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Theoretical Basis of Digital Transformation of Manufacturing Industry based on the Perspective of Resource Agglomeration

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Abstract: Manufacturing industry, as the foundation of a country and the basis of a strong country, is the pillar industry of China's national economy. With the rise of a new round of industrial revolution, the digital economy era, follow the pulse of the times, and actively promote the digital transformation is to realize the transformation and upgrading of the manufacturing industry is the way to go, but also to achieve China's economic development of high quality is an inevitable choice. At present, the foundation of China's manufacturing industry digital transformation is relatively weak, there is a general problem of "do not want to turn, will not turn, cannot turn". In the face of a turn on the death, not turn the dilemma of death, how to effectively and efficiently promote the integration of digital reality, the successful completion of the digital transformation of the current development of the manufacturing industry is a key issue that needs to be resolved. This paper analyzes the process mechanism of digital transformation of manufacturing industry based on the perspective of resource agglomeration, and analyzes the current situation of digital transformation of manufacturing industry and existing problems, and finally proposes relevant policy measures and research outlook. It aims to provide theoretical guidance and policy recommendations for the digital transformation of manufacturing industry.

Keywords: Manufacturing; Digital Transformation; Resource Pooling; Process Mechanisms.

1. Introduction

Today's global manufacturing industry is in a period of rapid change, and the rapid development and popularization of digital technology has brought great opportunities and challenges to the manufacturing industry. This digital wave has not only changed the production methods and processes, but also profoundly reshaped the entire manufacturing business model and ecosystem [1-2]. The digital transformation of the manufacturing industry has become an inevitable choice for enterprises to comply with the development trend of the new era, and its success is not only related to the development and competitiveness of the enterprise itself, but also directly affects the change and progress of the entire industry [3].

In the context of digital transformation, the resource agglomeration perspective has become a new research perspective [4-5]. Resource agglomeration emphasizes the formation of a company's unique core competencies and competitive advantages through the integration of various internal and external resources, such as technology, talent, and data. Especially in the process of digital transformation of the manufacturing industry, resource integration and optimization are crucial to the transformation and upgrading of enterprises [6]. This resource aggregation perspective study helps to understand the essence of digital transformation more comprehensively. It delves into the important role of resource integration on enterprise change and provides important insights for the development of effective digital transformation strategies.

Digital transformation refers to the use of digital technologies by an enterprise or industry to change business models, processes, activities, and assets to improve efficiency, create value, and maintain competitive advantage [7]. Its underlying theories include the rapid development and application of digital technologies, and the impact of digital transformation on the enterprise value chain and ecosystem. Understanding the core concepts, implementation paths and influencing factors of digital transformation is an important foundation for the study. Resource agglomeration theory focuses on the integration, combination and optimization of resources, emphasizing the shaping of core competencies and competitive advantages of enterprises by resource integration. In the context of digital transformation of the manufacturing industry, resource agglomeration theory points out that enterprises form unique digital capabilities and competitive advantages by integrating digital technology, talent, data and other resources. Understanding the essence and role of the resource agglomeration perspective is an important theoretical basis for exploring resource integration and optimization in manufacturing digital transformation.

The digital transformation of manufacturing industry as the key development direction of the current global manufacturing industry, the rapid development of digital technology brings new development opportunities for the manufacturing industry [8-9], and the theory of resource agglomeration perspective proposes the key role of resource integration for enterprise transformation. Therefore, combining these two theoretical backgrounds to explore the intrinsic relationship and influence mechanism between resource integration and digital transformation can provide a more in-depth and comprehensive theoretical foundation for digital transformation in the manufacturing industry. In addition, studying the digital transformation of the manufacturing industry from the perspective of opportunity resource aggregation actually stands at the forefront of technological storms and industrial changes, hoping that by deeply exploring the relationship between resource

integration and digital transformation, we can seek a more forward-looking and effective development direction for enterprises and the entire manufacturing industry.

2. Digital Transformation and its Evolution in Manufacturing

2.1. Digital Transformation

Digital transformation is the process by which a firm or organization uses digital technologies to change its business model, processes, operations, and value creation in order to improve efficiency, create more value, and maintain a competitive advantage [10-11]. This transformation involves a complete disruption and re-conceptualization of the existing business to adapt to the changing market and technological environment.

