

The Intrinsic Logic of Industrial Internet Driving the Digital Transformation of SMEs and Policy Recommendations

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ABSTRACT

The industrial internet, as a deep integration of new-generation information and communication technologies with the industrial economy, provides an accelerator for the digital transformation of small and medium-sized enterprises (SMEs). By connecting people, machines, objects, and systems, it constructs a new type of manufacturing and service system that encompasses the entire industrial chain and value chain, promoting the transformation and upgrading of the manufacturing industry. SMEs face challenges in digital transformation, such as insufficient digital knowledge reserves among management and employees, unclear transformation paths, and a lack of support for key elements. The intrinsic logic of the industrial internet lies in improving production efficiency and reducing costs, promoting innovation and business model transformation, and strengthening supply chain collaboration. Policy recommendations include enhancing the guidance of enterprise transformation capabilities, improving the supply level of transformation, and increasing policy support for transformation, to promote the digital transformation and high-quality development of SMEs.

KEYWORDS

Industrial Internet; Digital Transformation; Small and Medium-sized Enterprises; Policy Recommendations.

1. INTRODUCTION

The industrial internet is a product of the deep integration of new-generation information and communication technologies with the industrial economy. It comprehensively connects people, machines, objects, and systems, creating a new manufacturing and service system that spans the entire industrial chain and value chain. This concept encompasses not only the infrastructure for the digitalization, networking, and intelligent transformation of industry but also represents an application model that deeply integrates the internet, big data, and artificial intelligence with the real economy. It also signifies a new business form and industry, with the potential to reshape enterprise forms, supply chains, and industrial chains.

The core of the industrial internet lies in four major systems: networking, platforms, data, and security. The networking system provides connections and data transmission between devices and systems; the platform system aggregates industrial data and model management, supporting industrial modeling analysis and intelligent decision-making; the data system serves as an element supporting the operation of the entire industrial internet; and the security system is the foundation for the healthy development of the industrial internet. Through the collaborative work of these systems, the industrial internet can promote the transformation and upgrading of the manufacturing industry, achieve efficient allocation of resources, and promote high-quality development of the manufacturing industry.

Small and medium-sized enterprises (SMEs) face multiple challenges in the process of digital transformation, including insufficient capital investment, weak digital capabilities, a lack of professional talent, and limited understanding of digitalization. These challenges prevent many enterprises from fully leveraging the opportunities brought by digitalization, placing them at a disadvantage in fierce market competition.

The industrial internet, as a key support for digital transformation, provides SMEs with a platform to accelerate transformation. By offering cloud services, big data analysis, artificial intelligence applications, and other functions, it helps enterprises enhance their capabilities in equipment management, data management, and market response. The industrial internet platform lowers the barrier for SMEs to apply new technologies, stimulates their digital intelligence, strengthens their resilience in uncertain environments, and creates new value for businesses.

For SMEs, the industrial internet is not just a technology but also an effective tool for connecting to the market, optimizing operations, and enhancing competitiveness. It can help enterprises break down information silos, achieve data integration and sharing, and improve the efficiency and accuracy of decision-making. At the same time, the industrial internet can also help SMEs better integrate into the global supply chain by accessing more market opportunities through platform-based services. Therefore, the industrial internet is of great significance for the digital transformation of SMEs and is a key factor in promoting high-quality development of enterprises.

2. THE REAL DILEMMA OF DIGITAL TRANSFORMATION FOR SMES

SMEs have insufficient digital knowledge reserves among management and employees. The issue of insufficient digital knowledge reserves among the management and employees of SMEs during digital transformation is manifested in several aspects. Firstly, the management of SMEs often lacks an understanding of the importance of digital transformation and has no clear ideas or plans on how to use digital technology to drive business development. This leads to the neglect of digital potential and needs when formulating strategies, thus failing to effectively promote the transformation process. Secondly, the lack of digital knowledge reserves at the employee level is also a prominent issue. Many employees may not have received relevant training and lack the necessary understanding and skills to use digital tools and systems. This not only affects work efficiency but also limits the enterprise's ability to innovate in digital applications. The resistance to new technology and the learning costs for employees are also challenges that SMEs need to overcome in digital transformation. Lastly, due to the limited resources of SMEs, it is difficult to invest a large amount of funds in digital skills training and education for employees. This leads to a vicious cycle: the less enterprises invest in employee training, the more difficult it is for employees' digital skills to improve; the less the skills, the harder it is for enterprises to advance digital transformation. Therefore, SMEs need to find cost-effective training solutions, such as online courses, workshops, and industry seminars, to enhance the digital knowledge level of management and employees.

