Influencing Factors of Digital Transformation of Manufacturing Enterprises

Jiaqi Yang[1], Wenchang Liu[1], Xiaofen Zhang[2,*], Ming Liu[1]

[1]*School of Economics and Management, Liaoning University of Technology, Jinzhou, Liaoning, 121001, China*
[2]*School of Economics and Management, Shenyang Ligong University, Shenyang, Liaoning, 110168, China*
*Corresponding author

Abstract: Digital economy has become the new engine of China's high-quality economic development stage. The digital transformation of manufacturing enterprises is a "must-answer question" to transform the manufacturing production mode and promote the high-quality development of the manufacturing industry, aiming to promote the in-depth application of digital technology in the whole process and all fields of the manufacturing industry, and cultivate and develop new formats and new models such as networked R&D, personalized customization, and flexible production. The digital transformation of manufacturing enterprises is a key part of improving the resilience and security level of the industrial chain and supply chain, can help stimulate the new dynamic energy of China's economic development, open up a new space for economic development, help open up and strengthen the connection and collaborative upgrading of manufacturing enterprises, enhance the toughness of the industrial chain, consolidate competitive advantages, and provide better support for leading China's high-quality economic development. Based on the analysis of the internal and external factors of digital transformation of manufacturing enterprises, we propose relevant policy recommendations to drive manufacturing enterprises to solve the problem of "not wanting to turn, not daring to turn, not knowing how to turn".

1. Introduction

Many traditional manufacturing enterprises in China have complex product structures, redundant organizational structures, relatively backward strategic concepts and management levels, and single aging production tools [1]. Digital transformation of manufacturing enterprises is an inevitable product of the integration of digital technology and real economy. For traditional manufacturing enterprises, it is an excellent opportunity for development, as enterprises rely on the Internet platform to achieve the integration of online and offline development, and promote the efficient circulation and accurate docking of production factors in the processes of R&D, production, supply and sales, so as to achieve the multiplied growth of business, rapid improvement of operational

efficiency and excellent progress of user experience. Although digital transformation has created new opportunities for manufacturing enterprises, there are still problems of "not wanting to turn, not daring to turn, and not knowing how to turn", mainly due to large investment cost of digital transformation and unclear digital transformation path, unclear understanding of key architecture and the main reasons are [2]. Based on the above knowledge, this paper will study the influencing factors of digital transformation of manufacturing enterprises based on the existing theories and literature; propose relevant policy recommendations to help manufacturing enterprises fully embrace digital innovation.

Hess (2016) argued that companies use technologies such as big data, cloud computing, and artificial intelligence in the process of transformation and upgrading, and this transformation can be called digital transformation[3] . Heilig (2017) argued that digital transformation is an organizational change driven by the development of new technologies [4]. Ilvonen (2018) considered digital transformation as a process in which companies drive an innovative shift in their R&D and production models through digital technologies [5]. He and Qin (2019) considered digital transformation as a means used by companies for strategic upgrading in the digital economy [6]. Qi and Cai (2020) believed that enterprises can achieve digitalization at all levels of production and management by introducing digital technology, thus realizing a qualitative leap in industry competitiveness, market insight, product and service innovation capability, quality control capability, and operational control capability [7] .

Various scholars have studied from different perspectives as to what factors affect digital transformation in manufacturing companies. Based on dynamic capability theory and resource base theory, Jing (2022) identified the antecedent variables of digital transformation, including organizational structure, organizational culture, digital technology, human resources, and external environment, among which digital technology, organizational structure, organizational culture, and human resources belong to the internal environment[8]. In this paper, we will review the literature related to the influencing factors of digital transformation from both internal environment and external environment.

