

# ***Digital Transformation in Manufacturing Enterprises: Unveiling the Path to Innovation and Efficiency***

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**Abstract:** With the development and advancement of technology, the manufacturing industry has undergone a major transformation in recent years. The emergence of digital transformation has become a defining force in the global manufacturing landscape, reshaping traditional paradigms and driving companies toward greater efficiency and innovation. This study delves into the far-reaching impact of digitalization on manufacturing companies, combining a comprehensive analysis of several Chinese companies. By seamlessly integrating advanced digital technologies such as the Internet of Things, big data analytics and artificial intelligence into traditional manufacturing processes, companies are opening up new realms of productivity and competitiveness. However, the road to digital integration is challenging, and companies need to deal with technical challenges and organizational resistance. This study illuminates the path for manufacturing companies to thrive in digitalization through empirical insights and strategic recommendations. By fostering a culture of innovation, optimizing productivity and expanding market reach, digital transformation becomes a key underpinning for sustainable growth in manufacturing.

**Keywords:** Digital transformation, Manufacturing enterprises, Innovation, Efficiency

## **1. Introduction**

As one of the foundational pillars of the global economy, manufacturing has experienced substantial transformations in recent years. The rapid evolution of digital technology has catalyzed what is commonly termed the Fourth Industrial Revolution. At the heart of this revolution lie four pivotal segments: cyber-physical systems, the Internet of Things (IoT), big data analytics, and artificial intelligence (AI) [1-3]. These technologies are seamlessly integrated into the traditional manufacturing processes, heralding a new era of efficiency and innovation. Drawing from a comprehensive analysis of 210 manufacturing companies in China, this research underscores the profound impact of digital capabilities on the manufacturing landscape. Not only do these digital advancements streamline production processes, but they also markedly enhance the efficiency of product manufacturing [4].

This study will illuminate the transformative potential of digitalization, demonstrating its capacity to revolutionize traditional manufacturing paradigms. Yet, amidst the promise of digitalization lie formidable challenges for businesses. While the benefits of digitization are undeniable, the journey toward adoption and implementation is fraught with complexities [5]. From technological integration hurdles to organizational resistance, navigating the digital terrain demands strategic foresight and

adaptive agility. In this context, this study endeavors to bridge the gap in existing research by delving into the intricate dynamics of digital transformation within manufacturing enterprises. Beyond merely filling a scholarly void, this research seeks to underscore the pivotal role of digitalization in driving economic development. By promoting innovation, optimizing production efficiency, and expanding market space, digitalization emerges as a linchpin for sustainable growth in the manufacturing sector. In essence, this study is poised to shed light on the transformative potential of digitalization, illuminating pathways for manufacturing enterprises to thrive in an increasingly digital-centric world. Through empirical insights and strategic recommendations, this study aims to empower businesses to harness the full spectrum of digital capabilities, propelling them towards greater competitiveness and resilience in the global marketplace.

## **2. The Relationship between Digital Transformation and Manufacturing Enterprises**

### **2.1. Definition and Importance of Digital Transformation**

Digital transformation is a major challenge and opportunity for manufacturing enterprises [6]. Digital transformation refers to integrating advanced digital technologies and solutions into various business areas of an enterprise [7]. Digital transformation is a kind of technological innovation and a new corporate culture form. In addition, digital transformation can also empower employees and unlock potential, which will also help drive the transformation and upgrading of the entire digital business. In today's world, the digital economy has become the main form of the global economy. China's digital economy accounts for more than 30% of GDP and has become the second-largest digital economy in the world [8]. At present, it is mainly manifested in two aspects: on the one hand, the continuous expansion of the scale of Internet enterprises leads to the extension of digital technology to many traditional industries.

On the other hand, the revenue growth of traditional enterprises has slowed down, the profitability level is under pressure, and the development of enterprises is becoming more and more difficult. Overall, digital transformation is a key challenge and opportunity for manufacturing companies. It involves advanced digital technologies and solutions across all business areas, reflecting a new corporate culture. In today's global economy, the digital economy accounts for a considerable proportion of GDP, and China has become a leader in this field. Digital transformation has become an inevitable requirement for the survival and development of enterprises.

### **2.2. The Impact of Digital Transformation on Manufacturing Enterprises**

In the era of digital economy, transformation has become a question of whether enterprises can survive and develop. The research on the digital transformation process has received extensive attention. Furr & Shipilov point out that the best digital transformation results come from adaptation rather than reinvention. Based on interviews with more than 60 companies and hundreds of executives, they show that for most companies, digital transformation delivers value incrementally through a series of steps rather than fundamentally disrupting traditional approaches [8]. Therefore, digital transformation can be seen as enterprises using digital technology to innovate, including technical and strategic issues. Digital transformation often begins with a strategic update to an existing business model and changes to the business model, followed by broader changes to enterprise collaboration, which, if implemented properly, will eventually lead to a bigger corporate culture change. In general, the relationship between digital transformation and the performance of manufacturing enterprises is that by optimizing the production process, realizing production automation and intelligent management, digital transformation can significantly improve manufacturing enterprises' production efficiency and further improve enterprises' performance.

