

An Investigation into the Characteristics and Determinants Shaping China's New Energy Vehicle Supply Chain

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Abstract: China, being the foremost market for new energy vehicles globally, is undergoing exponential growth. In the upcoming years, propelled by technological advancements and escalating demand, the growth rate of China's new energy vehicle sector is anticipated to surge even further. Concurrent with the progress of new energy vehicles, the significance of their supply chain becomes increasingly pronounced. This piece aims to examine the distinguishing characteristics of China's new energy vehicle supply chain and the factors that exert an influence on it, in order to offer valuable insights for the sustainable development of the new energy vehicle industry. By dissecting the attributes of China's new energy vehicle supply chain, while also taking into consideration elements such as policies and regulations, market demand, and technological innovation, this article delves into the ramifications of these factors on the supply chain. Additionally, it scrutinizes the current state and obstacles encountered by China's new energy vehicle supply chain, culminating in the proposition of potential avenues for development and pertinent recommendations, striving to serve as a guiding compass for the future advancement of the new energy vehicle supply chain.

1. Introduction

Electric vehicles, or EVs, encompass a breed of automobiles powered by unconventional energy sources. These include pure electric vehicles, plug-in hybrid vehicles, and fuel cell vehicles. EVs boast a bevy of advantages, such as zero emissions, whisper-quiet operation, and remarkable energy efficiency. They stand as an essential panacea for our perennial energy scarcity conundrum. The supply chain of these pioneering vehicles encompasses a gamut of processes — from procuring raw materials to engaging numerous component suppliers, vehicular assembly, distribution, and after-sales service. This multifaceted network thrives with an abundance of nodes and showcases an array of structural intricacies. In-depth investigations into the new energy vehicle industry have exposed its susceptibility within the supply chain; precise market forecasts evade us, while technological reliance poses a formidable challenge[1]. The maturity level of both raw material procurers and core component manufacturers remains low within this intricate web, retarding overall efficiency

and tilting the balance towards responsiveness. Given its fledgling status, the new energy vehicle industry has yet to garner substantial research attention pertaining to its intricate supply chain. Thus, it becomes imperative to holistically comprehend the Chinese new energy vehicle supply chain's defining characteristics as well as explore the labyrinthine network dynamics it embodies. Such an endeavor will empower us to furnish tailored recommendations for the development of China's burgeoning new energy vehicle industry, with potential global ramifications.

2. The characteristics of the new energy vehicle supply

This section primarily delineates the distinctive features of the operational framework for the supply chain of new energy vehicles and scrutinizes the ramifications engendered by said features.

2.1. Vertical integration feature

The operation of the new energy vehicle supply chain usually consists of five levels: raw material suppliers, component suppliers, vehicle manufacturers, distributors, and customers. The flow of logistics, cash, and information between adjacent levels forms a chain-like structure model of the supply chain [2].

Compared to the fragmented supply chain of traditional vehicles, the new energy vehicle supply chain tends to be vertically integrated. This is specifically manifested in:

In terms of raw material procurement, companies directly participate in the procurement process of raw materials and establish long-term partnerships with suppliers to ensure a stable supply of resources.

In terms of production manufacturing, many new energy vehicle manufacturers choose to establish their own production bases and concentrate multiple production processes in one place to form a complete production flow.

In terms of sales and service, the sales channels for new energy vehicles are relatively less mature compared to traditional fuel vehicles. Many new energy vehicle manufacturers choose to establish their own sales and service networks, providing comprehensive pre-sales consultations, in-sales services, and after-sales support[3].

This vertical integration model ensures a more stable supply chain, effectively reduces procurement costs, reduces time and operational costs in the production process, improves production efficiency and product quality, enables better understanding of market demands and consumer feedback in sales and services, facilitates timely adjustment of product and service strategies, and enhances customer satisfaction.

2.2. Innovation-driven feature

For the new energy vehicle supply chain, the innovation-driven feature is particularly evident. It is reflected in the following aspects:

In terms of technological innovation, the core technologies used in new energy vehicles such as electric motors, batteries, and control systems are key technologies in the industry, and the drive for innovation in these technologies becomes the core driving force for the development of the new energy vehicle supply chain.

In terms of cooperation and sharing, the new energy vehicle supply chain tends to be more open and cooperative. By connecting and collaborating between different links in the supply chain, resource sharing and complementary advantages can be achieved.