The key features of digital transformation are mainly reflected in the following aspects: technology-driven, digital transformation relies on the latest digital technologies, such as artificial intelligence, the Internet of Things, big data, cloud computing, etc., which provide organizations with new tools and platforms to carry out their business activities in a more efficient, intelligent, and flexible way [12]; holistic and integrated, the Digital transformation is an all-encompassing change that involves all departments and levels of the organization. It is not just a technological change, but also a reshaping of organizational culture, processes and strategy; customer orientation, this transformation emphasizes the importance of the customer experience and needs, and companies use digital technologies to better understand and meet customer needs and to provide personalized and customized services and products; innovation and agility, digital transformation encourages innovation and agility, which enables companies to respond more quickly to market changes and remain agile in the face of competition. In addition, digital transformation involves changes in multiple areas, including but not limited to production, supply chain management, marketing, customer service and data analytics. Through digital transformation, organizations can increase efficiency, reduce costs, strengthen competitiveness, and stay ahead of the curve in the ever-changing business environment.

Digital transformation is becoming a central topic of increasing interest. The main driver of this trend is, on the one hand, the rapid development of technology, including the application of technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Big Data analytics. The rise of these technologies has provided new opportunities for the manufacturing industry, such as the application of real-time data to monitor production processes, automated production, and intelligent supply chain management, which have significantly improved efficiency and reduced costs [13]. On the other hand, there are changes in market demand and customer expectations. Modern consumers are increasingly demanding personalized and customized products, which requires the manufacturing industry to be able to flexibly adjust its production and supply chain to meet these demands. Digital transformation can help companies better understand market demand, predict trends, and quickly adjust production to market changes. In addition, digital transformation is driving a shift in business models in the manufacturing industry. From the traditional product-oriented model to a service-oriented model, enterprises not only provide products, but also focus on providing customers with a full range of solutions and value-added services. This shift requires enterprises to establish smarter, more flexible and customizable production methods, for which digital transformation provides important support and guarantee.

2.2. Impact of Digital Transformation on Manufacturing

Digital transformation has had a broad and far-reaching impact in the manufacturing industry, from production models to business models, from production intelligence to supply chain optimization, bringing higher efficiency, more flexible operations, and a better customer experience.

First, it reshapes the entire manufacturing ecosystem. Through the application of digital technologies, the production, management, and delivery processes of manufacturing have changed dramatically [14]. The application of tools such as automated production lines, smart manufacturing equipment, and real-time data analytics has improved production efficiency, reduced costs, and accelerated the speed of product development and marketing [15]. This transformation has not only changed the operation mode of the manufacturing industry, but also given rise to new business models, such as services based on the subscription model, digitalized factories, and customized production, which provide a broader development space for enterprises [16]. Secondly, digital transformation promotes the development of intelligent manufacturing. The manufacturing industry has built smarter and automated production environments with the help of advanced technologies such as artificial intelligence, Internet of Things and big data analytics [17]. This intelligence has led to greater predictability and stability in production processes, improving product quality and consistency. Smart manufacturing also makes companies more flexible and able to respond more quickly to changes in market demand and personalize production to meet customer needs [18-19]. In addition, digital transformation enhances the visualization and intelligent management of the supply chain. Through the application of digital technologies, the manufacturing industry is able to realize real-time monitoring and management of all aspects of the supply chain. This enables firms to better forecast and plan inventory, logistics, and production, reducing inventory costs, minimizing the risk of supply chain disruptions, and improving overall supply chain efficiency and transparency.

