ISSN: 2664-9640

Research On The Life Cycle Determination Of New Energy Vehicle Technology

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Abstract

While the economy has developed rapidly, the number of fuel vehicles has also increased day by day. Although the arrival of fuel vehicles has brought many conveniences to people's lives and production, the ensuing environmental pollution and oil safety problems have also continuously aroused people's attention. In this context, governments have gradually begun to support automobile companies to vigorously develop new energy vehicles, and new energy vehicles have begun to be favored by the market and have obtained good development opportunities. In this context, it is of great significance to study the technical life cycle of new energy vehicles. Through research, it is found that the dominant technology of new energy vehicles is power battery technology, and it is currently in the technology development period.

Keywords

New Energy Vehicles; Technology Life Cycle; Research.

1. Introduction

With the rapid development of the economy, fuel vehicles have gradually gained popularity and have entered thousands of households. Although fuel vehicles bring many conveniences to people's food, clothing, housing and transportation, and significantly improve people's quality of life and production efficiency, the tailpipe emissions generated by fuel vehicles have also increased significantly, causing serious pollution problems. In addition, because the oil on which fuel vehicles depend is a non-renewable resource, the relative scarcity of petroleum resources and the strong dependence of fuel vehicles on oil are a pair of irreconcilable contradictions, so the rapid growth of crude oil imports has triggered strong social concerns about energy security.

As one of the effective means to solve problems such as environmental pollution and energy resource shortage, the new energy automobile industry has received widespread attention from the society [1]. Although the new energy automobile industry at home and abroad has developed rapidly in recent years, from the actual situation, the development path of new energy vehicles is not optimistic, and there are still considerable technical obstacles, such as immature power battery technology and relatively high research and development costs, which hinder the development of new energy vehicles. At this time, enterprises in the new energy vehicle supply chain want to innovate, not limited to their own limited resources, but should be completed through supply chain cooperation. Since cooperation and innovation in different cycles have different characteristics, it is of great significance and value to judge the technical life cycle of new energy vehicles.

ISSN: 2664-9640

2. The cycle of new energy vehicles dominating technology

2.1. Definition of leading technologies for new energy vehicles

Regarding the definition of dominant technology, there is no standard paradigm in academia, and scholars often expound it from different perspectives. For example, Nascimento[2] argues that a technology can be considered dominant in either of two of the following situations: First, there are clear signs that important alternative technologies in a given field have disappeared from technology competition. Second, a certain technology has a high market share, and according to the market situation, the market share of the technology continues to increase. Deng Xuxia[3] believes that dominant technology refers to being able to break the balance of the original technology system for a period of time, and causing other entities to follow it to innovate, and even eventually lead to technological or industrial revolution. Until 2016, the National Committee for the Approval of Scientific and Technological Terms defined it as a core technology that can play a leading role in the existing and extended product platforms of enterprises in the "Management Science and Technology Terminology". Based on the research of scholars, this paper defines the dominant technology as a core technology that has an increasing market share over a period of time and can break the original technical system and even trigger a technological revolution or industrial revolution.

In 1961, benefiting from the development of petroleum, steel and other industries, the traditional fuel vehicle technology system with diesel and gasoline as the main power source embarked on the fast track of development. After years of development, technologies such as internal combustion engines and mechanical control with traditional automotive drive systems as the core have continuously made breakthroughs. Despite this, traditional fuel vehicles still cannot get rid of their dependence on petroleum resources. With the deepening of environmental pollution problems and the emergence of energy crises, innovative entities have begun to slowly shift their attention to new energy vehicles. With the breakthrough of new energy vehicle power batteries in terms of mileage and safety and stability, the automobile industry has entered a new round of technological change[4]. The power battery technology of new energy vehicles has broken the technical system of traditional automobiles, built a new technology system with power batteries, battery management systems and other technologies as the core, and led a new round of technological change.

