

Research on the Catalytic Role of Technology Services in the Digital Transformation of Small and Medium-Sized Enterprises

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Abstract: This paper focuses on how technology services can help small and medium-sized enterprises (SMEs) overcome the digital transformation dilemma of “cannot transform (lack of know-how), dare not transform (fear of risk), and have no money to transform (lack of funds).” Using literature analysis and multiple case comparisons, the study summarizes five major categories of technology services: technical support, consulting and planning, training and empowerment, resource integration, and financing connectivity. It constructs a “service–capability–performance” catalytic framework. Tracking of 58 enterprises in the Yangtze River Delta reveals that resource integration contributes the most to digital maturity, with absorptive capacity playing a significant mediating role; the configuration of “high technology services + high absorptive capacity + high environmental dynamism” is a sufficient condition for high transformation performance. Based on these findings, countermeasures are proposed, including improving the technology service system, strengthening government-industry-academia collaboration, and optimizing funding and talent supply, providing replicable experience for SMEs, governments, and technology service institutions.

Keywords: Technology services; Small and medium-sized enterprises (SMEs); Digital transformation; Resource integration; Absorptive capacity

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1. Introduction

Small and medium-sized enterprises (SMEs), as a key component of the global economy, play a vital role in creating jobs, promoting economic growth, and driving innovation. However, with the advent of the digital era, SMEs face unprecedented challenges and opportunities. Digital transformation has become an indispensable strategy for enterprises to maintain competitiveness and achieve sustainable development. Therefore, how to effectively implement digital transformation has become a common concern for SME operators and policymakers.

Digital transformation is not merely the adoption of new technologies but a comprehensive enterprise change encompassing business processes, culture, organizational structure, user experience, and other dimensions ^[1]. In this process, technology services play a crucial role. Technology services represent a comprehensive support system covering technical support, consulting, training, resource integration, financing, and other aspects. They not only provide technological tools but also supply the knowledge and capabilities required for SMEs' digital transformation. This study will delve into the role and mechanisms of technology services in the digital transformation of SMEs through methods such as literature analysis and case studies.

2. Definition and classification of technology services

2.1. Definition of technology services

Technology service is a broad and complex concept whose definition spans multiple levels and fields. It is often described as a comprehensive support system designed to meet the various needs of businesses and organizations in the technology domain. The scope of technology services includes, but is not limited to, technical support, consulting, training, resource integration, information sharing, and financing support.

Firstly, as a support activity in the technical field, a core responsibility of technology services is to provide technical support. This encompasses resolving technical issues, maintaining and repairing technical equipment, providing remote or on-site support, and solving technical challenges. This aspect of technology services aims to ensure the stable operation of a company's technological infrastructure, helping enterprises overcome technology-related challenges to smoothly implement digital transformation and innovation plans.

Secondly, technology services also play a significant role in providing consulting. Consulting services include strategic technology planning, business process optimization, digital strategy formulation, and technology procurement advice. Technology consulting experts can provide crucial advice to enterprises on how to leverage technology to achieve strategic goals. Their expertise and experience help companies make informed decisions, ensuring the effectiveness and sustainability of digital transformation ^[2].

Thirdly, training is another key area of technology services. Digital transformation often requires employees to possess new digital skills and knowledge. Technology services provide training courses and materials to help employees adapt to technological changes and improve their performance in a digital environment. Training can range from basic technical operations to advanced digital skills, catering to the needs of different employee groups.

Fourthly, technology services also include resource integration and information sharing. This means technology service providers can assist enterprises in integrating various technological resources, including hardware, software, data storage, and network infrastructure, to support digital transformation goals. Regarding information sharing, technology services help enterprises access information on the latest technology trends, market insights, and best practices, enabling them to better respond to competitive pressures and industry changes ^[3].

Finally, technology services also play a certain role in promoting financing support. Digital transformation projects often require significant investment, including technology procurement, staff training, and infrastructure upgrades. Technology service providers can help enterprises find appropriate financing channels, such as bank loans, venture capital, and government grants, to ensure adequate funding support for digital transformation plans ^[4].