2.3. Drivers of Digital Transformation in Manufacturing

Comprehensive scholars' views on the drivers of digital transformation of the manufacturing industry, the drivers of digital transformation of the manufacturing industry are summarized and divided into two parts: internal drivers and external drivers. Regarding the external drivers of the digital transformation of the manufacturing industry, some scholars believe that with the development of science and technology, digital technology is gradually applied to various industries, and the arrival of the digital era has prompted traditional enterprises to carry out digital transformation, and some scholars believe that an important motivation for the digital transformation of traditional enterprises is to be able to achieve high-quality development through digital transformation, which will lead to the transformation of our country's economy from high-speed development to the process of high-quality development [20]. Some scholars also believe that external factors are important factors that

motivate manufacturing enterprises to carry out digital transformation, and empirically verified that the local government has exerted pressure on enterprises, which has played a driving role in the digital transformation of enterprises. The progress of technology is also considered to be one of the important factors in promoting digital transformation, and the integration and penetration of information technology, such as "big intelligence, mobile cloud", provides an important guarantee for the digital transformation of enterprises. Combining the views of the above scholars, this paper argues that the external factors of the digital transformation of the traditional manufacturing industry include the influence of the background of the times, the needs of the market, and the progress of digital technology, etc., and that the external factors provide the conditions for the digital transformation of the manufacturing industry.

Regarding the internal factors of digital transformation of manufacturing enterprises, scholars have found that the promotion of management is an important driving force for enterprise transformation. Secondly, the digital transformation of the enterprise can drive itself to achieve high-quality development, and can make its production mode also change, the organizational structure has also been upgraded in addition to improving the independent innovation ability of the enterprise. Secondly, some scholars believe that the enterprise's own needs drive manufacturing enterprises to carry out digital transformation, and he believes that the digital transformation of manufacturing enterprises can improve efficiency in production [21-22]. Combining the above views, this paper argues that internal motivation can be divided into entrepreneurship, the enterprise's own pressure, and the need for enterprise development needs, and that the drive of internal motivation can often bring greater momentum, prompting enterprises to take the initiative to find the realization path of digital transformation.

3. Resource Agglomeration Theory

3.1. Concept and Application of Resource Agglomeration Theory

The theory of resource agglomeration plays an important role in enterprise management and strategy formulation. It highlights the importance of enterprises integrating various internal and external resources, including technology, talent, capital and information, in order to form unique core competitiveness and innovation advantages. It also emphasizes the strategic nature of resource integration, combining enterprise resources organically to create value that is difficult to be imitated. From a broader perspective, resource agglomeration theory not only focuses on the resources themselves, but also on the synergies between them and the way of integration, emphasizing that the key to the success of an enterprise lies in how to maximize the use and integration of these resources.

Several key issues have been studied in the literature using the resource agglomeration theory. For example, one literature focuses on the relationship between resource integration and firms' core competencies. The research examines how firms shape and maintain their competitive advantages by integrating internal and external resources, such as technology, talent and capital. Second, there is literature on the mechanisms and paths of resource integration, exploring the ways in which different resources are linked and integrated, and how this integration affects firms' strategy formulation and execution. Third, researchers focus on the impact of resource agglomeration on firms' innovation capabilities, exploring how resource integration drives innovation, supports new product development, and facilitates technological progress. At the same time, the research also looks at internal and external factors that influence resource pooling, such as organizational structure, leadership style, cultural climate, and external collaboration, and how these factors affect the effects of resource pooling. Recently, with the rise of digital transformation, research has also begun to focus on the impact of digital transformation on resource integration, exploring how digital technologies change the patterns and effects of resource integration in firms. These research questions are exploring in depth the mechanisms by which resource integration affects the development and competitiveness of enterprises, and provide important theoretical guidance for enterprise management practices and strategic decision-making.

3.2. Application of Resource Agglomeration Theory in Manufacturing Industry

The theory of resource agglomeration has a multifaceted impact in the manufacturing industry, which can help enterprises realize the optimal allocation and integration of resources to adapt to the rapidly changing market and technological environment. This application not only improves the competitiveness of enterprises, but also promotes the overall development and innovation of the manufacturing industry.

Firstly, the manufacturing industry optimizes the supply chain with the help of resource agglomeration theory, and achieves synergy among suppliers by integrating the resources of each link, so as to improve the efficiency and flexibility of the supply chain. Second, the resource agglomeration theory is used to optimize the manufacturing process in terms of production processes and technologies. Firms use the theory to integrate advanced technologies, such as the Internet of Things, big data analytics and automated production lines, in order to improve production efficiency, reduce costs and ensure product quality. The theory is also closely related to innovation and R&D, where firms integrate various resources to drive innovation and facilitate the development of new products and services. Finally, the resource agglomeration theory guides the development of strategies for digital transformation in manufacturing, helping companies integrate digital technologies and other resources to build smart, flexible and efficient production models.