The core technology that distinguishes new energy vehicles from traditional cars is "three electricity", including electric drive, battery, and electronic control. Among the three, battery technology is the most critical, which is not only the "soul" and "heart" of new energy vehicles, but also the decisive factor for whether China can achieve "curve overtaking" and become a world automobile power[5]. Data from the Lithium Battery Research Institute of Gaogong Industry and Research Institute shows that China's power battery shipments in 2019 have reached 71GWh, compared with the power battery shipment data in 2018, an increase of 9.2% over the same period, and the market share has continued to grow. According to the "2019 Global Electric Vehicle Outlook" released by the International Energy Agency, it is expected that by 2030, the global new energy vehicle ownership will reach about 250 million, so it can be expected that the demand for power batteries will continue to increase in the future. At present, enterprises continue to invest a lot of resources in power battery-related research, through the analysis of new energy vehicle patents found that battery technology is the focus of research at home and abroad enterprises, in the number of new energy vehicles related patents battery technology occupies the first position [6], which shows that the power battery as a key technology has been valued in the industry. Based on GTM algorithm, some scholars use text mining methods to identify technological innovation opportunities in the new energy automobile industry, and the research results show that the layout of power batteries can help new energy automobile enterprises seize the commanding heights of science and technology,

thereby occupying scientific and technological advantages [7]. In addition, the cost of power batteries accounts for the highest proportion of the total vehicle cost. Relevant analysis found that the cost of power batteries accounts for about 50% of the total cost of new energy vehicles, which is the highest added value of products in the supply chain of new energy vehicles[8]. Based on the above relevant reports and research, it can be concluded that power battery technology is the leading technology in the new energy automobile industry.

2.2. New energy vehicles dominate the technology life cycle

The technology life cycle was developed from Harvard University professor Reymond Vernon's International Investment and International Trade in the Product Cycle in 1966,[9] which refers to the process from research and development to application and marketing, and finally launches a technology to the market[10]. Drawing on existing relevant research, this paper divides the technology life cycle into four cycle stages, namely: germination, development, maturity and decline. The characteristics of each stage are as follows：

1. In the embryonic stage of technology, related technical products are in the research and development stage, and the relevant knowledge is less, mainly for the research of basic knowledge, and related products have not entered the market.

2. In the period of technological development, with the accumulation of relevant knowledge, the technological innovation system has been rapidly developed, the research and development team has grown rapidly, the number of patents has increased rapidly, funds have been invested in technology in large quantities, there are few alternative products on the market, and the technology gap is large[11].

3. In the mature period of technology, through the continuous development of various innovative entities in the technological development period, most of the technical problems have been solved, the market demand is large, the number of patents is large, and a certain number of alternative technologies appear, the technology gap becomes smaller, and the capital investment is relatively stable.

4. In the period of technological recession, technological development has reached the bottleneck, there are many alternative technologies and new technologies on the market, the technology to obtain less and less profits, gradually not valued by the main body of research and development [12], the main body of innovation began to slowly withdraw from the technology market, began to develop another technology.

At present, the research on the technical life cycle of new energy vehicles mainly focuses on the study of new energy vehicle technology, and the lack of technical life cycle research on new energy vehicle power batteries, so this paper divides the life cycle of the leading technology of new energy vehicles - power battery technology according to existing research methods.

In terms of data sources, the research data in this paper comes from the incoPat global science and technology analysis and operation platform, which collects more than 1.3 billion patent data from 120 countries around the world, which not only ensures continuous update of data 24 hours a day, but also processes the legal status and language of patent information. Retrieval method Above, this article adopts the method of advanced retrieval, using the search formula is: TIAB=Power battery AND TIAB=(New energy vehicle OR battery car OR cell-driven vehicle OR electric car OR electric vehicle OR electric automobile) for retrieval. The deadline is October 2021. According to the existing literature, the IPC classification number was screened, the unrelated patents were excluded, and finally the same patent was merged, and 38894 patents were finally obtained, and the application trend was shown in Figure 1 below.