From the internal environment, Bharadwaj (2013) believed that digital strategy is the key for enterprises to achieve digital transformation, and manufacturing enterprises can achieve product quality and efficiency improvement as well as cost reduction by developing a perfect digital strategy, so as to reshape the core competitiveness of manufacturing enterprises and provide better strategic support for the high-quality development body of manufacturing enterprises [9]. Wang (2018) classified organizational structure into degree of flatness, degree of cardinality and multi-functionality of employees, which believes that for manufacturing enterprises, a perfect organizational structure can coordinate and integrate existing resources quickly and help organizations respond quickly to demand to adapt to new production methods, business forms, resource allocation and business models [10,11] .

Analyzed from the perspective of external environment, external factors usually include political, economic, social and cultural aspects [12], which have certain influence on the digital transformation of manufacturing enterprises through government policies, economic system, social investment [13,14] and so on. In the process of digital transformation of manufacturing enterprises, some small and medium-sized manufacturing enterprises are unable to realize digital transformation due to their resources as well as technical limitations; Chen (2021) believed that the government should introduce relevant policies to provide some assistance to small and medium-sized enterprises to help them complete digital transformation [15]. Jin (2020) believed that the digitalization level of the industry can promote the healthy competition among enterprises, so as to stimulate the innovation and creation ability of enterprises under the competitive pressure and accelerate the change of product innovation, production mode and business model [1] .

2. Analysis of Factors Influencing Digital Transformation of Manufacturing Enterprises

Digital transformation is a battle between old and new forces, including old and new organizations, old and new businesses, old and new technologies, and old and new ideas. When manufacturing companies decide to undergo digital transformation, they need to invest more money, involve more people and organizations, and the integration of R&D and production technologies and business becomes more complex. Once the transformation process goes wrong, it brings irreversible risks to the enterprise. Therefore, manufacturing enterprises from organization, business to technology need to carefully deliberate and balance the relationship of key variables [16].

2.1. Internal Environment

2.1.1. Organizational Structure

Barnard saw organizations as collaborative systems between people, and believes that there are three main aspects of collaborative systems, including common goals, willingness to collaborate, and information exchange, which must be reconciled for manufacturing companies that want to sustain growth and realize the implementation of digital transformation strategies [17].

First of all, common goal is one of the important factors for enterprise transformation. Common goal can help enterprises clarify the responsibilities of each department and the division of authority, and enterprises can empower and empower employees by establishing flat and decentralized organizations, incorporating all participants from upstream and downstream in the industry chain into the platform to realize information sharing, breaking the barriers between systems and data, which will reduce complex operations to enhance agility. It will reduce complex operations to improve agility and collaboration efficiency among teams, realize information sharing, application sharing and service sharing, and promote digital transformation.

Second, Barnard argued that the extent to which goals are achieved depends on the degree of willingness to collaborate. Different people have different willingness to collaborate, and members of a company may collaborate because they have access to technical support, financial support, etc., but their willingness to collaborate fades away as goals are accomplished [17]. For managers of manufacturing companies, they need to have an ambitious vision that leaves enough room for employees' imagination in order to stimulate their willingness to collaborate. At the same time, managers need to break the grand vision into small, phased projects to reduce the risk and cost of digital transformation through rapid iteration and rapid failure, and to ensure that digital transformation continues to advance effectively.

Finally, Barnard believed that only a well-established information exchange mechanism can combine common goals and the willingness to collaborate [17,18]. In recent years, managers of manufacturing companies have placed organizational transformation at the top of their list. The larger the scale, the number of employees and the complexity of business, the higher the cost of communication and collaboration between the organization and employees, which also brings more transformation costs. Only by using information technology, establishing and upgrading information systems to improve employees' inflexible working environment as well as office experience, connecting upstream and downstream resources, and achieving three major penetrations, vertically, horizontally as well as internally and externally.

2.1.2. Digital Technology

Traditional manufacturing enterprises are generally labor-intensive and capital-intensive, and they pursue production scale with a low proportion of technological elements. However, the

technology element is particularly important for companies that want to undergo digital transformation, and many studies have shown that both technology input and technology application are key elements to facilitate digital transformation [19].