3.3. Digital Transformation in the Context of Resource Clustering

Resource agglomeration theory is seen as one of the key theoretical underpinnings to drive digital transformation. Research has shown that digital transformation requires companies to integrate and optimize internal and external resources, and resource agglomeration theory provides a powerful framework that explains how companies can integrate resources, such as technology, talent, and information, in order to achieve the goals of digital transformation. Resource Aggregation Theory is also recognized as one of the core factors that drive the success of digital transformation. The literature points out that enterprises need to fully integrate internal and external resources in the process of digital transformation, and the concepts of resource agglomeration theory can help

enterprises manage these resources more effectively and improve the success rate of digital transformation. In addition, the resource agglomeration theory is also seen as a guiding principle for digital transformation strategies. The researcher emphasizes that digital transformation needs to be planned and implemented from the perspective of resource integration, and the resource agglomeration theory provides effective methodologies and strategies to help enterprises better cope with the challenges and opportunities brought by digital transformation.

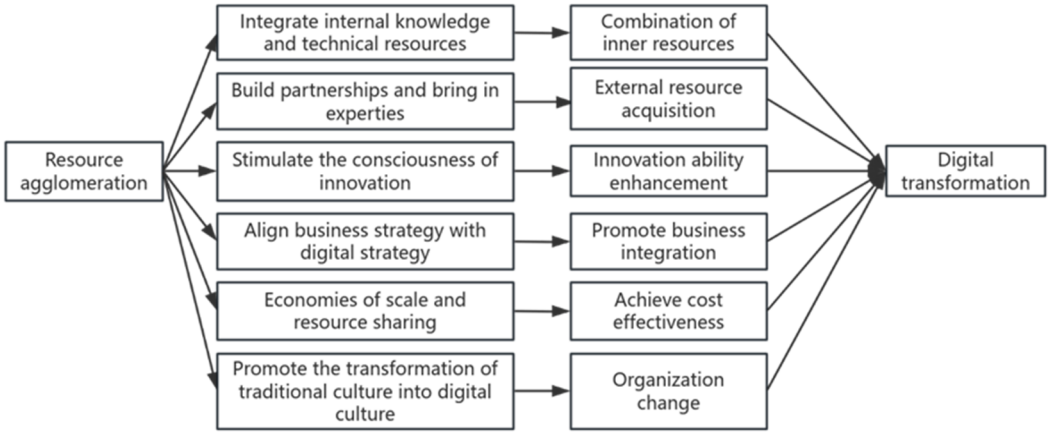

Figure 1. Theoretical Foundations of Digital Transformation from a Resource Agglomeration Perspective

Resource clustering plays multiple roles in promoting digital transformation. First, it builds a platform for information sharing through the integration of internal knowledge and technology resources, and promotes communication and cooperation among various departments within the enterprise. This internal resource integration not only enables enterprises to make more efficient use of existing knowledge reserves and technical capabilities, but also fosters an innovative culture that encourages cross-disciplinary cooperation and knowledge exchange among employees, providing an endogenous impetus for digital transformation. Second, resource pooling also focuses on building external partnerships and bringing in key talent. By working with external partners, companies are able to access the latest external knowledge, technology and market insights, providing diversified resource support for digital transformation. At the same time, bringing in key talent with cutting-edge technology and industry experience can inject new ways of thinking and innovative energy into the enterprise, accelerating the process of digital transformation.

In addition, resource clustering helps coordinate business strategy with digital strategy. It enables enterprises to organically integrate digital transformation with the overall corporate strategy, ensures that the direction of digital transformation is consistent with the long-term goals of the enterprise, and helps to realize the orderly advancement of business development. In addition, resource clustering brings the benefits of economies of scale and resource sharing. Through resource consolidation, enterprises can reduce duplication of inputs, improve resource utilization efficiency, lower the cost of digital transformation, and accelerate the transformation process. Finally, resource clustering also drives the change from traditional culture to digital culture. It prompts organizations to update their cultural concepts, cultivate digital thinking and work styles, and make enterprises more adaptable to the new culture and values required for digital transformation. Together, these aspects make resource pooling an indispensable key support in digital transformation.

