

Analysis of the Transformation of the New Energy Vehicle Industry under the Background of the Digital Economy

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Abstract. Today, the digital economy has become the main theme. The digital economy includes digital industrialization, industrial digitization, digital governance, and data value. In this context, data has become the kinetic energy of factors for economic development. In recent years, China's new energy vehicle industry has risen rapidly. In the 2024 "Global Top 100 Auto Supply Chain", three Chinese enterprises have entered the top 20: CATL, Weichai Group, and Huayu Automotive. This represents the profound accumulation and innovation ability of Chinese component enterprises and shows the indispensable role and status of Chinese enterprises in the global auto supply chain to the world. The development of the new energy vehicle industry has promoted the reconstruction of the auto industry chain, including the production and manufacturing of core components such as batteries, motors, and electronic controls, as well as the development of fields such as intelligent driving and intelligent interconnection. This transformation has not only promoted technological innovation and business model innovation within the industry but also driven the construction and improvement of related infrastructure, such as the construction of charging piles and battery swapping stations, as well as the development of intelligent transportation systems, providing convenience for the popularization and use of new energy vehicles.

Keywords: Digital economy, new energy vehicle, technological innovation.

1. Introduction

In the era of surging digital waves today, the digital economy has become the core driving force for global economic development [1]. With its unique advantages, it reshapes the ecological pattern of various industries and injects new vitality into economic growth. The digital economy covers a wide range of fields from digital industrialization to industrial digitization, and its connotation is rich, involving the application of a series of cutting-edge technologies such as big data, cloud computing, and artificial intelligence. The rapid development of these technologies has not only changed people's lifestyles and consumption habits but also brought unprecedented impacts and opportunities to traditional industries.

The new energy vehicle industry, as a representative of emerging industries, shows a booming development trend globally. In recent years, China's new energy vehicle industry has achieved remarkable achievements. From government policy support to enterprise active innovation, from the initial exploration of the market to the current competitive and rational development, the new energy vehicle industry in China has experienced multiple stages of transformation. In the 2024 "Global Top 100 Auto Supply Chain", three Chinese enterprises, namely CATL, Weichai Group, and Huayu Automotive, have entered the top 20, demonstrating the strong strength of Chinese component enterprises and their important status in the global auto supply chain [2].

The rise of the new energy vehicle industry is not accidental. On the one hand, the increasing awareness of environmental protection has prompted people to seek cleaner and more sustainable transportation solutions. The exhaust emissions of traditional fuel vehicles have caused serious pollution to the environment, while new energy vehicles, with their advantages of low or even zero emissions, have become an important choice for relieving environmental pressure. On the other hand, the continuous progress of technology has provided a solid foundation for the development of new energy vehicles. Breakthroughs in battery technology, the improvement of intelligent driving systems, and the gradual popularization of charging infrastructure have continuously improved the performance and convenience of new energy vehicles.

However, the new energy vehicle industry also faces many challenges during its development. For example, in the early development stage, some enterprises relied too much on financial subsidies, resulting in insufficient technological innovation motivation and uneven product quality. As subsidy policies gradually decline, market competition becomes increasingly fierce, and enterprises need to continuously improve their technological level and market competitiveness to establish themselves in the market. At the same time, the development of the new energy vehicle industry also needs to solve a series of infrastructure construction problems, such as the layout of charging piles and the improvement of charging speed [3].

In the context of the digital economy, the new energy vehicle industry has ushered in new transformation opportunities. The application of digital technology can bring about changes in many aspects such as technological innovation, industrial chain upgrading, and business model innovation for the new energy vehicle industry. Through in-depth analysis of the impact of the digital economy on the transformation of the new energy vehicle industry, helps us better grasp the trends and directions of industry development and provides theoretical support and practical guidance for the sustainable development of the industry.

This article will focus on the theme of the transformation of the new energy vehicle industry in the context of the digital economy. Firstly, it will overview the theory of the digital economy, then analyze the current situation of the new energy vehicle industry, then focus on discussing the impact of the digital economy on the transformation of the new energy vehicle industry, and finally draw conclusions and put forward relevant suggestions, hoping to provide useful references for the development of the new energy vehicle industry.

2. Overview of the Digital Economy Theory

Digital economy refers to a series of economic activities that use digitized knowledge and information as key production factors, modern information networks as important carriers, and the effective use of information and communication technologies as an important driving force for efficiency improvement and economic structure optimization [4]. It is a relatively broad concept, and any economic form that directly or indirectly uses data to guide resources to play a role and promote the development of productive forces can be included in its category.

Data-Driven: In the digital economy era, data has become the core asset and driving force. It permeates every aspect of economic activities, from production to consumption. For example, companies can use data analytics to understand consumer preferences and optimize production processes accordingly.