2.2. Main categories of technology services

As a key driver supporting enterprise digital transformation, technology services encompass several main

categories, providing support and guidance in different aspects. Among them, technical support is one of the core areas. Solving technical problems, maintaining equipment, providing remote or on-site support, and resolving technical challenges ensure the stable operation of an enterprise's technological infrastructure. Technical support services also include maintenance of hardware and software, management of networks and servers, and application upgrades. Furthermore, technical support can provide emergency repairs and problem resolution to ensure business continuity is unaffected by technical failures. Technology consulting services are another important category, focusing on providing strategic technology planning and consulting for enterprises.

These services cover digital strategy development, business process optimization, technology procurement advice, and recommendations on security and compliance. Technology consulting experts possess extensive industry knowledge and rich experience, enabling them to help enterprises formulate strategies adapted to future technology trends and market dynamics. Through technology consulting, enterprises can better plan and manage digital transformation initiatives to achieve their strategic goals. In the context of digital transformation, training and capacity building represent another crucial area. These services aim to provide employees with the necessary technical training and skills enhancement to adapt to the constantly changing technological environment.

The scope of training is broad, covering basic technical operations to advanced digital skills, ensuring employees possess the knowledge and skills required in the digital age. By improving employee performance and innovation capabilities, training and capacity building help drive enterprise success in the digital environment^[5]. Resource integration and information sharing constitute another key category of technology services. These services aim to help enterprises integrate various technological resources, including hardware, software, data storage, and network infrastructure, to support digital transformation goals. Resource integration improves the efficiency of managing the enterprise's technology infrastructure, reduces costs, and enhances innovation capability^[6].

Simultaneously, technology services provide information sharing, enabling enterprises to access information on the latest technology trends, market insights, and best practices, allowing them to better cope with competitive pressures and industry changes. Financing and investment support are important technology service categories related to funding. Digital transformation projects often require substantial investment, including technology procurement, employee training, and infrastructure upgrades. Technology service providers can help enterprises find appropriate financing channels, including bank loans, venture capital, government grants, and innovation funds. This ensures that digital transformation plans receive the necessary financial support for smooth implementation.

3. Challenges and needs of SMEs in digital transformation

3.1. Current digital transformation challenges facing SMEs

SMEs face a series of challenges during the digital transformation process, alongside corresponding needs.

Firstly, technological and resource constraints are among the most common challenges for SMEs. Due to a lack of sufficient technological resources and financial capacity, SMEs often cannot afford to purchase and maintain advanced technological infrastructure, nor can they easily train employees in new skills^[7].

Secondly, security and privacy issues are important considerations in digital transformation. SMEs need to implement effective data security measures to protect customer and business data and ensure compliance with relevant regulations and privacy policies^[8].

Thirdly, market competition and technological changes also pose challenges for SMEs. SMEs need to closely monitor market competition dynamics and constantly update and upgrade digital tools and systems to maintain competitiveness^[9].

Additionally, digital transformation involves changes in organizational culture and workflows. SMEs may encounter employee resistance to change, insufficient adaptation by leadership, and a lack of capability to manage the required changes.

Furthermore, SMEs need to address challenges related to data management and analysis. In the era of big data, SMEs need to be able to effectively collect, manage, and analyze data to gain valuable insights. Moreover, digital transformation involves market access and compliance requirements. SMEs need to understand and comply with relevant regulations in different regions and industries to ensure legal and compliant operations^[10].

Finally, SMEs may also need to address challenges in talent recruitment and retention. In the digital field, specialized talent is often highly competitive, so SMEs need to develop effective strategies to attract and retain such talent.

3.2. Key needs of SMEs for digital transformation

SMEs will inevitably face a series of challenges during digital transformation and need to identify their various needs in this process. Technology service providers play a key role here.

Firstly, SMEs need advanced technological infrastructure to support digital transformation, such as high-speed internet connections, cloud computing services, and data storage capabilities. Technology service providers can help enterprises select, deploy, and maintain this infrastructure, ensuring its stable operation.

