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Thesis of the Department of International Economics:

TRANSFORMATION PROCESS IN THE EUROPEAN AUTOMOTIVE INDUSTRY AND OPPORTUNITIES FOR UKRAINE

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АНОТАЦІЯ

Ван Сюфан. Процес трансформації європейської автомобільної промисловості та можливості для України – Рукопис

Дослідження на здобуття освітнього ступеня «магістр» за спеціальністю 051 Економіка, освітньо-професійна програма – Міжнародна економіка – Західноукраїнський національний університет, Тернопіль, 2024.

У магістерській роботі аналізується необхідність трансформації автомобільної промисловості та можливості та виклики, які несе Україні процес трансформації європейської автомобільної промисловості, а також пропонуються українські контрзаходи, щоб впоратися з трансформацією європейської автомобільної промисловості..

Ключові слова: автомобільна індустрія, трансформаційний процес, електрифікація, диджиталізація, нова енергія автомобільної промисловості, викиди, енергозберігаючі технології.

ANNOTATION

Xiufang Wang . **TRANSFORMATION PROCESS IN THE EUROPEAN AUTOMOTIVE INDUSTRY AND OPPORTUNITIES FOR UKRAINE**.- Manuscript

Research for the degree of "Master" in the field of 051 Economics, educational-professional program - International Economics - Western Ukrainian National University, Ternopil, 2024.

The master's thesis analyzes the necessity of the transformation of the automotive industry and the opportunities and challenges that the process of transformation of the European automotive industry brings to Ukraine, and proposes Ukrainian countermeasures to cope with the transformation of the

European automotive industry.

Key words: automotive industry, transformation process, electrification, Digitalization, new energy vehile industry, emissions energy-saving technologies.

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INTRODUCTION

Actuality of the research. With the arrival of the era of digital economy, the development of new technologies represented by big data, cloud computing, artificial intelligence, automotive technology, automotive products, automotive industry and even transportation related to it is undergoing systematic changes, how to meet the new development trend brought about by digitization and intelligence, and to help automotive enterprises comfortably cope with the challenges of the era of change and win market opportunities has become an important issue.

Against the backdrop of a new round of technological revolution and industrial change, European countries stand at the forefront of the zeitgeist of transformation and upgrading of the automotive industry, and take electrification, intellectualization, and Internet connectivity as the development trend of the automotive industry, and continue to accelerate the speed of technological innovation. With the continuous promotion of energy saving and emission reduction and the "dual carbon" goal, the high fuel cost has affected the market demand of traditional car companies to a certain extent, making traditional energy car companies face great pressure in the process of realizing high-quality and sustainable development. Under such circumstances, many traditional automobile enterprises have accelerated the pace of transformation to new energy automobile enterprises.

Ukraine is the largest country in Europe except Russia, it is located in the geopolitical intersection of the European Union and Russia, and has a relatively solid foundation of heavy industry. In the current situation, if Ukraine can follow the trend of technological innovation, vigorously develop the automotive industry, and use this to pull the related industries to achieve modernization and technological upgrading, then it is expected to occupy a place in the transformation and upgrading of the European automotive industry. This will not

only enhance Ukraine's competitiveness in the international market, but also lay a solid foundation for the country's sustainable development, which will in turn promote the prosperity of the country's overall economy.

The aim of the study is to tinvestigate and analyze the reasons for the transformation of the European automotive industry, its current situation and opportunities for Ukraine, and to discuss the measures of Ukraine to cope with the transformation of the European automotive industry.

Tasks of the investigation:

1) to investigate the position of the automotive industry in the national economy and the necessity of its transformation;

2) to analyze the main features of the transformation of the automotive industry;

3) to evaluate the process and structure of the transformation of the automotive industry;

4) to analyze the process of transformation of the European automobile industry;

5) to study the impact of the transformation of the European automotive industry on Ukraine;

6) to search for countermeasures for the development of the automotive industry in Ukraine by seizing the opportunities.

The object of the work is the research into the transformation process in the European automotive industry and identifying opportunities for the development of this industry in Ukraine.

Subject of the study is the main principles, policies and consequences of the transformation process in the automotive industry in Europe, as well as measures aimed at regulating this movement and supporting it in Ukraine

Information basis of the study. The study used statistics from Eurostat, OECD, DaaS-Auto Data, S&P Global Mobility, ACM Digital Library, Elsevier - Global,

Google Scholar Search, research papers by Chinese and Ukrainian scientists, information materials from reference and statistical publications, Internet resources, textbooks, handbooks, economic guides, reports, etc.