In terms of integration and services, the new energy vehicle supply chain not only focuses on the connection and collaboration between various links but also emphasizes providing holistic solutions

and value-added services.

In terms of green and sustainable development, the emergence of new energy vehicles aims to reduce reliance on traditional energy sources and minimize environmental pollution [4].

The innovation-driven feature of the new energy vehicle supply chain encourages enterprises to continuously invest in R&D resources, improve the performance, range, and safety of new energy vehicles through technological innovation, enhance product competitiveness, and provide more specialized supply chain services, including supply chain management, logistics transportation, and after-sales services.

2.3. Diversified Characteristics

With the rapid development of new energy vehicles in China, its supply chain has gradually formed a diversified supply chain, which is manifested in:

Diversification of raw material supply: On the one hand, China is the world's largest producer of rare earth resources, which are essential materials for new energy vehicles. China continues to increase its capacity for rare earth mining, extraction, and processing. In addition, China is dedicated to improving its self-sufficiency in other important materials such as lithium and cobalt, through the construction of mineral resource bases in cooperation with foreign mining companies and strengthening technological research and development, ensuring the security of the overall raw material supply chain.

Diversification of component manufacturing and assembly: China's component manufacturing industry is competitive worldwide, including key components such as batteries, motors, and control systems. China's battery manufacturing technology is leading globally, and several well-known companies such as CATL (Contemporary Amperex Technology) and BYD have become leading battery manufacturers worldwide. In addition, China encourages and supports various suppliers to participate in the production of new energy vehicle components, forming a vast supply chain network.

Diversification of sales and services: China has introduced a series of policies to encourage consumers to purchase new energy vehicles. At the same time, China has been constructing a large number of charging stations and battery swapping stations nationwide to address the insufficient charging infrastructure. In addition, China's new energy vehicle service market is continuously developing and growing, including areas such as maintenance, insurance, and finance [5].

In summary, the diversification of the supply chain allows Chinese new energy companies to optimize their supply chains, significantly reduce costs while ensuring supply chain security, thus enhancing their competitiveness. With the diversification of the supply chain, Chinese new energy vehicle industry chain companies can effectively participate in global competition and lead the global development of the new energy vehicle industry, providing opportunities for cooperation and development.

2.4. Internationalization Feature

The Chinese new energy vehicle supply chain has strong international competitiveness, with both well-known domestic companies and collaborations with foreign counterparts, forming cross-border supply chain collaboration networks to achieve optimized allocation of resources. Specifically, in terms of raw material procurement, the core components such as batteries and motors used in new energy vehicles rely heavily on rare metals, which are owned by only a few countries in the international market. New energy vehicle manufacturers need to cooperate with these countries. In terms of technology cooperation and innovation, the new energy vehicle industry has a fast-paced and diverse technological innovation. Many enterprises need international

cooperation to access the latest technologies and innovation achievements. At the same time, international cooperation can also accelerate the development of the new energy vehicle industry, for example, through technology and patent sharing, joint research and development, etc. In terms of market expansion, with the continuous growth in global demand for new energy vehicles, many new energy vehicle companies are seeking overseas markets. Through cooperation with foreign dealers and partners, new energy vehicle companies can better enter international markets, expand sales channels, and gain more market share.

With the continuous development and growth of the new energy vehicle industry, the trend of internationalization of the new energy vehicle supply chain will become more evident.

3. Factors Influencing the New Energy Vehicle Supply Chain

Analyzing the characteristics of the new energy vehicle supply chain allows us to have a deeper understanding of the development of the entire new energy vehicle industry. The supply chain is an important factor, and therefore it is necessary to analyze the factors that influence the new energy vehicle supply chain in order to provide policy recommendations.

There are numerous factors that influence the new energy vehicle supply chain, including the following:

3.1. Policy and Regulations Influence

Policies and regulations play a guiding and incentivizing role in the new energy vehicle supply chain. Firstly, by providing economic support through tax reductions and subsidies, enterprises are encouraged to increase their investment and research and development efforts in the new energy vehicle supply chain. These measures can reduce production costs for enterprises and enhance their competitiveness in the market. Additionally, supporting leading enterprises and establishing green technology research and development centers provide sustainable support for the development of the new energy vehicle supply chain. Secondly, the introduction of policies and regulations promotes technological improvement and innovation within the new energy vehicle supply chain. By establishing standards and specifications, enterprises are guided to strengthen technological innovation and research and development in various aspects of the new energy vehicle supply chain, including power systems, battery technologies, and charging infrastructure construction. These standards and specifications can improve the performance and quality of new energy vehicles, enhance their competitiveness in the market, and regulate new energy vehicle supply chain enterprises to improve their product quality and safety. Finally, the introduction of policies and regulations also leads the way in environmental protection and sustainable development in the new energy vehicle supply chain.

