagnation of SMEs' digital development will impede overall economic growth and innovation.

Addressing these challenges is crucial for unlocking the full potential of SMEs, enabling them to enhance operational efficiency, improve product and service quality, and create new business models. It is also essential for fostering a more inclusive and sustainable digital economy, ensuring that no segment of the business community is left behind in the digital age. Immediate action is required from policymakers, industry associations, and technology providers to develop targeted solutions and support systems that can help SMEs overcome these barriers and embrace digital transformation successfully.

5. Cost and Efficiency Analysis of Digital Transformation of SMEs

5.1 Cost Composition
The costs of digital transformation of SMEs mainly include hardware equipment procurement costs, software system development or purchase costs, personnel training costs, data security maintenance costs, etc. Hardware equipment such as servers and computers needs to be updated regularly; software systems may need to be customized according to the enterprise's needs; personnel training requires a lot of time and capital investment to ensure that employees can use digital tools proficiently.

5.2 Efficiency Improvement Mechanism
Digital transformation can improve enterprise operational efficiency by optimizing business processes, realizing data sharing, and intelligent decision - making. For example, using big data analysis technology, enterprises can accurately grasp market demand, optimize product design and production plans; through supply chain management systems, real - time information sharing of all supply chain links can be achieved, improving supply chain collaboration efficiency and reducing inventory costs.

Cost Composition	Specific Content	Efficiency Enhancement Mechanism	Implementation Approach
Hardware Procurement Cost	Servers, computers, digital production equipment, etc., requiring regular updates.	Business Process Optimization	Optimize production plans using big data analysis, and realize information sharing through supply chain systems.
Software Development/Purchase Cost	Customized management software, cloud service platform leasing, data analysis tools, etc.	Data Sharing & Intelligent Decision-making	Integrate customer data via CRM systems and achieve precise marketing and dynamic inventory adjustment through AI algorithms.
Personnel Training Cost	Employee digital skills training, recruitment, and cultivation of technical talents.	Supply Chain Collaboration Efficiency Improvement	Adopt SCM systems to synchronize real-time information with upstream and downstream enterprises, reducing inventory costs and procurement cycles.
Data Security Maintenance Cost	Network security protection, data encryption, backup system construction, etc.	Accurate Market Demand Grasping	Mine user behavior data through big data to optimize product design for market needs.

Table 1 Comparison Table of Cost Composition and Efficiency Improvement Mechanism for Digital Transformation of Small and Medium sized Enterprises

5.3 Relationship between Cost and Efficiency
In the initial stage of digital transformation, enterprises need to invest a large amount of costs, but the efficiency improvement effect may not be obvious. At this time, there is a negative correlation between cost and efficiency. With the in - depth promotion of digital transformation, enterprises gradually realize the digitalization and

intelligence of business processes, efficiency will be greatly improved, and costs will gradually decrease with the emergence of scale effects. Then, there is a positive correlation between cost and efficiency.

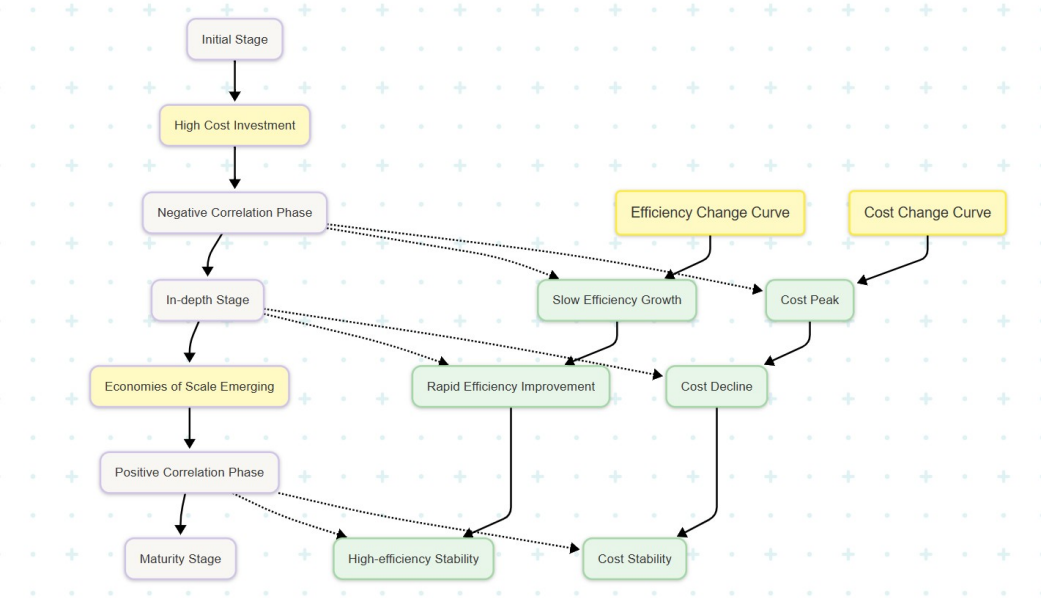

Fig.6.Dynamic Cost-Efficiency Relationship Model for SMEs' Digital Transformation

6. Strategic Solutions for Digital Transformation Challenges Faced by SMEs

Aiming at core challenges including funding shortages, talent scarcity, technological mismatch, data security risks, insufficient strategic planning, and inadequate service support, the following multi-dimensional strategies are formulated by integrating policy support, corporate self-optimization, and market collaboration:

6.1 Resolving Funding Bottlenecks and Strengthening Financial Support

Diversifying Financing Channels

Governments establish special funds or low-interest loans for digital transformation, providing interest subsidies to qualified enterprises. Financial institutions develop exclusive financial products like "Digital Transformation Loans" to lower financing thresholds.