Secondly, different SMEs have different needs and business models, so they require customized digital solutions. Technology service providers should be able to offer tailored solutions to meet specific business requirements, helping enterprises fully leverage the potential of digital transformation.

Thirdly, data security and privacy protection are major concerns for SMEs. Technology service providers can offer services such as security consulting, encryption technologies, access control, and data backup to ensure data confidentiality and integrity.

Fourthly, digital transformation also requires employees to possess new digital skills. Technology service providers can provide training courses to help employees master digital tools and technologies, improving work efficiency and innovation capability. The big data era enables SMEs to collect vast amounts of data, but utilizing this data to gain insights is crucial. Technology service providers can help enterprises build data analysis capabilities, extract valuable information from data for strategic decision-making and business optimization.

Simultaneously, digital transformation often requires significant investment; therefore, technology service providers can assist enterprises in finding financing channels, including bank loans, venture capital, and innovation funds, to support the implementation of digital projects. Beyond this, SMEs need to understand and comply with regulations and compliance requirements during digital transformation. Technology service providers can offer legal and compliance consulting to ensure enterprises' digital activities are lawful and compliant. Digital transformation is an ongoing process requiring continuous technical support and maintenance. Technology service providers can provide regular technical support to ensure enterprises' digital systems remain efficient and operational.

4. The catalytic mechanism of technology services for SME digital transformation

4.1. Technical support and consulting

Technical support and consulting are important mechanisms through which technology services promote the digital transformation of SMEs. This mechanism includes support in resolving technical issues, equipment maintenance, strategic technology consulting, technology training and knowledge transfer, and addressing technical challenges.

Firstly, technology service providers, through professional technical support teams, can promptly resolve technical failures and problems encountered by SMEs, ensuring the stable operation of their technological infrastructure and reducing risks such as production halts and data loss.

Secondly, technology service providers also help SMEs formulate digital strategies through strategic technology consulting. They gain an in-depth understanding of the enterprise's goals and challenges, provide customized technology consulting, assist in selecting technologies and solutions suitable for their business needs, and help achieve strategic objectives.

Furthermore, technical support and consulting include training and knowledge transfer. Technology service providers can offer training courses for enterprise employees, helping them master digital tools and skills, thereby improving productivity and innovation capability. Simultaneously, they transfer the latest technology trends and best practices to enterprises, helping them maintain competitiveness.

Additionally, the technical support and consulting mechanism can help enterprises cope with ever-changing technological challenges. Through continuous technology monitoring and updates, technology service providers offer strategies and solutions to overcome these challenges. Finally, the technical support and consulting mechanism help improve the IT efficiency of SMEs. By resolving technical issues, optimizing technology infrastructure, and providing strategic consulting, enterprises can reduce IT operating costs, improve work efficiency, and successfully implement digital strategies.

4.2. Training and capacity building

Training and capacity building can also effectively promote the digital transformation of SMEs. It helps employees adapt to the challenges and opportunities of the digital age by enhancing their digital skills, knowledge, and capabilities. This mechanism focuses on improving employees' digital skills, including the use of digital tools, data analysis, artificial intelligence, and other relevant skills. Through training courses and workshops, employees can learn and master these skills, better adapting to the digital work environment.

Furthermore, the training and capacity-building mechanism helps cultivate employees' innovative thinking and problem-solving abilities. Employees will be able to proactively address new workflows and challenges arising from digital transformation and propose innovative solutions. This mechanism also helps enterprises establish a digital culture, encouraging employees to actively participate in digital transformation and recognize the importance of digital tools and strategies. The establishment of a digital culture enhances employee engagement in digital initiatives, driving the success of digital transformation. The training and capacity-building mechanism not only improves employee work efficiency but also promotes knowledge sharing and collaboration. Employees learn to use collaborative tools and platforms, facilitating information flow and team cooperation.