The business environment in the digital era is full of uncertainty and contingency, which requires manufacturing enterprises to be more agile, resilient and extensible in digital technology, which is the only way to meet business change needs. This all requires manufacturing companies to evaluate the industry characteristics as well as the development stage, and apply technologies to restructure their business and upgrade and iterate their production equipment. On the one hand, the application of digital technology reduces operating costs, accelerates the rate of information acquisition for manufacturing enterprises, and enables them to make judgments and rapid decisions about the market based on current information. At the same time, digital technology can use digital technology to predict risks and quantify them, so that the whole production process is well organized and risk-controlled, and the process of transforming production results is accelerated [20]. On the other hand, the application of digital technology can promote the optimization and reorganization of the original resources and structures, and promote the adjustment and deployment of digital strategies in the form of quantitative growth, qualitative improvement and resilience enhancement, thus promoting the digital transformation of manufacturing enterprises [21]. At the same time, the integration of digital technology and manufacturing enterprises can also enhance the technology absorption capacity of enterprises[22], thus helping manufacturing enterprises to improve the level and quality of innovation[23], providing better support for enterprises to complete digital transformation.

2.1.3. Business Model

The business model discussed in this study is for the economic development and value creation of manufacturing companies in the process of digital transformation The focus of digital transformation of manufacturing enterprises is now shifting from the supply side to the demand side, and how to obtain valuable resources and improve competitiveness in a complex and uncertain business environment has become a question for many manufacturing enterprises in need of digital transformation [24]. By adopting new business models, manufacturing enterprises can realize efficient and low-cost linkage and collaboration among various nodes in a richer value network; share data resources, application resources, service resources and user resources on a larger scale; enhance the decision-making ability of enterprises through digitization of all elements, and create new values in addition to the value of products sold. The cross-system digital transformation can collect consumer data through online and offline channels, accurately build consumer portraits and insight into their needs, and launch targeted sales activities. Through the interconnection of the platform, it is the consumer data timely response to production, design and other front-end links, accelerating production model and business model transformation [25].

2.2. External Environment

The external environment is important for the transformation of manufacturing firms and their future development, Vera (2016) analyzed from a macro perspective and argued that the political, economic and technological environment has an impact on the digital transformation [26]. Cheng (2022) analyzed the factors of digital transformation of manufacturing firms from a micro perspective, which argues that the emergence of digital technologies has opened up industry barriers, changed consumer habits, and intensified competitive pressures between industries, and such pressures may facilitate digital transformation or push firms out of the current competitive market [27]. Integrating the research of related scholars, this paper will analyze the influencing factors of

digital transformation of manufacturing companies from two perspectives: macro and micro.

2.2.1. Macro Environment

First, the 14th Five-Year Plan clearly proposes to accelerate digital development to build digital China, which has become the action program for digital transformation development in the next five or even fifteen years, which is undoubtedly a solid support for manufacturing enterprises that want to carry out digital transformation. The digital transformation of manufacturing enterprises needs the support of a systematic policy system, including resource supply, infrastructure support and system improvement. The government helps enterprises break the bottlenecks of digital transformation through financial and fiscal policies; guarantees the steady progress of digitalization through effective market supervision, provides a good digital ecological environment, and effectively improves the depth and breadth of digital application in enterprises. Whether the government can introduce relevant laws to protect the market rules, and whether to formulate policies to ease the market pressure [27].

Second, at present, the epidemic and a century of change overlapping evolution, the world economy into the downturn, from 2022, the domestic epidemic point, wide, frequent, and mostly concentrated in economically active areas, the supply chain and the capital chain have caused a major impact. This impact has increased the uncertainty of the external environment of the transformation of manufacturing enterprises, especially the traditional manufacturing enterprises in the digital transformation of the pre-investment is large, the specialization of investment, coupled with the role of digital technology requires a certain role time, there is not necessarily a clear return cycle as well as return benefits, which may cause the production efficiency is not obvious as well as the transformation risk of unforeseeable, will to a certain extent affect the manufacturing Enterprises' confidence in transformation.

