Proceedings of the 2nd International Conference on Management Research and Economic Development
DOI: 10.54254/2754-1169/84/20240824

The Impact of Digital Economy Development on the Transformation of Manufacturing Industry under the Background of Low-carbon Development

Wence Lin[1], Jingxi Wang[2,a,*], Ruochen Zhang[3]

[1]Suzhou North America High School, Suzhou, China
[2]School of Environment and Energy Engineering, Beijing University of Civil Engineering and Architecture, Beijing, China
[3]Canberra Grammar School, Canberra, Australia
a. 2021221555@stu.bisu.edu.cn
**Corresponding author*

Abstract: As global climate change has become a dominant issue, China, as one of the world's largest carbon emitters, has significant impacts on low carbon development by policies organizing energy and emission reduction. This paper explores how the digital economy affects the transformation of manufacturing under environmental policies, such as the Energy Conservation Law and the "13th Five-Year Plan" which assist in transforming the manufacturing industry under a low-carbon background. Though China has made significant efforts to renewable energy and its role in manufacturing industries, however, the challenges especially in traditional industries still exist, which include high costs and limited techniques. Moreover, this paper discusses the impacts of new concepts such as "New Retailing" on the manufacturing transformation. It has emphasized its significance in boosting efficiencies, sustainable development, and encouraging low-carbon transformation. Through the case studies and empirical analysis, this paper at last gives an outlook of China's environmental policy intersection, manufacturing transforming and innovating digital economy towards a sustainable future.

Keywords: Low-carbon development, digital economy, manufacturing transformation

1. Introduction

Nowadays, the transformation of manufacturing industries and economy upgrading under low-carbon background has become mainstream in the world. In China, Environmental policies and laws, and the digital economy take significant place in assisting the development of traditional industries.

The digital economy has become a key driver of global economic growth due to the continuous progress of science and technology and the in-depth development of globalization. In China, the digital economy has shown vigorous development, injecting new vitality into the optimization, and upgrading of economic structure. Additionally, low-carbon development has become a common goal pursued by all countries in response to the increasingly severe global climate change. In this context, the manufacturing industry, as the core of the national economy, is facing unprecedented challenges and opportunities.

DOI: 10.54254/2754-1169/84/20240824

On one hand, the rapid development of digital technology provides strong technical support for the transformation and upgrading of the manufacturing industry. By utilizing advanced technologies such as big data, cloud computing, and artificial intelligence, the manufacturing industry can achieve intelligent, automated, and refined production processes, resulting in improved production efficiency and product quality. This not only enhances the core competitiveness of the manufacturing industry but also promotes the upgrading and optimization of the entire industrial chain.

On the other hand, policies related to environmental issues do affect and assist the ongoing of low-carbon development of manufacturing industries. Environmental policies monitor the settled goals, such as greenhouse gas reduction target, and to improve efficiency, reduce energy waste and consumptions, etc. They had not just helping achieved specific environmental issues, but also several social developments as people's living standard have been achieved as policies promote the transformation. As low-carbon development has presented new demands for the manufacturing industry. In the context of responding to climate change and protecting the environment, the manufacturing industry needs to shift away from traditional high-energy consumption and high-emission development modes and adopt more environmentally friendly and low-carbon production technologies and management methods. This not only promotes sustainable development but also reduces production costs, improves resource utilization efficiency, and expands market space for enterprises.

The integration of the digital economy and low-carbon development has become a crucial direction for the transformation of the manufacturing industry. Studying the impact of digital economy development on the transformation of the manufacturing industry and exploring ways to promote its transformation and upgrading under the framework of low-carbon development is of great theoretical and practical significance. This not only helps us to deeply understand the intrinsic connection between the digital economy and the transformation of the manufacturing industry, but also provides useful references and lessons for policy makers to promote the manufacturing industry to realize the goal of green, low-carbon and circular development.