SMEs have uncertain transformation path and lack of long-term strategic planning. In the current economic environment, the digital transformation of SMEs has become particularly important. However, many enterprises feel confused during the transformation process due to the lack of long-term strategic planning. Firstly, many SMEs lack a clear digital transformation strategy, which leads to a lack of direction and steps when implementing transformation, making it difficult to determine priorities and resource allocation, and making the transformation process arbitrary and inefficient. Secondly, the lack of long-term strategic planning means that enterprises may not be able to continuously track and evaluate the effects of transformation, making it difficult to adjust and optimize transformation strategies. This not only leads to resource waste but may also cause enterprises to miss key market opportunities. Long-term planning can help enterprises set clear goals and formulate specific action plans to achieve these goals. Lastly, without long-term strategic planning, SMEs may become unadaptable when facing rapidly changing markets and technological

advancements. Enterprises need a flexible but stable digital transformation blueprint to ensure they can quickly respond to external changes while maintaining the coherence and consistency of internal operations.

Key support elements for digital transformation are not enough for SMEs. SMEs generally face challenges in terms of funding and weak technical foundations during the digital transformation process, which constitute the main dilemma of lacking key support elements for digital transformation. Firstly, a shortage of funds is an important obstacle to the digital transformation of SMEs. Digital transformation requires enterprises to invest a large amount of funds in purchasing software and hardware, developing or upgrading systems, training employees, etc., and SMEs often have limited funds and cannot afford the high costs of transformation. This leads to many enterprises that are willing to transform being hindered in the implementation process and unable to fully utilize the opportunities brought by digitalization. Secondly, a weak technical foundation is also a problem faced by SMEs. Many SMEs lack sufficient technical reserves and R&D capabilities, making it difficult for them to independently develop or integrate complex digital solutions. In addition, with the accelerating pace of technological iteration and updating, SMEs also face pressure in maintaining and upgrading existing technologies. Moreover, the challenges of data security and privacy protection are also issues that cannot be ignored in the digital transformation of SMEs. With the increase in the volume of enterprise data, how to ensure data security, prevent data leaks, and misuse has become a problem that enterprises must face. SMEs often lack professional cybersecurity teams and effective security measures, which increases the risks for enterprises in the process of digital transformation. Therefore, establishing a comprehensive data security management system and raising employee awareness of data security are crucial for the digital transformation of SMEs.

3. THE INTRINSIC LOGIC OF INDUSTRIAL INTERNET DRIVING THE DIGITAL TRANSFORMATION OF SMES

The industrial internet provides SMEs with effective ways to enhance production efficiency and reduce costs through its built-in intelligence and automation features. Firstly, it optimizes production processes by monitoring production lines and equipment status in real-time, using data analysis to predict equipment failures, and reducing downtime. For instance, by deploying sensors and automation systems, companies can reduce production delays and resource waste caused by human errors, while increasing the flexibility of production lines to adapt to the production needs of different products. Additionally, the industrial internet supports companies in gaining market and customer insights through data analysis, enabling precise marketing and service innovation. Utilizing industrial internet platforms, companies can better acquire and analyze market data, thus responding quickly to market changes and developing new products. At the same time, through the platform's data analysis capabilities, companies can explore new business models, such as data-based services or personalized customization services, thereby achieving business diversification and value addition. Finally, the industrial internet helps companies detect and prevent equipment failures in advance through predictive maintenance technologies, reducing unexpected downtime and extending the service life of equipment. This preventive maintenance strategy not only reduces maintenance costs but also improves production efficiency and product quality. In this way, companies can use resources more effectively, reduce energy consumption, and achieve cost savings.

The development of the industrial internet provides strong momentum and a broad platform for the digital transformation of SMEs. By integrating advanced information technologies such as the Internet of Things, big data, and artificial intelligence, the industrial internet promotes innovation in production, management, and services. It not only enhances production efficiency and product quality but also drives the transformation of companies from traditional manufacturing to intelligent manufacturing, allowing them to respond more flexibly to market changes and personalized demands. In terms of promoting innovation, the industrial internet helps companies discover new business

opportunities and improve decision-making efficiency through data analysis and intelligent algorithms. For example, companies can use industrial internet platforms to collect and analyze customer data, thereby more accurately predicting market trends and designing and developing new products that meet market demands. Moreover, the industrial internet also supports companies in achieving more refined management in the production process, optimizing resource allocation and production processes to reduce costs and improve efficiency. In terms of business model transformation, the industrial internet enables SMEs to explore new business and service models. Through platform-based design, intelligent manufacturing, and networked collaboration, companies can not only provide more personalized products and services but also extend their services to provide full lifecycle support for customers, such as remote monitoring, maintenance, and upgrades. This service-oriented manufacturing model not only increases the added value of companies but also opens up new revenue streams for them.