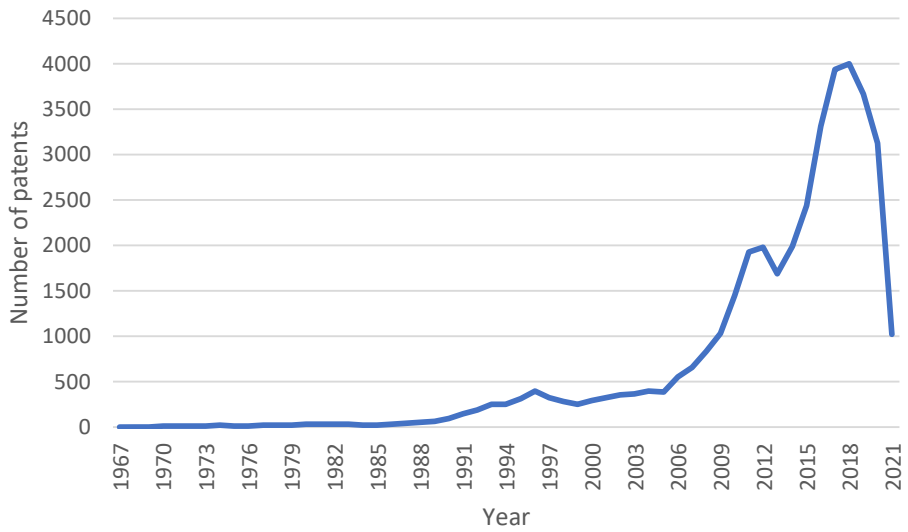

Figure 1 New energy vehicle power battery technology application trend

According to data analysis, the number of patents for new energy vehicle power batteries has maintained an overall growth trend. Between 2018 and 2021, the number of patent applications for new energy vehicle power batteries fluctuated greatly, which occurred because it took 1 to 3 years for patents to go from application to publication, so the number of patents counted in the three years from 2018 to 2021 was not accurate. Based on this, this paper selects the patent data from 1970 to 2018 and enters it into the Loglet Lab, and plots the patent S-curve model, and finally obtains the parameter fitting results (as shown in Table 1).

Table 1 Logistic model fitting results of new energy vehicle power battery technology

Index	a	tm	1%	10%	50%	90%	99%
Outcome	25.5	2024	1997	2011	2024	2037	2051

Figure 1 is the fitted distribution map of the technical life cycle of the new energy vehicle power battery, the horizontal axis is the time, the vertical axis is the number of patent applications for the new energy vehicle power battery technology in that year, the solid line part is the fitted part, and the dotted line part is the prediction part. Table 3.1 is the result of the Logistic model fitting of the new energy vehicle power battery technology, tm is the demarcation point of the technological development period and the technological maturity period, before t10 is the embryonic stage of technology, between t10 and t50 is the technological development period, t50 to t90 is the technological maturity period, and after t90 is the technological decline period. According to the data of Table 3.1, before 2011, the power battery of new energy vehicles was in the embryonic stage of technology, and from 2011 to the present, the power battery of new energy vehicles was in the stage of technological development. According to the model prediction, the power battery of new energy vehicles will be in a mature stage of technology between 2024 and 2037, and the power battery of new energy vehicles will be in a period of technological decline after 2037.

3. Literature References

Different industrial supply chains often have different characteristics due to different factors such as structure. NanJiangxia[13] considers the characteristics of the missing feature value of the sub-alliance of the cloud service supply chain, and studies the situation under which the participants in the cloud service supply chain make decisions on patent labeling and cooperative innovation based on the non-cooperative-cooperative game. Dang Lin et al. [14]