The article aims to explore the impact of China's environmental policies in the context of low-carbon development, especially how the digital economy can promote the low-carbon transition and improve the manufacturing efficiency under new concepts such as new retail. In addition, China's challenges and solutions in renewable energy applications and manufacturing, as well as how the intersection of environmental policy and the innovative digital economy is sustainable. As an emerging field, digital economy provides new opportunities for low-carbon transformation and the improvement of manufacturing efficiency under new concepts such as new retail. At the same time, innovative digital economy can promote the low-carbon transformation, improve the efficiency of manufacturing, and solve environmental problems. Therefore, we should strengthen the integration of environmental policies and the digital economy, promote the sustainable development of the manufacturing industry, and contribute to the green development of China's economy.

2. Environmental Policy Research in the Context of Low-Carbon Development

As the issue of global climate change becomes increasingly prominent, low-carbon development has become a common pursuit of the international community. As one of the world's largest carbon emitters, China's environmental policy formulation and implementation have a significant impact on the global low-carbon transition. In the face of global warming and environmental degradation, the Chinese government attaches great importance to environmental protection and the development of a low-carbon economy. In recent years, China has adopted a series of proactive environmental protection measures, striving to reduce greenhouse gas emissions, improve the energy structure, and achieve sustainable economic and social development.

DOI: 10.54254/2754-1169/84/20240824

2.1. Environmental Policy Research

As a responsible country, China will achieve the global greenhouse gas reduction target by 2030, and will also make every effort to achieve global warming by 2060.

2.1.1. Energy Conservation Law of the People's Republic of China

The core objective of the law is to improve energy efficiency, reduce energy waste and consumption, optimize the energy structure, and promote the sustainable use of energy through a series of measures and regulations. At the same time, the law also emphasizes the protection of the environment, the reduction of negative impacts on the ecosystem, and the coordination of energy use with environmental protection. In addition, the law also aims to ensure the country's energy security, ensure the country's energy supply is stable and reliable, and prevent energy risks. Finally, the law aims to promote sustainable economic and social development, promote economic transformation and upgrading, and improve people's living standards.

2.1.2. "13th Five-Year Plan" Comprehensive Work Plan for Energy Conservation and Emission Reduction

During China's 13th Five-Year Plan, the state formulated this comprehensive work plan to achieve sustainable economic and social development. The plan not only puts forward specific energy conservation and emission reduction targets but also clarifies the energy conservation requirements in key areas and industries. These goals and requirements are aimed at ensuring the efficient use of energy, reducing environmental pollution, and promoting the optimization and upgrading of the industrial structure. The plan not only focuses on energy conservation in key areas but also attaches importance to the actual operation of various industries to ensure that the goal of energy conservation and emission reduction can be achieved in every link. With the 13th Five-Year Plan, China will vigorously promote energy conservation and emission reduction, to promote the sustainable development of the world and achieve more social well-being.

2.2. Effectiveness and Challenges of Policy Implementation

China has made significant progress by vigorously promoting low-carbon and environmentally friendly policies. According to the 2023 Government Work Report, China's carbon dioxide emissions have fallen by 14.1% over the past five years, demonstrating China's positive contribution to mitigating climate change and promoting green development.

However, some traditional industrial enterprises still adopt extensive production and management methods, and lack of attention and investment in environmental protection. These enterprises are faced with the problem of a high proportion of factor inputs and unsatisfactory performance outputs, as well as the challenge of high emission reduction costs and technical barriers [1]. As a result, some companies have been constrained from achieving a low-carbon transition.

How to promote the low-carbon development of traditional high-polluting and high-emission enterprises is a major practical issue in the process of high-quality development. The government and enterprises need to take a series of measures, including strengthening policy guidance and support, promoting green technology and clean energy, and improving enterprises' environmental awareness and responsibility. Only in this way can we promote the low-carbon transformation of traditional enterprises and promote the sustainable development of the economy and society.

China has always adhered to the spirit of responsibility, bravely responded to global warming, adhered to the principles of environmental protection and low carbon, accelerated the development of healthy and low-carbon industries, deeply explored the possibilities of low-carbon economic

DOI: 10.54254/2754-1169/84/20240824

development, grasped new development opportunities, implemented new development strategies, promoted sustainable economic growth, and finally achieved harmonious coexistence between human beings and nature, and built a modern country with distinctive characteristics [2].