The scientific novelty lies in the identification of opportunities for Ukraine in the development process of the European automobile industry and Ukraine's response.

Practical significance of the obtained results is that the theoretical provisions and practical suggestions put forward by the author in the master's thesis are the basis for Ukraine to seize the opportunity of the transformation of the European automobile industry to develop the direction and focus of the automobile industry.

Structure of work. The paper consists of 57 pages and 3 pictures, a list of sources with several items.

Chapter I analyzes the status of the automobile industry in the national economy, the necessity of the transformation of the automobile industry, the new characteristics of the transformation of the automobile industry, and the process and structure of the transformation of the automobile industry.

Chapter II analyzes the factors driving the transformation of the European automobile industry and the European government's new energy vehicle policy, explains the process of the transformation of the European automobile industry, and puts forward the trend of the transformation of the European automobile industry.

Chapter III analyzes the current development of the Ukrainian automobile industry, the opportunities brought by the transformation of the European automobile industry to the Ukrainian automobile industry, and puts forward countermeasures and suggestions on how Ukraine can seize the rare market opportunities to develop the automobile industry and improve the national economic level.

This study analyzes the necessity of the transformation of the automotive industry and evaluates its characteristics, process and structure. Data is collected from different sources and analyzed using different methods. The results show that Ukraine will face many opportunities in the process of the transformation of the European automotive industry. As long as it responds properly, Ukraine will definitely embark on a unique path of automotive industry development.

CHAPTER1: TRANSFORMATION OF AUTOMOBILE INDUSTRY

1.1 The Importance of The Automobile Industry In The National Economy

The automobile industry is not only an important pillar of the national economy, but also relates to technological innovation, environmental protection, export earnings and social well-being, and is of great significance to the overall development of the country. Automobile production is associated with many upstream and downstream industries, such as iron and steel, rubber, glass, electronics, etc., which can drive the synergistic development of related industries and create huge economic value. Relevant data show that in Japan, the direct correlation between automobile industry and other industries is 1:2.4~2.74, and every increase of 100 billion yen or more in the output value of automobile industry will bring 240 billion yen or more to the related industries, and if we consider the indirect effect, the impact on the national economy will be even greater.

The automobile industry brings the country abundant tax revenue and also provides a large number of employment opportunities, ranging from high-end talents in R&D and design to skilled workers on the production line, as well as employees in the fields of sales and after-sales service. In 1990, each job in Japan's automobile industry could create seven jobs for other sectors, and the number of direct and indirect employment in the U.S. automobile industry is even higher, accounting for about 1/6 of the total number of employed people in the country. According to the calculation of the German automobile industry association, if those industrial jobs related to the use of automobiles are also counted, the direct and indirect employment of the German automobile industry reached 5 million people in 1997, of which the direct employment of the automobile industry was 670,000 people, the indirect employment of the supporting industrial sector was 980,000 people, and the indirect employment related to the sale and use of automobiles was 3.35 million people, and the indirect

employment of the automobile industry was 3.35 million people. The indirect employment in the automobile industry is 6.5 times of the direct employment.

On the other hand, the automobile industry is at the forefront of technological innovation. With the advancement of science and technology, it is actively promoting the development of electrification, intelligentization and Internet connectivity. The research and development and promotion of new energy vehicles will help reduce dependence on traditional fossil energy, reduce environmental pollution and realize sustainable development. Intelligent driving technology leads major changes in transportation, improving safety and efficiency. Its scientific and technological innovation results also radiate to other industrial fields, promoting the national scientific and technological level. At the same time, a strong automobile industry can enhance the country's position in the global economy, automobile exports bring foreign exchange income, show the country's industrial strength and manufacturing level, and in the global competition in the automobile industry, competitive brands and advanced technology can enhance the country's economic discourse and influence. Because of this, the political leaders and economic elites of the United States, European countries, Japan, South Korea and other countries regard the automobile industry of their countries as one of the most important strategic industries in the global economy.

1.2. The Necessity of Automobile Industry Transformation

Affected by environmental factors such as climate warming, excessive pollutant discharge and renewable energy depletion, the living environment is deteriorating and energy security is becoming more and more serious. Countries all over the world have formulated policies to promote the exploration of renewable energy to replace traditional fuels. Reducing automobile exhaust gas, improving air quality and looking for low-pollution clean energy that can replace

fuel power are political factors to promote the transformation of automobile industry.