Exploring Lightweight Investment Models

Encourage enterprises to adopt subscription-based services such as SaaS (Software as a Service) and cloud computing to launch digital transformation with low costs and risks.

Support enterprises in reducing financial pressure through tax relief and subsidies.

6.2 Constructing a Talent Ecosystem to Overcome Human Resource Shortages

University-Enterprise Collaborative Cultivation

Enterprises cooperate with universities and vocational colleges to offer customized courses for digital transformation, targeting practical talent cultivation in data analysis, AI application, etc. Establish internship bases to lock in high-quality graduates in advance.

Flexible Talent Recruitment Mechanisms

Introduce high-end technical talents through flexible methods such as part-time employment, project outsourcing, and consulting cooperation. Establish internal digital training systems to regularly carry out skill training for management and employees, improving digital literacy across the board.

6.3 Optimizing Technological Adaptability and Reducing Implementation Difficulty

Customized Solutions

Encourage technology service providers to develop lightweight tools adapted to the characteristics of SMEs, offering modular and scalable digital products (such as simplified ERP systems and intelligent marketing platforms), supporting pay-as-you-go and functional iteration.

Industry Standardization Construction
Industry associations take the lead in formulating technical standards for SMEs' digital transformation, promoting cross-platform data interconnection and reducing repeated development costs.

6.4 Building a Solid Security Line of Defense to Ensure Data Security
Strengthening Investment in Security Technologies
Governments subsidize enterprises in purchasing security devices such as data encryption, firewalls, and intrusion detection systems. Promote SMEs to access third-party security service platforms for real-time risk monitoring and protection.

Enhancing Security Awareness
Regularly carry out cybersecurity training and emergency drills, formulate data security management systems, and clarify employee operation specifications. Guide enterprises to obtain security certifications such as ISO 27001 to improve the security management system.

6.5 Deepening Cognitive Planning and Clarifying Transformation Paths
Strengthening Policy Advocacy
Governments and industry associations popularize the strategic value of digital transformation through seminars, case sharing sessions, etc. correcting the misunderstanding of "focusing on tools over planning"

Providing Strategic Consulting
Form expert teams to provide free or low-cost transformation planning services for enterprises, helping them formulate phased goals to ensure deep integration of technological investment and business needs.

6.6 Improving the Service System and Strengthening Full-cycle Support
Building One-stop Service Platforms
Integrate resources such as policy interpretation, technology docking, talent recruitment, and financing services to provide enterprises with "full-process, full-chain" services.
Introduce third-party evaluation institutions to regularly diagnose the progress of enterprise transformation.

Promoting Benchmark Demonstration
Governments select excellent cases of digital transformation, establish benchmarks through financial rewards, publicity, etc.and guide SMEs to learn from successful experiences and reduce trial-and-error costs.

6.7 Promoting Ecological Collaboration and Achieving Resource Sharing
Establishing SME Alliances,
Encourage enterprises to jointly purchase technical services and share data resources, reducing costs through scale effects. Promote collaborative transformation of upstream and downstream enterprises in the industrial chain to achieve digital collaboration in the supply chain.

Opening up Government Data Resources
Governments open public data interfaces (such as market data, industry reports) to help SMEs enhance data-driven decision-making capabilities and unleash data value.

Through the collaborative promotion of the above strategies, SMEs can systematically address core obstacles in digital transformation, accelerate the deep integration of technology and business, and enhance their competitiveness and sustainable development capabilities in the digital economy.

7. Conclusion

In the era of the digital economy, the digital transformation of SMEs is inevitable. Although facing problems such as high costs and shortages of technical talents, through optimizing strategies such as clarifying the transformation strategic plan, reasonably controlling costs, improving efficiency, and seeking policy support and enterprise cooperation, SMEs can improve the efficiency of digital transformation while controlling costs and achieve sustainable development. In the future, with the continuous development and improvement of digital technologies, the digital transformation of SMEs will face more opportunities and challenges, and enterprises need to continuously explore and innovate transformation paths.In the future, research on SMEs' digital transformation could focus on integrating emerging technologies (e.g., generative AI, edge computing) to explore lightweight solutions, examining ecosystem collaboration for resource sharing, analyzing data assetization under regulatory frameworks, and addressing the balance between globalization and localization.

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