Technology-Intensive: It is characterized by the intensive use of emerging technologies. As mentioned, technologies such as big data, cloud computing, the Internet of Things, blockchain, artificial intelligence, and 5G communication are integral to the digital economy. These technologies enable new business models and operational efficiencies.

Network Effects: Digital economy activities often exhibit strong network effects. The value of a digital platform or service increases as more users participate. For instance, a social media platform becomes more valuable as more people join, creating a virtuous cycle of growth.

Rapid Innovation and Disruption: The digital economy is marked by rapid innovation cycles. New technologies and business models emerge constantly, disrupting traditional industries. For example, the rise of e-commerce has significantly changed the retail landscape.

At the technical level, the concept of the digital economy encompasses emerging technologies such as big data, cloud computing, the Internet of Things, blockchain, artificial intelligence, and 5G communication [1]. At the application level, "new retail" and "new manufacturing" are typical representatives of the digital economy [5]. The digital economy can be divided into five categories: digital product manufacturing, digital product service industry, digital technology application industry, digital factor-driven industry, and digital efficiency improvement industry. These categories correspond to different major categories, medium categories, and small categories in the "National

Economic Industry Classification", reflecting the in-depth landscape of China's digital economy development [1].

Currently, the development of the digital economy has entered a fast lane. China's position in the global digital economy is becoming increasingly important, showing a leading position and competitive advantage [1]. In addition, China has entered a new stage of economic development, and the digital economy plays a more important role in it. The fourth industrial revolution has promoted the great development of digital technologies and formed a new economic form. The development of the digital economy is particularly important today because the low-cost advantage no longer exists and there are challenges brought.

3. Analysis of the Current Situation of the New Energy Vehicle Industry

3.1. Development Stages and Characteristics

The development process of China's new energy vehicle industry is mainly divided into four stages, each with its specific characteristics and milestones.

Exploration Period (2000 - 2012): During this period, the Chinese government began to attach importance to the research and development of new energy vehicles and included them in the national science and technology plan, and encouraged the development of energy-saving and environment-friendly electric vehicles and hybrid vehicle technologies [1]. In addition, China introduced relevant national standards and specifications, laying the foundation for the industrialization of new energy vehicles.

Wild Growth Period (2013 - 2017): Driven by policies such as national and local financial subsidies and tax exemptions for vehicle purchases, the new energy vehicle market developed rapidly. However, this stage also exposed some problems such as some enterprises being opportunistic and having immature technology platforms, resulting in products being relatively "makeshift" and difficult to meet normal private consumption needs [1].

Shuffling and Clearing Period (2014 - 2020): With the significant reduction of subsidies, the market growth almost stagnated, and the industry entered a painful adjustment period. During this period, the micro cars in the market shrank dramatically, while the long-range and high-end models began to increase, and the acceptance of new energy vehicles by consumers gradually increased [1].

Competition and Rational Development Period (2021 - present): As the financial subsidies gradually withdrew, the new energy vehicle market entered a period of market-oriented competition and rational development. At this time, the micro cars represented by Hongguang MINIEV and high-end brands such as NIO, Li Auto, XPeng, and Tesla's products were listed in a concentrated manner, promoting the polarization of the market [1].

3.2. Policy Support and Market Environment

The development of China's new energy vehicle industry has also received strong support from the government, including measures such as vehicle purchase subsidies and charging infrastructure construction, which have paved the way for the development of the industry [1]. At the same time, domestic automobile enterprises have achieved independent innovation in key technologies such as batteries, motors, and electronic controls, improving the international competitiveness of products. With the progress of technology and the maturity of the market, the performance and mileage of new energy vehicles have approached or even exceeded those of traditional fuel vehicles, and intelligent driving technology has also become an important direction

4. The Impact of the Digital Economy on the Transformation of the New Energy Vehicle Industry

4.1. Technological Innovation

Digital twin technology refers to a virtual model that accurately replicates a physical object or system in a digital environment. It enables real-time monitoring, analysis, and optimization of the physical entity by synchronizing data between the digital and physical worlds. In the context of the new energy industry, digital twin technology finds applications in various aspects. It is applied in optimizing new energy power generation, energy transmission, and distribution, energy consumption management, energy storage, and planning, as well as ensuring the security of the energy market and transactions. By establishing virtual models, the processes of energy production, transmission, and consumption can be simulated and optimized, thereby enhancing energy utilization efficiency and system reliability while safeguarding the security of energy transactions [1].

Artificial intelligence has diverse applications in the field of intelligent energy. It encompasses intelligent analysis, prediction, and decision-making. Through data analysis and machine learning algorithms, it can analyze energy consumption patterns, optimize energy scheduling, and achieve efficient utilization of energy. Additionally, artificial intelligence can be applied to predict energy supply and demand and analyze the energy market, providing intelligent support for the development of intelligent energy [1].