3. The Current Situation and Causes of Manufacturing Transformation and Upgrading

3.1. Current Situation of the Manufacturing Industry

3.1.1. Major Trends of Manufacturing Industrial Transformation

Currently, the transformation and upgrading of the manufacturing industry is a crucial direction for economic development. Countries worldwide are striving to promote the transformation of traditional manufacturing into intelligent, environmentally friendly, and efficient processes. This section analyses some major trends in the current transformation and upgrading of the manufacturing industry, with a focus on technological innovation, environment and collaboration.

The manufacturing industry has a significant opportunity for transformation with the rapid development of new technologies such as artificial intelligence, big data, and the Internet of Things. The application of intelligent equipment, such as robots and automated production lines, has made the manufacturing process more efficient and accurate, while reducing labour costs. This technological innovation has not only changed the way products are manufactured but also spawned a new business model.

Environmental protection and sustainable development have become a global consensus. The manufacturing industry is actively promoting green production to reduce pollution, improve resource utilization, and promote the development of a circular economy. Green manufacturing can help enterprises reduce production costs, improve their corporate image, and attract more consumers and investors.

The transformation and upgrading of the manufacturing industry require the cooperation of all parties to form collaborative innovation in the upstream and downstream of the industrial chain. Enterprises should share technology and resources and jointly develop new products and technologies. This collaborative innovation can accelerate the transformation and upgrading of the manufacturing industry and enhance the core competitiveness of the enterprise.

3.1.2. The Achievements made in the Chinese Manufacturing Industry

China's manufacturing sector has advanced significantly in terms of gross output and technological level over the last ten years. China now has a wide variety of autonomous manufacturing systems, encompassing capital- and technology-intensive as well as labor-intensive industries. These sectors create a vast array of goods, from big machinery like high-speed trains to everyday essentials like toys. 'MADE IN CHINA' items are sold all over the world. China surpassed the US to become the world's manufacturing superpower in 2010, with 19.8% of global manufacturing output, according to figures from the US-based economic consultancy firm IHS Global Insight. 25% of global manufacturing production in 2014 came from China. Furthermore, 95.9 million machine tools are made in China, which accounts for 38% of global output. Out of the 100 Chinese companies included on the Fortune 500 in 2014, 56 were in the manufacturing sector (not including Hong Kong, Macao, or Taiwan). For two years running, China has had the second-highest number of Fortune 500 companies worldwide, after only the United States (130). [3].

DOI: 10.54254/2754-1169/84/20240824

3.2. Causes of the Transformation and Upgrading of the Manufacturing Industry

3.2.1. Technological Innovation

The manufacturing industry is being transformed and upgraded due to the development of emerging technologies such as artificial intelligence, big data, and the Internet of Things. These technologies can optimize the production process and improve the automation and intelligence of the manufacturing process, thereby reducing production costs and improving efficiency.

Additionally, technological innovation has increased the innovation vitality of the manufacturing industry. Enterprises constantly upgrade their products and services through research and development of new technologies and products to meet the changing needs of the market.

Technological innovation has not only changed the way products are manufactured but also spawned new business and service models. For instance, emerging models like intelligent manufacturing, customized production, and remote services offer more business opportunities and development space for enterprises.

3.2.2. Environmental Pressure

With the increasing global awareness of environmental issues, governments have implemented strict regulations and policies to protect the environment. These regulations require the manufacturing industry to reduce pollutant emissions, improve resource utilization, and promote the development of green manufacturing and a circular economy. As a result, enterprises are forced to transform and upgrade to meet environmental protection requirements.

Additionally, changes in consumer demand have also played a role in this transformation. The improvement of environmental awareness prompts consumers to pay more attention to the environmental performance of products and the environmental behavior of enterprises. This inclination towards environmentally friendly and resource-saving products and services provides new market opportunities for enterprises.

Furthermore, the rise of green supply chains has further facilitated this trend. Enterprises are promoting the construction of green supply chains to meet customers' environmental protection needs. The entire supply chain, from raw material procurement to product production, transportation, and recycling, is striving for environmental protection and sustainable development.