Third, The government's support policy can create a good research environment for manufacturing enterprises, and in this good environment, enterprises will develop the will to transform, and at the same time accelerate the connection of people, equipment, products and other elements, and open up the "information island" of the whole element and accelerate the flow of data between different businesses and different industries.

2.2.2. Micro Environment

Three aspects are analyzed in terms of enterprise scale, inter-firm competition, and industry chain changes. First, enterprise scale affects the scale efficiency and thus the enterprise scale and SMES are an important part of the real economy, which is the focus and difficult point of digital transformation [17]. On the one hand, the vast majority of SMEs are in the primary stage of digital transformation, and compared with large enterprises, SMES are short of resources, scarce talents, weak digital foundation, information infrastructure to be improved, and certain data security problems exist. In the process of digital transformation of SMES, they should be provided with a new lightweight development model to turn potential into power [28].

Secondly, the differences in resources and capabilities possessed by manufacturing enterprises will lead to competition among enterprises. For traditional manufacturing enterprises, under the traditional closed industrial technology system, the business value of manufacturing enterprises comes from products, and their business models are mostly one-time sales of products, and the manufacturing industry is in the homogeneous saturation stage. This means that whoever takes a step of transformation first will have the advantage of occupying the market first. Using digital technology to shift the development logic from providing products to satisfying customers' whole life cycle requirements, taking data elements, user assets and digital assets as important resources is

an inevitable choice.

Finally, the manufacturing industry chain and value chain are facing restructuring due to factors such as the new crown epidemic and the Russia-Ukraine conflict, and the improvement of the industry chain resilience is imminent. Digitalization creates opportunities to open up connections and synergies among enterprises. Through the reorganization of production system, inputs can be effectively transformed into outputs to improve production efficiency and product quality through the introduction of advanced production lines to speed up the launch of new products, thereby improving the technological content of products; through the establishment of a collaborative data supply chain to dynamically dispatch resources, thereby accelerating the response to market changes and improving the industrial chain resilience of manufacturing enterprises [29].

3. Conclusion

Comprehensively promoting digital transformation, using data to optimize decision making and innovate business is an inevitable choice for manufacturing enterprises to cope with the impact of external environment in the new era. As a result, this paper makes the following recommendations.

First, digital transformation is the first thing to turn is thinking, managers should embrace the new digital thinking. Managers should develop a reasonable digital strategy according to the current market demand and the strength of the enterprise itself, from small to large, from light to medium, from simple to complex. Through an effective strategy to promote digital transformation smoothly, so that the transformation effect can be seen within the organization, to gain more trust and resources, and then promote the digital project to carry out more solid.

Second, digital transformation does not mean abandoning all the original business models and technologies. Rather, it is to innovate and improve on the original technology to make it more suitable for the current development of enterprises. Fully release the innovative vitality of digital technology, promote other technologies with the entire industrial chain, digitally reconfigure the resources and structure of the original industry, provide products and services that meet the real needs of customers, and create value for business directly.

Third, the government should do a good job in guiding and providing policy guarantee for manufacturing enterprises. First, the government should introduce digital fiscal and financial policies, and give certain R&D subsidies to manufacturing enterprises in the R&D stage to solve the most important problem of financial constraints for digital transformation. The government can also effectively drive the R&D of digital transformation tools through government procurement and promotion, third-party transformation performance evaluation and rewards during the market expansion stage, and at the same time reduce the cost of digital transformation of SMES due to information asymmetry. Second, the government should improve the evaluation system of digital transformation. Through the construction of digital transformation process normalized detection system to grasp the dynamic process of digital transformation of manufacturing enterprises, combined with the characteristics of different industries and transformation progress to develop digital development evaluation standards and evaluation models, it is to provide comprehensive evaluation services. Finally, the government should play a good role in market supervision, create and protect a market environment of fair cooperation and competition, insist on treating all kinds of market players equally and equally, give full play to and stimulate the important role of manufacturing enterprises in promoting the internal circulation of the economy, encourage them to serve the state-owned economy and the real economy, and enhance the competitiveness.

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