In the domain of intelligent energy, big data plays a crucial role. Its main applications are reflected in the collection and analysis of massive data in the energy system, enabling precise monitoring and prediction of energy consumption, ensuring the safe and stable supply of energy. Moreover, big data can also be utilized for energy demand prediction and energy market monitoring, providing support for the optimized scheduling of intelligent energy [1].

4.2. Upgrading of the Industrial Chain

The optimization of the new energy industrial chain by digital technology is mainly reflected in the following aspects:

Digital technology, through emerging technologies such as the Internet of Things, big data, and AI, can achieve unified collaborative management and intelligent monitoring of various intelligent devices such as charging, energy storage, and discharging, thereby enhancing the utilization rate and management efficiency of energy facilities.

Digital technology can collect and analyze a large amount of data in real time, providing energy enterprises with unprecedented insights, optimizing energy production and management processes, predicting energy demand, helping enterprises balance supply and demand, and improving production efficiency.

Digital technology integrated into the energy production end can solve problems such as poor production management and inaccurate demand prediction, promoting the "optimization of the structure" of the energy industry, and realizing the digitalization and low-carbon development of energy.

Digital technology provides advanced technical support for new energy infrastructure construction, making the energy system more intelligent and efficient, driving the development of the energy industrial chain, and promoting the incubation of new technologies and new business forms.

4.3. Business Model Innovation (Platform-based Operation)

The impact of digital technology on the platform-based operation of new energy vehicles is mainly reflected in aspects such as enhancing the intelligence level, improving efficiency and reliability, strengthening interconnectivity, and optimizing energy management.

Firstly, the advancement of digital technology enables new energy vehicles to perceive and respond to their surrounding environment, realizing the autonomous driving function and thus enhancing the intelligence level. This intelligence not only improves the user's travel experience but

also enables the vehicle to better adapt to road condition changes, providing more convenient, efficient, and safe travel services.

Secondly, digital technology provides more accurate and real-time data, enabling new energy vehicles to better adapt to road condition changes, thereby improving efficiency and reliability. These data can be fed back to the vehicle's decision-making system, allowing the vehicle to better adapt to road condition changes and providing remote upgrade and advanced technology upgrade support for the vehicle, thus prolonging the reliability and lifespan of new energy vehicles.

Furthermore, the application of digital technology enhances the interconnectivity of new energy vehicles, enabling users' cars to be combined with other systems such as renewable energy, smart homes, and smart cities, significantly enhancing user experience and usage efficiency. This interconnectivity not only enhances the complementarity between different fields but also promotes the more rapid development of new energy vehicles.

Finally, digital technology also plays an important role in enhancing the intelligence level of energy production and management. By optimizing resource allocation, reducing costs, and improving energy utilization efficiency, it provides a powerful impetus for the development of new energy.

In conclusion, the application of digital technology in the platform-based operation of new energy vehicles, through enhancing the intelligence level, efficiency, and reliability, strengthening interconnectivity, and optimizing energy management, provides new opportunities and challenges for the development of the new energy vehicle industry, promoting the innovation upgrade and high-quality development of the industry.

5. Conclusion

The digital economy has significantly enhanced the technological innovation capacity of the new energy vehicle industry. Research indicates that the digital economy has a remarkable promoting effect on the technological innovation of new energy vehicles, especially in terms of invention patents. Meanwhile, the digital economy has promoted the optimization and upgrading of the new energy vehicle industry. The introduction of digital intelligence technology has changed the traditional R&D and production modes of automobiles, realizing the digitization and intelligence of the R&D process, optimizing the production process, and improving production efficiency and product quality stability. In addition, the digital economy has accelerated the expansion of the new energy vehicle market. With the enhancement of environmental awareness and the support of the government for new energy vehicles, the market demand continues to grow. The application of digital technology has helped new energy vehicles break through the inherent bottlenecks, improving the technology and performance and promoting the rapid development of the new energy vehicle industry. The digital economy has promoted the coordinated development of the new energy vehicle industry chain.

The impact of the digital economy on the new energy vehicle industry is mainly reflected in technological innovation and industrial upgrading. Therefore, it is recommended to start from the following aspects to fully utilize the advantages of the digital economy to promote the development of the new energy vehicle industry. Firstly, it is necessary to strengthen technological innovation and R&D. The digital economy provides new technologies such as big data, the Internet, and artificial intelligence, providing powerful technical support for the development of automobile electrification, networking, and intelligence. The overall promotion of the integration of the three aspects of automobiles should be strengthened, and the planning, policies, standards, and infrastructure construction such as charging, roads, and tests for promoting the development of the three aspects should be further improved. Secondly, it is necessary to promote the in-depth integration of industry-university-research. Actively guide the participation of scientific research institutes, universities, new energy vehicle enterprises, power battery enterprises, etc., and jointly overcome the key core technical problems in to.

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