3.2.3. Market Competition

The manufacturing industry is facing intense global competition due to the in-depth development of globalization.

To maintain a competitive advantage, enterprises must improve product quality, reduce costs, and increase added value through transformation and upgrading to win market share. Additionally, there is a demand for industrial upgrading. The manufacturing industry must upgrade to meet market demand, with the development of the economy and the upgrading of the consumption structure. To improve the added value and market competitiveness of products, enterprises should introduce advanced technology, optimize the production process, and improve the brand image.

Market competition also prompts enterprises to pay more attention to changes in customer needs. Enterprises must provide more customized and high-value-added products and services to meet the diversification, personalization, and quality of customer needs. This will help to win the trust and loyalty of customers.

DOI: 10.54254/2754-1169/84/20240824

4. The Impact of Digital Economy on the Transformation of Manufacturing Industry in China

4.1. Digital Economy and the "New Retailing" Conception

Digital Economy has a wide definition, it can be defined as a form that utilizes data directly or indirectly to promote the development of production capacity and reasonable resource allocation. Any theory or innovative technologies related to data utilization that assist in manufacturing industry in transformation can be classified as a part of the Digital Economy. It has assisted the manufacturing industry in transforming through its rising innovative technologies such as Big Data, Cloud Computing, and the IOT (Internet of Things). A brand-new theory on production and Sales has been found and become the main produce and sales strategy of Manufacturing Industries in China: "New Retailing" was generated and proposed by Jack Ma in 2016. This conception has been improved by Chinese scholars until nowadays since it was proposed. Lingya Yang considers that "New Retailing" is based on technologies to advocate the combination of online, offline and logistics services [4]. It can comprehensively boost the transformation of the existing manufacturing industry and, in the meantime, make the transportation of production and goods services more efficient. Miaomiao Yu thinks that Under the "new retail" model, the function of retailers is not only as a platform but also to promote the interaction and coordination of supply and demand [5]. The essence of "new retail" is to provide consumers with goods and services that exceed expectations.

4.2. Application of the "New Retailing" and its Impacts on China's Manufacturing Industry

4.2.1. E-commence Companies Found Higher Efficiencies when using Innovative Technologies

Several E-commences such as JD.com, Taobao, Hema, etc. have applied "New Retailing" by establishing and operating online and offline sales platforms. Xiaoran Li held that the "New Retailing" has created a flat industrial ecosystem, shortened the intermediate links of channels, and significantly improved operational efficiency in the manufacturing industry [6]. The E-commerce platforms collect consumers' information and upload the data, calculate, and give a customized outcome that predicts individual consumer's interests. This sector of backstage data calculation is the Big Data, which can achieve higher efficiency in information transferring, production, coordination, and operational efficiency. Benefits of Big Data, these E-commerce platforms have significantly, and effectively improved the transaction efficiency and Supply & Demand relationships between sellers and customers. For example, Hema has built a community membership surrounded by single offline stores through Tmall's Big Data capabilities to distribute its products. This system driven by data processing technology has achieved precise control of the supply chain, sales, and logistics fulfillment chain, with greatly improving efficiencies of manpower, platform, and logistics.

4.2.2. Boosting Green and low-carbon Transformation of Manufacturing Industry

The Digital Economy has not just assisted Manufacturing Industry Transformation by improving efficiencies, but also by achieving sustainable manufacturing and decreasing overwhelmed energy utilization and environmental pollution. Wei Zhang and his colleagues proposed two theories in the paper "An Empirical Analysis of the Impact of Digital Economy on Manufacturing Green and Low-Carbon Transformation under the Dual-Carbon Background in China": First hypothesis (H1): The manufacturing sector is changing to become more environmentally friendly and low-carbon due to the digital economy [7]. hypothesis 2 (H2): By enhancing businesses' capacity for technological innovation, the digital economy fosters the growth of the industrial sector's green transformation. Thus, they collected data on transform efficiency from 30 provinces in China, and calculated and

DOI: 10.54254/2754-1169/84/20240824

verified the results. Thus, the digital economy's influences positively on the green, sustainable economy has been proven sufficiently, its innovative technologies have significantly pushed the green, low-carbon economy and transformation of the Manufacturing Industry [8].