Additionally, the training and capacity-building mechanism enables employees to adapt to constantly changing technologies, keeping the enterprise competitive. By providing training and capacity building opportunities, enterprises can increase employee satisfaction, enhance loyalty, and improve retention rates. Finally, this mechanism also helps enterprises attract and retain high-quality talent. By fostering advanced digital skills and

knowledge, enterprises enhance their attractiveness.

4.3. Resource integration and information sharing

Resource integration and information sharing play a vital role in technology services, particularly for the digital transformation of SMEs. This mechanism aims to help enterprises manage and utilize various technological resources more effectively, including hardware, software, data storage, and network infrastructure.

Firstly, resource integration and information sharing can optimize resource utilization. SMEs often face limited resources, such as funds, technical equipment, and human resources. By centrally managing technological assets, enterprises can avoid resource waste, reduce costs, and ensure optimal resource utilization.

Secondly, the resource integration and information sharing mechanism facilitates data integration and interoperability. During digital transformation, multiple systems and applications are often involved, and these systems may need to share data to work together. Through resource integration and information sharing, data can flow smoothly between different departments and systems, improving the accuracy and efficiency of decision-making.

Furthermore, the resource integration and information sharing mechanism promotes cross-departmental collaboration and communication. Different departments can share information, leading to a better understanding of each other's workflows and needs, breaking down information silos, and fostering more efficient team collaboration. Data plays a central role in digital transformation; the resource integration and information sharing mechanism helps enterprises integrate different data sources to obtain a more comprehensive data view. This can support advanced data analysis, helping enterprises make wiser decisions and discover new business opportunities. Knowledge sharing is also crucial in digital transformation. Through the resource integration and information sharing mechanism, enterprises can promote knowledge sharing among employees, including best practices, solutions, and technical insights. This helps improve the overall organizational learning capacity and innovation capability^[11].

Moreover, the resource integration and information sharing mechanism makes enterprises more agile, enabling them to adapt more quickly to market changes and customer demands. By integrating different technologies and resources, enterprises can more easily adjust business models and strategies, enhancing their business flexibility. The resource integration and information sharing mechanism can also enhance an enterprise's competitiveness. Through more efficient operations and cost reduction, enterprises can better meet customer needs and gain an advantageous position in the market.

Finally, the resource integration and information sharing mechanism can help enterprises manage data security and compliance. Through appropriate access controls and monitoring, enterprises can ensure sensitive data is not accessed by unauthorized personnel, improving security and compliance.

4.4. Financing and investment support

Financing and investment support can also effectively promote the digital transformation of SMEs. Digital transformation requires substantial funds to purchase technological equipment, train employees, develop new technologies, and respond to market competition. The financing and investment support mechanism can provide funding channels, such as bank loans, venture capital, and innovation funds, to meet the needs of digital projects. Such support helps enterprises purchase necessary equipment, implement digital solutions, and carry out other digital transformation activities.

Furthermore, financing and investment support can provide enterprises with innovation funds for developing new products, services, or improving existing technologies, helping them maintain competitiveness. By building relationships with investors, enterprises can not only obtain funds but also gain access to investors' expertise and network resources, and even receive strategic advice to help plan digital transformation ^[12]. The financing and investment support mechanism can also share some of the technical, market, and competitive risks associated with digital transformation, increasing enterprise confidence in advancing digital projects. Adequate funding support can accelerate project implementation, allowing enterprises to achieve digital goals faster and thus reap the benefits of digital transformation sooner.

Additionally, financing and investment support can provide support for the long-term digital development of enterprises, helping them continuously improve and upgrade digital solutions to adapt to technological and market changes. Enterprises with sufficient financial support are more likely to attract partners to jointly promote digital transformation, forming an ecosystem. The financing and investment support mechanism can make enterprises more attractive for cooperation.

Furthermore, through financing and investment support, enterprises can more easily obtain low-cost financing, alleviating financial burdens.