constructed an empirical model for the characteristics of cooperative innovation of manufacturing enterprises in the digital economy, which proved the improvement effect of cooperative innovation in the digital economy manufacturing industry. Based on the data of listed companies in the manufacturing industry, Yu Maojian[15] studies the relationship between the innovation of supply chain partners and the performance of enterprises from the perspective of the organizational structure characteristics of enterprises. He Xinran et al.[16] Faced with the problems existing in traditional supply chain finance, they made suggestions for the development direction of supply chain finance by introducing blockchain technology. Yang Li et al.[17] studied how capability innovation affects logistics service supply chain cooperation by considering the innovation characteristics of logistics providers and logistics integrators in the logistics service supply chain.Leng Siping[18] Aims at the characteristics of the integration and development of the retail industry and the Internet, and conducts a study on the service innovation path of the retail industry. Yan Zhanghua et al.[19] In view of the characteristics of the tourism service supply chain, double-price and low-price sales restrictions are introduced on the basis of the NYOP model to solve the problems existing in the tourism supply chain. Chen Wei et al. [20] took the automobile industry as an example, added its characteristics of knowledge dependence to the model, and designed a formal contract and relationship contract incentive mechanism for knowledge transactions between enterprises in the supply chain under bilateral moral hazard. JC et al. [21] Based on the characteristics of agricultural supply chains, foreign horticultural supply chains were analyzed, and the results found that upstream collaboration was more profitable than collaboration with customers. Zhang et al. [22] Analyze the cooperation and innovation problems between contractors and owners in the construction supply chain in view of the characteristics of project value-added in the construction supply chain, and believe that if the project value-added can be realized in knowledge cooperation, the partial entrustment method can be adopted.Hou et al. [23] considered the importance of user feedback in the medical supply chain, analyzed the medical supply chain, and believed that user feedback played a positive role in the cooperative innovation of the medical supply chain. Xia et al. [24] For the green building materials industry, through the study of collaborative innovation that integrates the green building materials supply chain, xia et al. studied the factors that need to be considered when selecting partners to improve the ability of collaborative innovation. Mu et al. [25] In the study of cooperative innovation in e-commerce supply chains, consumer e-commerce preferences were included in the model, and found that the higher the level of innovation in supply chain cooperation, the later manufacturers opened online channels. Hu et al. [26] introduce innovative investment and government support factors in the photovoltaic industry into the game model, and analyze how to improve cooperative innovation in the photovoltaic industry through numerical simulation and case analysis. Fang et al. [27] Based on game theory, fang et al. studied the problem of cooperative innovation in the satellite industry, and believed that a reasonable distribution coefficient could promote the stability of cooperative innovation.

4. Summary

This paper analyzes the definition of the leading technology, sorts out the leading technology of new energy vehicles according to the definition of leading technology, and finds that the leading technology of new energy vehicles is power battery technology, and at the same time, this paper processes patent data based on the incoPat global science and technology analysis and operation platform and Loglet Lab, and finds that new energy vehicles are currently in the stage of technological development, which will enter the technological maturity period in 2024 and be in a period of technological decline after 2037.

References

[1] Xu X , Gui M . Applying data mining techniques for technology prediction in new energy vehicle: a case study in China[J]. Environmental Science and Pollution Research, 2021:1-18.

[2] Nascimento P T D S , Yu A S O , Nigro F , et al. The case of Magneti Marelli Brasil: Endogenous and exogenous factors in local dominant technology development[C]// Portland International Conference on Management of Engineering & Technology. IEEE, 2009.

[3] Deng Xuxia, Liu Chunyang. On the Leading Technology of Circular Agriculture and Its Development Countermeasures [J]. Journal of Agricultural Mechanization Research,2014,36(09):1-5.

[4] Wang Bo, Liu Zeyuan, Liu Shengbo. Research on the evolution path of my country's new energy vehicle industry technical standards [J]. Science Research Management,2020,41(03):12-22.

[5] Zhang Houming. Problems and suggestions for the development of my country's new energy vehicle power battery industry [J]. Scientific Management Research,2018,36(06):58-61.

[6] Li Guoqiu, Fan Xiaoting. Global Patent Analysis of New Energy Vehicles [J]. Journal of Modern Information,2017,37(07):123-130.

[7] Xu Xueguo, Gui Meizeng. Recognition of Technological Innovation Opportunities Based on GTM Reverse Mapping--Taking New Energy Vehicles as an Example [J]. Information Studies:Theory & Application,2021,44(06):146-153+198.

[8] Masiero G , Ogasavara M H , Jussani A C , et al. Electric vehicles in China: BYD strategies and government subsidies[J]. Rai Revista De Administrao E Inovao, 2016, 13(1):3-11.