5. Conclusion

The article discusses the efforts and achievements of the Chinese government in low-carbon development, the impact of the digital economy on the transformation of China's manufacturing industry, and the proposal and significance of the concept of "new retail". In the context of low-carbon development, China is actively responding to the challenge of global climate change by implementing environmental policies to reduce greenhouse gas emissions, improve energy structure, and achieve sustainable development. The government has implemented measures such as the Energy Conservation Law and the 13th Five-Year Plan for Energy Conservation and Emission Reduction to promote efficient use of energy and reduce environmental pollution. Despite some progress, traditional industrial enterprises still face challenges and need further support and guidance from governments and enterprises to promote the low-carbon transition. China will continue to uphold the spirit of responsibility, explore the possibility of low-carbon economic development, and achieve sustainable economic and social development. At the same time, the transformation and upgrading of the manufacturing industry is the key direction of the current economic development, and the main trends include technological innovation, environmental protection, and collaboration. The rapid development of emerging technologies has brought great opportunities and challenges to the manufacturing industry, and technologies such as artificial intelligence, big data, and the Internet of Things have made the manufacturing process more efficient and accurate, reduced labor costs, and given birth to new business models. Environmental protection and sustainable development have become a global consensus, promoting the transformation of manufacturing to green production, reducing production costs, and improving corporate image.Simultaneously, firms should pool technical resources and work together to develop new goods and technologies in order to expedite transformation and upgrading while enhancing core competitiveness. This is because collaborative innovation is essential to transformation and upgrading. In addition to offering consumers goods and services that surpass their expectations, the concept of "new retail" offers fresh perspectives and avenues for the transformation of China's manufacturing sector. It also encourages the green and low-carbon transformation of the manufacturing sector, which lowers energy consumption and pollution levels while achieving sustainable manufacturing. Empirical research demonstrates that the digital economy is positively influencing the shift toward a low-carbon, green economy and manufacturing. In order to improve product quality and added value and satisfy market demand, businesses should take advantage of the opportunity for transformation and upgrading, increase investment in technological innovation, support environmental protection and sustainable development, and strengthen industrial chain cooperation.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

References

[1] *Ni, X.M., Yan, C.Y., Zhang, J.C, et al. (2024) How can digital resources empower enterprises with low-carbon development?—Take Weiming Environmental Protection as an example.Management Case Studies and Reviews, 17(01), 149-162.*

[2] *National Development and Reform Commission. (2021) White Paper on China's Policies and Actions to Address Climate Change. Retrieved from https://www.gov.cn/zhengce/2021-10/27/content_5646697.htm.*

DOI: 10.54254/2754-1169/84/20240824

[3] *Zhang, X.H., William, A. P., Bohdan, P., Tenpao, L. (2016) The transformation and upgrading of the Chinese manufacturing industry: Based on "German Industry 4.0". Journal of Applied Business and Economics, 18 (5), 97-105.*

[4] *Yang, L.Y. (2019) The connotation, characteristics, and types of "new retail" Modern Marketing: Academic Edition.*

[5] *Yu, M. (2021) Discussion on the Innovative Development Path of New Retail in the Era of Internet Plus.Broad Review Of Scientific Stories, 19(20), (455).*

[6] *Li, X.R. (2018). New Retail - Reshaping a Human-Centric Business Model. Retrieved from https://www.toutiao.com/article/6530113924665180679/?source=seo_tt_juhe&wid=1706950073005*

[7] *Zhang, W., Zhou, H., Chen, J., Fan, Z. (2022) An Empirical Analysis of the Impact of the Digital Economy on Manufacturing Green and Low-Carbon Transformation under the Dual-Carbon Background in China. International Journal of Environmental Research and Public Health, 19(20), 13192.*

[8] *Zhang, Z.L. (2023) Study on the promoting effect of digital economy on the green development of China's economy. Shandong University of Finance and Economics.*