4. Challenges and Responses during Digital Transformation

4.1. Possible Obstacles in Digital Transformation

First of all, manufacturing enterprises are facing the problem of insufficient transformation capacity. The traditional manufacturing industry itself has insufficient funds, infrastructure is not perfect, in the digital transformation of the early stage does not have enough capital, technology investment, resulting in greater difficulty in the transformation of enterprises, and some small and medium-sized enterprises do not even have any application of digital technology. Digital transformation itself has a large information input, high conversion costs, long return cycle, input-output ratio is difficult to predict and other characteristics, even if the enterprise has enough capital investment in the early stage, but also need to be innovative concepts and innovative talents to add. Some traditional manufacturing industry because of the concept of solidification of the transformation does not have the correct cognition, failed to develop a long-term digital transformation strategy in a timely manner. For example, most enterprises simply regard digital technology as a tool to improve labor productivity, but fail to realize its long-term role in value-added and other aspects. In addition, the input of digital technology will also have a certain impact on the traditional production management mode, which will also cause adverse effects if enterprises do not make timely countermeasures.

Secondly, the digital support capacity is insufficient according to the study found that most enterprises still have the problem of low utilization of digital facilities, inadequate construction, etc., and simply rely on their own enterprises to build information exchange platforms. This will not only increase the investment costs of enterprises, but also lead to inter-industry information blockage hindering the development of industrial integration. At the same time, enterprise digital transformation itself is a systematic process that requires the synergy of various departments. At present, other industries in the manufacturing industry has not reached

a consensus on digital transformation, there are still various knowledge barriers, in the application of infrastructure and digital system have not reached a cooperative and synergistic relationship, which invariably increases the cost of digital technology investment in the manufacturing industry, hindering the digital development of the manufacturing industry.

Thirdly, the information sharing between enterprises is not enough previous information technology is only in the company's internal information integration, but the company and the company still exists between the information silos, which results in the inability to mobilize the subjective initiative of other economic subjects completely, thus suppressing the possible economic development momentum. Under the conditions of the digital economy, companies are faced with the characteristics of industry development driven by consumer demand. Because the construction of information technology is a huge investment project, the building of information platforms is often monopolized by large companies with strong capital, technology and human resources, thus enabling them to enjoy the benefits of information technology. Under the effect of technological monopoly and technological barriers, the monopolistic gains obtained through information technology innovation are often obtained by one company or industry. The digital transformation of the manufacturing industry involves not only the penetration of technology and the integration of the industry, but also profound changes in the property rights and organizational structure of the relevant enterprises.

Finally, the data management and security system needs to be improved Data resources are the core raw materials for building digital business and catalyzing industrial intelligence, and have rich strategic value, but they are also the resources with the lowest security. With the deepening of enterprise digital transformation, data resources are also widely used by enterprises because of their fast speed and high timeliness. The manufacturing industry is able to analyze consumer demand through the integration of data to develop more personalized production solutions. However, because data resources are new resources, the system and laws have not been perfected, and the enterprises themselves have problems such as weak supervision and weak awareness of confidentiality, which in turn lead to enterprise network security problems. The manufacturing industry is an important part of the national economy and is closely linked to other important industries, which can be harmful to citizens and even the state once data is leaked during sharing or transmission. At the same time, there may also be unclear ownership of data flow between the same industries, leading to the problem of unclear rights and responsibilities for data security.