Since the 21st century, global scientific and technological innovation has entered an intensive and active period, and the digital economy represented by new generation technologies such as artificial intelligence, cloud computing and big data analysis is booming. The digital transformation of industry will become the new engine of global economic recovery, and digital transformation is defined as a national strategy. The technological changes represented by the new generation of information technology, new materials, big data, artificial intelligence, etc. have changed the traditional automobile design, verification, manufacturing, sales and service modes, and inspired new business models and transportation organization modes represented by OEM and V2X, which have become the endogenous driving force to lead the progress of automobile technology. [3]

With the increasing number of cars, the automobile market is gradually saturated, which also leads to the slowdown of the automobile industry. The emergence of new energy vehicles has forced traditional automobile enterprises to make changes. Some traditional automobile enterprises have formulated the development strategies of plug-in hybrid electric power (including expansion plans), pure electric power and fuel cells, and transformed from traditional automobile manufacturers into technology enterprises integrating interconnection, artificial intelligence and new energy [4].

With the increase of the added value at the front and back ends of the automobile industry chain, the positioning of traditional automobile enterprises has no longer stopped at "automobile manufacturers", but turned to "mobile travel service providers", and the business value logic is no longer limited to automobile manufacturing, but turned to "travel as a service (MaaS)". At the same time, the business boundaries of traditional car companies will continue to expand, from

traditional manufacturing to software intelligent scene experience and mobile travel services.

The reconstruction of the core framework of automobile manufacturing under the trend of electrification leads to the diversion of the profit of traditional automobile enterprises. In the era of electrification, the core of electric vehicle is three electric systems (battery, electric control and electric drive), which is different from the powertrain structure of traditional fuel vehicle (vehicle engine and gearbox). The proportion of powertrain module, the core profit source of traditional fuel vehicles, has decreased by 40%, while the proportion of batteries in the whole vehicle has increased to 50%, resulting in a large amount of vehicle profits being diverted by battery suppliers. Traditional OEMs are facing greater profit pressure in the development of electric vehicle business. At the same time, traditional car companies that have been deeply involved in the research and development of fuel vehicles for many years do not have the technical advantages of the three-electric system. In order to improve the profit of new energy vehicles, traditional car companies are required to master the core technologies in the fields of battery system, motor and electronic control independently [3].

Intelligence is reshaping the automotive industry. Under the trend of "software-defined cars", the core of competition among automakers has shifted from hardware to software. The centralized electronic architecture has transformed the core competitiveness of the entire vehicle from the "fuel consumption + power" of the traditional powertrain to the "intelligence + technology" brought by automotive electronics. The design and development process has also changed from traditional integrated development to independent software and hardware development. In the entire vehicle system, the value share of the software module has increased from the original 15% to 65%, and the cost share will also increase from 10% to 50%. It is an inevitable trend that the sum of the value of software and automotive electronics exceeds that of hardware and becomes the core of the value of the entire vehicle. The profit model of the

automobile has shifted from one-time vehicle sales to the premium generated by continuous software services, which requires continuous upgrades of automotive software and product iterations, rather than relying on hardware upgrades [10]. Taking Tesla's software charging as an example, the software service combination with autonomous driving functions as the core is expected to contribute 20% of Tesla's gross profit of the entire vehicle in 2025. Traditional automakers need to transform from "automotive companies" to "automotive + technology companies" and create a new business model with software as the core.

In the new wave of changes, automotive ecological services strengthen the core competitiveness of automakers and provide broad incremental space. The full-process service of "see, buy, use, and replace" at the back end of the industrial chain is not only the key for car companies to improve product experience and extend core competitiveness in the fierce competition, but also contains broad incremental space and is expected to become the third pole of growth.

Against the background of increasingly strong consumption upgrades and personalized needs, car buyers are gradually increasing their requirements for the service quality of car sales. At present, when consumers buy cars, they mainly consider factors such as purchase experience, price transparency, convenient process, and delivery time. However, the dealers and 4S store channels of traditional car companies have problems such as opaque prices, insufficient professionalism of sales staff, cumbersome after-sales service, and untimely interaction with users, which highlights the limitations of traditional distribution channels. This mismatch of supply and demand for channel services has made it increasingly obvious that consumers want to buy products directly from the OEM and obtain related professional and customized services. Therefore, traditional car companies urgently need to create end-to-end solutions, strengthen new energy vehicle business, explore more direct and professional models, and achieve product information symmetry, transparent and unified prices, and

excellent service experience. At the same time, the layout of channel touchpoints that directly contact consumers can also help traditional car companies reduce the cost of obtaining user data information and speed up the response to changes in market demand.