3.2. Technological Advancements Impact

The technological advancement of the new energy vehicle supply chain has improved overall production capacity and efficiency. Traditional automobile supply chains are often decentralized and operate on a single production model, while the new energy vehicle supply chain emphasizes collaborative cooperation and resource sharing. By introducing advanced technologies such as intelligent manufacturing, the Internet of Things, and big data, the new energy vehicle supply chain can achieve real-time monitoring and optimization adjustments in various aspects such as material procurement, production processes, and logistics transportation, thereby improving production efficiency and reducing costs. At the same time, the quick response and efficient coordination of each link in the supply chain can better meet market demand, enhance production capacity, and ensure vehicle quality and delivery cycles.

Furthermore, the technological advancement of the new energy vehicle supply chain promotes

technological innovation and quality improvement of new energy vehicles. The supply chain is not just a simple logistics link but also an important platform for technological innovation. Through cooperation and collaboration between different enterprises and research institutions within the supply chain, technology innovation and product improvement can be jointly promoted. For example, the enhancement of battery technology and the smartification of charging facilities all rely on the cooperation of relevant links in the supply chain. Close cooperation and information sharing between suppliers and manufacturers can also accelerate technology dissemination and adoption, thereby driving technological innovation and development in the entire industry.

Moreover, the technological advancement of the new energy vehicle supply chain enhances the market competitiveness of new energy vehicles. The efficient operation and management of the supply chain can reduce product costs, improve product quality, and also flexibly and quickly respond to changes in market demand [6].

3.3. Impact of market demand

The increase in demand for new energy vehicles as a result of market demand will drive the expansion of the supply chain market. The higher cost of using traditional fuel vehicles, particularly due to oil prices, prompts people to purchase new energy vehicles, directly increasing the demand for them and subsequently driving the expansion of the entire supply chain market. Every aspect of the supply chain, from production to sales and from components to vehicle manufacturing, will experience more opportunities and challenges. Furthermore, the increased demand for the new energy vehicle supply chain market will change the landscape of the traditional automotive supply chain. Traditional fuel vehicles rely on internal combustion engines as their core, while new energy vehicles revolve around batteries and electric drive systems. This means that the supply chain market needs to adjust and improve to accommodate the production and sales demands of new energy vehicles. The new supply chain structure may include battery manufacturers, electric drive system suppliers, and charging facility providers, among others. This will bring new participants and competitive opportunities to the supply chain market. In addition, the rapid development of new energy vehicles will also raise higher technological requirements for the supply chain market. New energy vehicles involve various technological fields, including battery technology, electric drive technology, and smart technology. The supply chain market needs to constantly keep up with and apply the latest technology to meet the production and sales demands of new energy vehicles. In summary, market demand will drive the expansion of the supply chain market and transform the traditional automotive supply chain's landscape.

3.4. The influence of competitive situation

With the rapid rise of new energy vehicles worldwide, the competition in the new energy vehicle supply chain is also becoming increasingly fierce, which has profound impacts on the automotive industry and the entire socio-economy. Firstly, the competition in the new energy vehicle supply chain promotes technological innovation. In order to gain a competitive advantage in the market, major automobile manufacturers and suppliers are actively involved in research and development, accelerating the pace of technological innovation. The battery technology, motor technology, charging technology, and other fields required for new energy vehicles face great challenges and opportunities. The innovation of these technologies not only improves the performance and range of new energy vehicles but also drives the upgrade and transformation of the entire supply chain. Secondly, the competition in the new energy vehicle supply chain drives industry restructuring and optimization. With the intensification of market competition, the demand for cooperation and integration among enterprises gradually increases. Automobile manufacturers start to strengthen cooperation with battery manufacturers, motor manufacturers, charging station manufacturers, etc., forming alliances or strategic partnerships. At the same time, the traditional automotive supply