[9] Wang Shan, Tan Zongying. A review of research on technology life cycle judgment methods [J]. Journal of Modern Information,2020,40(11):144-153.

[10] Taylor M , Taylor A . The technology life cycle: Conceptualization and managerial implications. 2012.

[11] Zhang Haifeng, Zhang Zhuo. Construction and determination of characteristic indicators of technology life cycle stages [J]. Journal of Technology Economics,2018,37(02):108-112.

[12] Li Jie, Huo Guoqing. A Preliminary Study on the Technology Innovation Model of my country's Strategic Emerging Industries [J]. Science and Technology Management Research,2017,37(23):31-39.

[13] Nan Jiangxia, Zhang Li, Zhang Maojun, Li Dengfeng. Two-type game model of multi-person cooperation and technological innovation decision-making in cloud service supply chain [J/OL]. Systems Engineering-Theory & Practice:1-16[2021-03-26].

[14] Dang Lin, Li Xuesong, Shen Shuo. Digital Economy, Innovation Environment and Cooperative Innovation Performance [J/OL]. Journal of Shanxi University of Finance and Economics,2021(11):1-15[2021-10-08].https://doi.org/10.13781/j.cnki.1007-9556.2021.11.001.

[15] Yu Maojian. Supply chain innovation, R&D organizational structure and corporate innovation performance [J]. Studies in Science of Science,2021,39(02):375-384.

[16] He Xinran, He Genqing. Research on Supply Chain Finance Innovation Based on Blockchain Technology [J]. Hainan Finance,2021(01):22-28+53.

[17] Yang Li, Wang Yanni. Research on Cooperation and Coordination of Logistics Service Supply Chain Based on Capability Innovation [J]. Global Science,Technology and Economy,2019,34(05):73-76.

[18] Leng Siping. Research on the innovation path of business services in the transformation of retail industry [J].Journal of Commercial Economics,2018(12):22-24.

[19] Yan Zhanghua, Liu Lei, Bai Shizhen. Research on the innovation of tourism service supply chain cooperation model based on NYOP [J].Soft Science,2017,31(07):39-43+75.

[20] Chen Wei, Zhang Xumei, Song Han. The Relational Contract Mechanism of Knowledge Transaction between Enterprises in Supply Chain: A Research Perspective Based on Cooperative Innovation [J].Science Research Management,2015,36(07):38-48.

[21] JC Pérez-Mesa, Piedra-Muoz L , E Galdeano-Gómez, et al. Management Strategies and Collaborative Relationships for Sustainability in the Agrifood Supply Chain[J]. Sustainability, 2021, 13(2):749.

[22] Zhang W , Zhang Q , Wu G . Interorganizational Knowledge Division Decision Model Based on Cooperative Innovation of Supply Chain System[J]. Abstract and Applied Analysis, 2014, 2014:1-9.

[23] Hou G S , Y Wang, Chen R . Cooperative Innovation in the Medical Supply Chain Based on User Feedback[J]. Complexity, 2020, 2020.

[24] Xia W , Li B , Yin S . A Prescription for Urban Sustainability Transitions in China: Innovative Partner Selection Management of Green Building Materials Industry in an Integrated Supply Chain[J]. Sustainability, 2020, 12(7):2581.

[25] Mu Zongyu,Zheng Yuangang,Sun Hao. Cooperative Green Technology Innovation of an E-Commerce Sales Channel in a Two-Stage Supply Chain[J]. Sustainability,2021,13(13):

[26] Hu J , Wu J , Wu J , et al. Evolutionary Game Study on Technical Cooperation Innovation of Photovoltaic Enterprises with Multi-agent Participation[J]. IOP Conference Series: Earth and Environmental Science, 2020, 508(1):012094 (7pp).

[27] Fang W , Wang C . The Cooperative Stability Evolutionary Game Analysis of the Military-Civilian Collaborative Innovation for China's Satellite Industry[J]. Mathematical Problems in Engineering, 2019, 2019.