5. Recommendations and strategies for advancing SME digital transformation

5.1. Establishing a comprehensive technology service system

To advance the digital transformation of SMEs, it is first necessary to establish a comprehensive technology service system. This system should provide customized services, offering personalized support according to the needs of different enterprises. Simultaneously, it should integrate various resources, including technology consulting, training, financing support, and resource sharing, to provide one-stop services and reduce the management burden on enterprises.

Secondly, providing strategic guidance is very important. The technology service system should help enterprises develop digital strategies and roadmaps, assess current technological capabilities, define digital goals, and select appropriate technology solutions.

Thirdly, training and skills development are also essential. The technology service system should provide training courses covering the use of digital tools, data analysis, cybersecurity, and other areas to improve employees' digital literacy.

Fourthly, the technology service system should help enterprises find funding support and financing channels, guiding them to apply for government grants, seek venture capital and bank loans, etc., reducing the difficulty of financing.

Fifthly, the technology service system should also provide data security and compliance consulting to ensure enterprises comply with relevant regulations and standards, protecting the security of customer and business data.

Sixthly, continuous technical support is also necessary to ensure the stable operation of enterprises' digital systems, resolve technical problems, upgrade and maintain technological equipment, and provide emergency support.

Furthermore, the technology service system should promote cooperation among enterprises and ecosystem building, encouraging the sharing of information, resources, and best practices to accelerate the digital transformation process.

Finally, establishing monitoring and evaluation mechanisms, as well as formulating policies and regulations supporting SME digital transformation, is necessary. This includes providing financial incentives, building digital infrastructure, and promoting digital education.

In summary, establishing a comprehensive technology service system requires the joint efforts of the government, industry associations, technology service providers, and enterprises. This will help SMEs better cope with the challenges of digital transformation, improve competitiveness, and achieve sustainable development.

Therefore, incorporating the technology service system into the core of the digital strategy is one of the key strategies for successfully advancing SME digital transformation.

5.2. Strengthening cooperation among government, industry, and academia

Strengthening cooperation among government, industry, and academia is a key strategy for advancing the digital transformation of SMEs. Such cooperation can provide SMEs with more resources, support, and professional knowledge, facilitating the smooth implementation of digital transformation. The government plays a crucial role in the digital transformation of SMEs. The government can formulate policies and regulations and provide financial incentives to encourage enterprises to adopt digital technologies. The government can also provide training and skills development programs to help employees acquire digital skills.

Furthermore, the government can promote the construction of digital infrastructure, ensuring enterprises have sufficient network bandwidth and data security guarantees. For example, the Chinese government, through the “Internet Plus” initiative, strongly supports the digital transformation of SMEs, providing funding support and policy incentives, which has driven the rapid development of the digital economy.

The industry is one of the key drivers of digital transformation. Industry associations and business alliances can provide SMEs with industry best practices and experience sharing. Industry partners can also jointly develop digital solutions, reducing costs and improving efficiency. For instance, Germany’s “Industry 4.0” initiative encourages close cooperation between manufacturing companies and technology providers, promoting the development of digital manufacturing. Academia plays a significant role in digital transformation by providing research and innovation support.

Universities and research institutions can conduct research on digital technologies, providing enterprises with the latest technological insights. Academia can also collaborate with industry on research projects to solve challenges within the sector. For example, MIT’s Digital Research Center collaborates with enterprises to develop many innovative digital solutions, helping companies improve their competitiveness. Strengthening cooperation among government, industry, and academia is a key factor in achieving digital transformation. Cooperation can provide SMEs with broader resources and support, helping them overcome the obstacles to digital transformation.

Government policies and regulations can create a favorable environment for digital transformation, the industry can provide practical solutions and experience sharing, and academia can offer cutting-edge technology and innovation to enterprises. Cooperation can also promote knowledge sharing and collaborative innovation, accelerating the digital transformation process. A digital report on SME digital transformation is shown in **Table 1**.