The industrial internet provides important support for the digital transformation of SMEs by promoting supply chain collaboration. Supply chain collaboration refers to a series of activities or final effects where all links in the entire supply chain (including upstream and downstream companies and various departments within a company) achieve collaborative operation. It involves deep cooperation at the strategic, tactical, and operational levels, achieving cooperation and coordination through information sharing, resource integration, and risk sharing, to improve the overall efficiency and competitiveness of the supply chain. Firstly, supply chain collaboration can significantly enhance the efficiency and flexibility of the supply chain. Through information sharing on the industrial internet platform, all participants in each link can obtain the required information in a timely manner, better carrying out production planning, inventory management, and logistics distribution. This increase in transparency reduces information asymmetry, enabling the supply chain to respond more quickly to market changes and improving the entire chain's response speed and adaptability. Secondly, supply chain collaboration helps reduce the risks and costs of the supply chain. By collaborating, companies can more accurately predict market demand, optimize inventory levels, and reduce situations of surplus or shortage. At the same time, collaborative efforts can reduce redundant links and logistics nodes, optimize resource allocation, and reduce the overall supply chain costs. This not only improves the profitability of companies but also enhances their market competitiveness. Lastly, supply chain collaboration can also enhance the competitiveness and innovation capabilities of the supply chain. In supply chain collaboration, companies share resources through cooperation, which can lead to faster development of new products and improvement in the quality of products and services. Moreover, collaboration promotes the sharing of knowledge and skills, helping companies learn new capabilities and expand existing technologies, thus driving innovation and upgrading throughout the entire supply chain.

4. POLICY RECOMMENDATIONS FOR INDUSTRIAL INTERNET-DRIVEN DIGITAL TRANSFORMATION AND UPGRADING OF SMES

Enhancing Enterprise Transformation Capability Guidance. Governments should provide guidance and support to help SMEs conduct digital assessments, clarify the priorities and paths for transformation. The key to enhancing the transformation capabilities of enterprises lies in guiding SMEs to recognize the strategic significance of digital transformation and to formulate feasible long-term strategic plans. Firstly, enterprises need to clarify the goals and paths of digital transformation from a strategic level, which includes a comprehensive assessment of existing business processes, organizational structures, and technical capabilities, and based on the assessment results, develop a digital transformation plan that matches the overall development strategy of the enterprise. Secondly, enterprises should establish an organizational structure suitable for digital transformation to ensure efficient execution of decisions during the transformation process, and support it with corresponding management systems and incentive mechanisms to increase employee participation and execution. In addition, SMEs also need to focus on the cultivation and introduction of digital talent. Enterprises

can cooperate with universities and research institutions to jointly develop training programs to enhance employees' digital skills and innovation capabilities. At the same time, enterprises should also explore the establishment of a dedicated team or department for digital transformation to concentrate resources and efforts to promote the implementation of transformation plans. Through these measures, SMEs can improve their digital level and enhance their competitiveness in the market.

Enhancing the Level of Transformation Supply. Enhancing the level of transformation supply is crucial for the digital transformation of SMEs, which mainly involves enhancing the service capabilities of the supply side to better meet the transformation needs of SMEs. Firstly, the supply side should focus on the common needs of SMEs and develop basic digital applications such as instant communication, remote collaboration, and project management. These applications should be small, fast, light, and precise to reduce the threshold for SMEs to adopt digital solutions. The supply side can demonstrate scene integration applications and transformation methods through online and offline integration, helping SMEs to understand and adopt these technologies. Secondly, the supply side should provide full-process services, including assessment planning, equipment transformation, system cloudification, and talent training. This kind of all-round accompanying service can help SMEs connect with product service ecosystem resources at different stages of transformation, promoting the gradual deepening of transformation. The supply side should also develop lightweight applications and develop subscription services to help SMEs achieve low-cost, high-efficiency digital transformation. Finally, the supply side needs to deepen ecological collaboration, promote the collaboration of upstream and downstream enterprises in the industrial chain and supply chain, and help SMEs achieve "chain-style" transformation. Large enterprises can drive the digital transformation of SMEs by applying or building industrial internet platforms, developing new models of industry and finance based on the industrial internet, and enhancing the financing capabilities of SMEs.

Increasing Policy Support for Transformation. Increasing policy support is one of the key factors in promoting the digital transformation of SMEs. Firstly, the government can support SMEs in cloud and platform adoption by providing special funds and subsidy policies, reducing the costs and thresholds for enterprises in the digital transformation process. For example, the central finance plans to support local governments in carrying out digital transformation pilots for SMEs in batches, providing award funds to support service platforms in providing digital transformation services for SMEs. Secondly, the government can promote pilot applications, creating "beacon" enterprises for digital transformation as samples, driving more SMEs to learn and follow suit. This includes not only technical support but also the digitalization of management and business processes, helping SMEs achieve comprehensive transformation and upgrading. Finally, the government also needs to improve supporting services, building a public service system that includes policy consultation, technical guidance, talent training, and project supervision, providing comprehensive support for SMEs. At the same time, it is necessary to optimize the development environment, strengthen infrastructure construction, and establish a sound evaluation system to create a development atmosphere conducive to the digital transformation of SMEs. Through these measures, the digital transformation process of SMEs can be accelerated, promoting high-quality economic development.

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