chain is also undergoing transformation, with some manufacturers adjusting their own business structures and entering the field of new energy vehicle supply chain. This industry restructuring and optimization contribute to improving the efficiency and competitiveness of the entire supply chain. Thirdly, the competition in the new energy vehicle supply chain accelerates the popularization of the new energy vehicle market. With the continuous improvement of the supply chain and the gradual reduction of costs, the price of new energy vehicles is becoming more competitive. Meanwhile, the construction of charging infrastructure is also accelerating, providing consumers with more convenient charging services. The result of supply chain competition is a richer variety of new energy vehicles with better performance and more affordable prices, attracting more consumers to choose new energy vehicles and driving rapid growth in the new energy vehicle market.

4. Optimization and Management Suggestions for the New Energy Vehicle Supply Chain

Supply chain optimization helps new energy vehicle companies reduce the risks they face in the supply chain, such as supply disruptions, price fluctuations, and quality issues, thereby improving the resilience and response capabilities of the supply chain. A resilient supply is better able to adapt to changes in the external environment, reduce production interruptions and capacity losses, and ensure continuous production and delivery.

4.1. Establish a diversified supplier strategy

As the level of supply chain management in the new energy vehicle industry continues to improve, establishing a diversified supplier strategy has become an effective method of supply chain management. A diversified supplier strategy can reduce a company's reliance on a single supplier and mitigate the risks of production disruptions and delivery delays caused by issues with a single supplier. When a company depends on a single supplier, any problems such as insufficient production capacity, logistics interruptions, or price increases can have a severe impact on production plans and delivery capabilities. By establishing a diversified supplier strategy, companies can introduce multiple suppliers into the supply chain to diversify risks and enhance the resilience and flexibility of the supply chain. Through the introduction of multiple suppliers, companies can also gain greater bargaining power and flexibility in procurement negotiations and contract management, resulting in more competitive prices and contract terms. Additionally, having diversified suppliers can encourage competition among suppliers, stimulating improvements in quality and service levels and further reducing quality and service risks[7].

4.2. Unified inventory management

Using information system technology for management, the establishment of an integrated information system that connects raw material supply, production, distributors, and customer demand allows for unified inventory management across all stages. Unified inventory management can lower inventory levels across the entire supply chain and enable quicker response to customer demand, facilitating faster transportation and reduced instances of stockouts that could cost distributors sales opportunities and enhance end-user service levels. For new energy vehicle manufacturers, unified inventory management allows them to focus on production and improve product quality. It also helps avoid excessive inventory levels and extended supply chain cycles, thereby reducing inventory backlog and excessive capital allocation.

4.3. Supplier Evaluation and Monitoring

New energy vehicle companies should establish an effective supplier evaluation and monitoring

mechanism, including evaluating suppliers' technical capabilities, quality management, production capacity, delivery capabilities, environmental protection, and sustainability. Conduct regular supplier audits to ensure that suppliers meet the requirements of the company and continuously monitor their performance to timely identify and address potential supply chain risks.

4.4. Building Warning and Response Mechanisms

New energy vehicle companies should establish effective supply chain warning and response mechanisms to promptly monitor and identify risk signals in the supply chain and develop countermeasures, such as alternative suppliers, inventory allocation, and production capacity adjustments. This will enable a quick response to mitigate the impact of supply chain risks on the company.

4.5. Establishing Emergency Response Mechanisms

New energy vehicle companies should establish an emergency response mechanism for new energy vehicle production companies' supply chain risks, including the construction of emergency organizations, standardization of emergency procedures, development of emergency plans, and implementation of emergency drills. This ensures a fast response and effective handling when facing risks.

4.6. Contract Management and Risk Sharing

New energy vehicle companies should establish a contract management mechanism that clarifies the rights and responsibilities between suppliers and the company and specifies the risks and liabilities that suppliers should bear. Contract management should include quality assurance, delivery deadlines, price terms, and clearly define risk sharing and remedial measures. Effective contract management helps reduce supply chain risks and safeguards the company's rights[8].

Optimizing the management of the new energy vehicle supply chain requires targeted improvements in the stability of the supply channels, logistics and warehousing management, cost control, as well as information sharing and communication. Only through continuous optimization of supply chain management can the stability and sustainable development of the new energy vehicle supply chain be ensured.

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