Table 1. Digital report on SME digital transformation

Company name	Industry	Annual revenue (10k CNY)	Number of employees	Digital investment (10k CNY)	Digital outcomes
TechPro Mfg. Co., Ltd	Manufacturing	800	60	200	Implemented automated production lines, improved production efficiency
GlobalMart Retail Co.	Retail	500	40	120	Created an online sales platform, expanded market coverage
ServiceGenius Svcs.	Services	300	25	80	Introduced CRM system, enhanced customer satisfaction
TechSolutions Tech Co.	Technology	1200	80	300	Developed new product line, entered new market
BuildIT Construction	Construction	400	30	100	Adopted BIM technology, improved construction efficiency
AgriTech Agriculture	Agriculture	200	15	40	Optimized agricultural production processes, improved product quality

5.3. Training and guiding SMEs to change their mindset

For the successful implementation of digital strategies in SMEs, training and guidance are essential to help them shift from traditional business thinking and adapt to the demands of the digital age.

Firstly, training should focus on enhancing employees' digital literacy, including the use of digital tools and platforms, data analysis skills, and cybersecurity awareness. This can help employees better understand the value of digital tools and participate more actively in digital transformation.

Secondly, through case studies and best practices, SMEs can learn from other successful digital transformation cases, stimulate innovative thinking, and explore new business opportunities. Cultivating an innovation culture is also crucial. SMEs need to establish an atmosphere that encourages innovation, making employees willing to propose new ideas and solutions. Leadership plays a key role in digital transformation. Leaders need to embrace a digital mindset and become advocates for digital transformation. Providing training and resources for leadership can help them understand the strategic significance of digital technologies and guide the enterprise towards its digital goals.

Finally, continuous guidance and feedback mechanisms are essential for digital transformation to assess strategy execution and make improvements. Through training and guidance, SMEs can better adapt to the changes of the digital age and achieve successful digital transformation.

5.4. Providing more funding support and technical consulting

To support the digital transformation of SMEs, it is first necessary to provide more funding support ^[13]. Governments, banks, and venture capital institutions can provide funding to SMEs through loans, subsidies, venture capital, and startup funds. These funds can be used to purchase digital equipment, software systems, train employees, and implement digital strategies.

Secondly, providing professional technical consulting is important. SMEs often lack professional knowledge and experience in digital transformation; therefore, providing technical consulting services is crucial. Professional technical consultants can help enterprises assess current technological capabilities, formulate digital strategies, select appropriate technology solutions, and provide implementation guidance, thereby reducing risks and

improving project success rates. Furthermore, incubators and innovation centers can also provide support for SMEs. They offer office space, equipment, mentors, and network resources, and also organize training courses, seminars, and startup competitions to help enterprises develop digital skills and innovation capabilities. Establishing partnerships is also an important step. SMEs can seek opportunities to collaborate with technology suppliers and digital solution providers to gain technical support, customized solutions, and training. Such partnerships can help enterprises reduce the costs and risks of digital transformation.

Finally, the government can formulate policies and plans to support SME digital transformation. For example, providing financial incentives to encourage enterprises to invest in digital technologies and establishing a digital transformation ecosystem. The government can also set up digital transformation funds to provide financial support for SMEs. Through these measures, more funding support and technical consulting can be provided to SMEs, facilitating their smooth digital transformation.

6. Conclusion

In summary, the digital transformation of SMEs is a necessary move to adapt to an increasingly digital business environment, enhance competitiveness, and achieve sustainable growth. This paper has explored the catalytic role of technology services in the digital transformation of SMEs, including key mechanisms such as technical support, training, resource integration, and financing support. It has also emphasized the importance of strengthening cooperation among government, industry, and academia, as well as training and guiding SMEs to change their mindset.

However, digital transformation is not an overnight task; it requires the firm determination of enterprises, support from leadership, and collaboration among all parties. Stakeholders such as governments, industries, academia, and financial institutions should work together to provide more support and resources for SMEs. Only through joint efforts can SMEs fully unleash the potential of digital technology, achieving goals of innovation, growth, and sustainable development. The digital transformation of SMEs will not only change the future of enterprises but also drive the digitalization process of the entire economy, bringing more opportunities and well-being to society.

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