4.2. Strategies and Approaches to Address Barriers to Digital Transformation

When developing a digital transformation strategy, an organization needs to consider the current business situation, market trends, and competitive environment, and set transformation goals and corresponding timelines. This may involve improvements and innovations in business processes, customer experience, data analytics, operating models, and so on. At the same time, it is important to ensure that the transformation is in line with the overall development strategy of the enterprise and that resources and investments are allocated rationally. Second, digital transformation requires companies to have advanced technology and specialized talent to support it. Provide employee training and learning opportunities to continuously improve digital skills and knowledge so that employees can adapt to digital workflows and related technology tools. Collaborate with technology companies or bring in specialized talent to expand the capabilities of internal technology teams. Third, companies need to build an organizational culture of openness, innovation and collaboration. Break down barriers between departments, promote cross-departmental cooperation and information sharing, and encourage employees to actively participate and contribute. At the same time, optimize the organizational structure, simplify the decision-making process, and improve flexibility and responsiveness. Fourth, companies need to emphasize data security and user privacy protection. Establish a sound information security management system, ensure encryption and backup of critical data, and take measures to prevent data leakage and cyber attacks. Develop privacy policies to ensure compliance, respect user privacy, and comply with relevant laws and regulations. Fifth, it is necessary to ensure sustainable investment and resource support Enterprises should reasonably plan capital investment to ensure the sustainable operation and development of transformation projects. At the same time, they should actively seek government support and cooperation for financial support and policy support to jointly promote digital transformation.

General Secretary Xi Jinping emphasized, "Actively participate in international cooperation on the digital economy. We should observe closely, act proactively, take the initiative to participate in negotiations on digital economy issues in international organizations, carry out bi-lateral and multilateral cooperation on digital governance, maintain and improve the multilateral digital economy governance mechanism, and put forward China's proposals in a timely manner to make China's voice heard". Although China has been rapidly developing digitalization, and the main body of digitalization drive tends to be diversified, developed countries are still the main body to promote digital transformation, and developed countries such as the European Union, the United States, the United Kingdom and other countries have a high level of digitalization development, we should make full use of China's huge market scale, multi-category types of industries, and other competitive advantages, to seek international cooperation with developed countries, and to accelerate the cooperation with the We should make full use of China's competitive advantages such as large market size and various types of industries to seek international cooperation with developed countries, accelerate the establishment of digital economy cooperation with countries along the "Belt and Road", master advanced application technologies and improve the international competitiveness of enterprises.

5. Conclusion and Outlook

Since the reform and opening up, China's manufacturing industry has achieved remarkable development results and become an important pillar of the national economy. However, along with the fading of the "demographic dividend", the advantage of labor resources is gradually weakening, and the competitiveness of its products is gradually decreasing, and it is facing great export pressure. At present, China's manufacturing industry has entered a critical period of transformation and upgrading. Accompanied by the rapid

development of the digital economy and the extensive use of digital technology, the transformation of the manufacturing industry is undergoing great changes. The manufacturing industry should grasp the opportunity to accelerate the deep combination with digitalization, realize the transformation and upgrading of enterprises, and contribute to the high-quality development of China's economy.

In future research, it is necessary to strengthen interdisciplinary cooperation and integrate knowledge and methods from manufacturing engineering, data science, artificial intelligence and other related fields to promote the in-depth development of the digital transformation of the manufacturing industry. In addition, governments, enterprises and research institutions should strengthen cooperation to jointly promote the practice and application of digital transformation and provide the necessary support and resources. First, the application of smart manufacturing and IoT technologies to the manufacturing industry can realize intelligent interconnection and data sharing among devices, and comprehensively improve production efficiency, quality, and collaboration capabilities. Future research can focus on data analysis and prediction, human-machine collaboration, and unmanned production in smart manufacturing scenarios. Second, through big data and artificial intelligence technology, the collection, analysis and application of manufacturing data can be realized to help enterprises make more accurate decisions and optimize operations. Future research could focus on the development of data governance, model building and optimization algorithms, and strengthen research on data processing and decision support in complex manufacturing environments. Third, research on how to apply artificial intelligence and machine learning technologies to the control and optimization of manufacturing processes to achieve automation, high efficiency and flexible production. Future research could focus on industrial robots, automated processes, intelligent testing and diagnosis, and promote the practical application of machine learning algorithms in manufacturing. Secondly, research on the theory and methods of digital supply chain management, through digital technology to achieve supply chain visualization, collaboration and responsiveness enhancement, in order to achieve the improvement of overall supply chain efficiency and flexibility. Future research could focus on supply chain big data analysis, supply chain network optimization and intelligent scheduling. Finally, with the transformation of manufacturing to service-based manufacturing, attention is being paid to the potential application of AI and robotics in service-based manufacturing, for example, in the areas of after-sales service, customized production and personalized delivery based on intelligent robots. Future research could explore the design and development of intelligent robots, as well as the creation and management of intelligent service systems.

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