Digital transformation can also improve the controllability and precision of the production process, achieve continuous monitoring and improvement of product quality, improve product quality levels, and enhance the competitiveness of enterprises. In addition, regarding digital talent, digital talent is an essential element of digital transformation. Businesses need complex talent and teams with digital literacy and operational skills across multiple fields. Enterprises need to establish digital talent as the core. Enterprises need to make machines serve people's consciousness and make rational use of automation and digital means to innovate continuously. In general, digital transformation has a profound impact on the performance of manufacturing enterprises. Digitalization significantly improves production efficiency and overall enterprise performance by optimizing production processes, promoting automation, and realizing intelligent management. In addition, it improves production control, precision, and product quality through continuous monitoring and process improvement.

### **3. Performance of Manufacturing Enterprises by Digital Transformation**

#### **3.1. Digital Transformation in Manufacturing Enterprises**

With the continuous popularization and advancement of digitalization, enterprises also integrate some digital resources into the actual research and development process of products. Because digitalization also has the characteristics of information mining, low cost, and so on, it has greatly improved the efficiency of enterprise research and development. Overall, digital transformation has a profound impact on the performance of manufacturing companies. By leveraging digital technologies, these businesses can increase production efficiency, improve product quality, and reduce costs, enhancing competitiveness and profitability. Here is an example of Xiaomi Company.

Xiaomi Company's digital transformation strategy includes technology investment, talent training, organizational structure adjustment, etc. The first point is that the data center is the first problem that enterprises have to solve. Xiaomi already has a huge 500 million monthly active mobile phone users and a larger scale of IoT devices, and the daily data collection and processing task is very large [9]. In 2017, Xiaomi advocated data intelligence in the group and proposed a three-layer model.

#### **3.2. Impact of Digital Transformation on Manufacturing Performance**

The first is the relationship between the model and data and the insight ability of the data. However, many mining algorithms must be customized for the business to be better applied. The second is enhanced analytics, data observation (what happens now), data prediction (what will happen in the future), and data decision-making (what you do now can affect what will happen in the future) [9]. Overall, digital transformation has a profound impact on the performance of manufacturing companies. By leveraging digital technologies, these businesses can increase production efficiency, improve product quality, and reduce costs, enhancing competitiveness and profitability. It can summarize the influencing factors into a framework based on this collective research of companies undergoing digital transformation. The framework Outlines the four pillars of digital transformation: IT enhancement, digital operations, digital marketing, and digital business. All four are part of most companies' digital transformation journey.

#### **3.3. Challenges and Considerations in Digital Transformation**

Years of research on transformations have shown that the success rate for these efforts is consistently low: less than 30 percent succeed. 2 This year's results suggest that digital transformations are even more difficult. Only 16 percent of respondents say their organizations' digital transformations have successfully improved performance and also equipped them to sustain changes in the long term. An

additional 7 percent say that performance improved but was not sustained. Even digitally savvy industries like high tech, media, and telecom are struggling. Among these industries, the success rate does not exceed 26 percent. However, in more traditional industries, such as oil and gas, automotive, infrastructure, and pharmaceuticals, digital transformations are even more challenging: success rates fall between 4 and 11 percent. Finally, upper-level data consumption, including analytics intent, conversations, and scenarios for data transformation [9]. These cases show that digital transformation is a technology upgrade and a comprehensive business change that can reshape a company's competitive advantage and market position. Overall, digital transformation has a significant impact on the performance of manufacturing companies. Through digital technology, manufacturing enterprises can improve production efficiency and product quality and reduce costs, thus enhancing their competitiveness and profitability. However, digital transformation also faces some challenges and problems. The upgrading of technology, the change of organizational structure and the training of talents are all obstacles that need to be overcome in digital transformation. In addition, the costs and risks of digital transformation also need to be carefully considered and evaluated by manufacturing companies.

Therefore, when carrying out digital transformation, manufacturing enterprises need to deeply understand the application scenarios and impact mechanisms of digital technology, formulate scientific transformation strategies and implementation plans, and strengthen organizational change and talent training to achieve a virtuous cycle of digital transformation and performance and promote sustainable development and innovation and upgrading of enterprises.

#### **4. Influencing Factors of Digital Transformation on Manufacturing Enterprise**

Digital transformation has a significant impact on manufacturing enterprises. First of all, there are several factors affecting digital enterprises. The first one is technology. The success of digital transformation is influenced by the foundation of existing technology and the maturity of digital technology. The second point is the internal organizational structure of the enterprise, and culture also plays an important role in digital transformation. The third point is based on the overall market, consumer trends, and future product development trends, which will also affect the degree of digital transformation. Let's take the example of a car.

First, automobile digitalization focuses on four dimensions: digital research and development, digital production, digital management and digital marketing. Through the digital platform, General Motors improves the user car purchase service system. Second, the automotive industry is the demand side of digitalization. Companies are building a multi-dimensional digital ecosystem from internal organization and digital talent management to product research and development, manufacturing, management, and marketing [10]. Now, the integration of digital technology and car companies is the general trend. While improving the overall operational efficiency of the enterprise through digital technology, auto companies also further optimize the consumer purchasing experience [10]. Third, for consumers, big data, machine learning and other technologies can connect users' personalized services by obtaining driver behavior data and supporting people's digital lives [10]. Digital transformation in the automotive industry generally consists of four main aspects: research and development, production, management and marketing. Companies such as General Motors are leveraging digital platforms to enhance their car-buying services, improving overall customer experience and operational efficiency. This focus on digitization extends to every aspect of car operations.

On the other hand, based on the perspective of car companies. By collecting vehicle operation data and road data, intelligent driving is realized with the gradual maturity of digital technologies such as high-precision maps and laser detection, which brings disruptive changes to consumers' travel experience. In terms of the future, digital transformation faces challenges in technological upgrading,

system integration and data security. At the same time, organizations must change their organizational structure and culture to adapt to the new demands and ways of working through digital transformation. Regarding talent, digital transformation requires the support of talents with corresponding technical and management capabilities, and enterprises need to increase the introduction and training of talents.

## 5. Conclusion

Through an in-depth discussion of digital transformation's impact on manufacturing enterprises' performance, this study draws the following conclusions. First, digital transformation has a significant impact on the performance of manufacturing enterprises. Through digital technology, manufacturing enterprises can improve production efficiency and product quality and reduce costs, thus enhancing their competitiveness and profitability. Secondly, successful cases such as Xiaomi show that digital transformation is a technological upgrade and a comprehensive business change, which can reshape enterprises' competitive advantage and market position. However, this study also has some things that could be improved. First, this study mainly relies on existing cases and literature, and the data sources are relatively limited, which fails to cover all situations, and there may be certain biases. Secondly, the digitalization process cannot be expressed intuitively with data, so it is difficult to represent the digital process of an enterprise with data directly. The future of digitalization will continue to play an important role, with far-reaching implications for various industries and sectors. This includes the following points: the first point is the development of the Internet of Things, artificial intelligence and big data technology. People's lives will become more intelligent and convenient. Developing smart homes, smart transportation, smart medicine and other fields will greatly improve people's quality of life and work efficiency. Second, smart cities will become the mainstream trend of future urban development. Digital technology will be widely used in urban management, transportation, energy utilization and other aspects to achieve efficient use of urban resources and sustainable development of the environment. However, with the popularization and application of digital technology, data security and privacy protection will become an important issue. Strengthening data security management and privacy protection mechanisms will be one of the important tasks of future digital development.

## References

- [1] Maresova, P., Soukal, I., Svobodova, L., Hedvicakova, M., Javanmardi, E., Selamat, A., & Krejcar, O. (2018) *Consequences of Industry 4.0 in business and economics. Economies*, 6(3), 46.
- [2] Andronie, M., Lăzăroiu, G., Iatagan, M., Uță, C., Ștefănescu, R., & Cocoșatu, M. (2021) *Artificial intelligence-based decision-making algorithms, internet of things sensing networks, and deep learning-assisted smart process management in cyber-physical production systems. Electronics*, 10(20), 2497.
- [3] Pivoto, D. G., de Almeida, L. F., da Rosa Righi, R., Rodrigues, J. J., Lugli, A. B., & Alberti, A. M. (2021) *Cyber-physical systems architectures for the industrial Internet of things applications in Industry 4.0: A literature review. Journal of manufacturing systems*, 58, 176-192.
- [4] Kumar, N., & Kumar, J. (2019) *Efficiency 4.0 for Industry 4.0. Human Technology*, 15(1).
- [5] Enyoghasi, C., & Badurdeen, F. (2021) *Industry 4.0 for sustainable manufacturing: Product, process, and system opportunities. Resources, conservation and recycling*, 166, 105362.
- [6] Telukdarie, A., Dube, T., Matjuta, P., & Philbin, S. (2023) *The opportunities and challenges of digitalization for SME's. Procedia Computer Science*, 217, 689-698.
- [7] Schwertner, K. (2017) *Digital transformation of business. Trakia Journal of Sciences*, 15(1), 388-393.
- [8] Yuan, X., Liu, X., & Zuo, J. (2015) *The development of new energy vehicles for a sustainable future: A review. Renewable and Sustainable Energy Reviews*, 42, 298-305.
- [9] Gurbaxani, V., & Dunkle, D. (2019) *Gearing up for successful digital transformation. MIS Q. Executive*, 18(3), 6.
- [10] Xu, J., Yu, Y., Zhang, M., & Zhang, J. Z. (2023) *Impacts of digital transformation on eco-innovation and sustainable performance: Evidence from Chinese manufacturing companies. Journal of Cleaner Production*, 393, 136278.