With the trend of younger consumer groups, the importance of online channels continues to increase. According to a survey by Juliang Suanshu, although "online understanding, offline purchase" is still the mainstream way for consumers to buy cars at this stage, 35% of potential consumers are willing to book and purchase car products online, which means that online platforms may become the main channel for car buyers to view and purchase cars. Traditional car companies need to continue to explore the "online + offline" seamless service experience, and achieve full coverage of sales touchpoints through the integration of all channels. However, this also puts higher requirements on the ability to mine and use user data. Traditional car companies need to mine user portraits and user needs from massive user data, based on user concerns and user pain points, and reversely deduce the functional forms of products, precision marketing and one-stop services [3].

In terms of service content, providing one-stop automotive ecological services throughout the life cycle may become a new value proposition for traditional car companies.

As consumers' requirements for after-sales service richness continue to increase, traditional car companies need to provide branded, standardized, and digital one-stop system services based on the user's full life cycle of automobile products to meet current needs, such as automobile financial services, leasing services, used car services, road services, and software intelligent system upgrade services. At the same time, due to the reshaping of automobile products under electrification, energy services such as charging piles and battery swap stations will also occupy an increasingly important position in the aftermarket value chain.

With the development of the times, consumers' desire for car ownership has gradually diminished, and the trend of car use rights shifting to OEMs and travel platforms has become increasingly obvious. This change in travel mode will eventually lead to a fundamental change in the automobile circulation model, and this change has also brought new opportunities to traditional car companies. Today, it has become a consensus in the industry that shared travel services will increase their share of the automobile market in the future. In this case, vehicle ownership will shift from private car owners to fleet operators. Traditional car companies should be keenly aware of this trend and promptly deploy and explore lightweight and convenient car use and travel service models such as online car-hailing, car time-sharing rental, and ride-sharing. By actively participating in these emerging mobility service sectors, traditional automakers can not only expand their business scope, but also better adapt to market changes and meet consumers' changing mobility needs, thereby gaining a favorable position in the fierce market competition.

In summary, if traditional automakers want to achieve high-quality and sustainable development in the next stage, they need to actively deploy hardware, software and mobility services to achieve the transformation from "product-centric automakers" to "customer-centric mobility service providers." At the same time, in the process of reconstructing their business models and deploying emerging businesses, traditional automakers often increase their R&D activities or resort to mergers and acquisitions, resulting in a significant increase in capital expenditure pressure. Automakers with different resource capabilities have relatively large differences in the asset layout models and transformation paths they choose [3].

1.3. Characteristics of Automobile Industry Transformation

1.3.1 Automatic Interconnection and Intelligence.

In the future, intelligent cars will fully realize automatic driving and effectively connect the collaborative relationship between people, vehicles and the environment. Form a corps collaborative combat system of "multi-unit collaborative innovation, multi-arms joint operations, multi-professional technology integration, and multi-customer interface unification". Based on artificial intelligence, big data, digital twin and other technologies, a real-time digital twin system is built to extract information such as vehicles, traffic incidents, and illegal behaviors in real time. Through the simulation and reconstruction of the real traffic system in the virtual digital space, the vehicle trajectory cross-lens tracking and traffic accident monitoring functions can be realized. The vehicle's unique ID can be continuously tracked, providing a more timely and comprehensive "holographic perspective" for traffic dispatch management, improving decision-making efficiency and helping driving safety. Build a full-process management system for smart highways to achieve the integration and interconnection of people, vehicles, roads and the environment, and provide drivers and passengers with convenient, comfortable, efficient and smooth travel services [4] .

1.3.2 Customized Production And use

In the context of digital economy, Mass Customization (MC), as a new type of production mode, will become an inevitable choice for automotive enterprises to meet customer demand and enhance competitiveness. Mass customization takes the cost and speed of mass production as the goal, combines with customer demand-oriented, and uses advanced manufacturing technology, information technology and management technology to realize customer personalized customized products or services [11]. This production model not only inherits the advantages of Ford mass production and Toyota lean production, but also has

higher flexibility to meet the common needs of customers for short lead times, personalized products and low costs. Therefore, mass customization is regarded as the most instructive new production mode after these two.

In the future, the automotive intelligent manufacturing industrial system will develop in the direction of personalization and efficiency, shaped by both digital and demand-driven. This system will be fully integrated with travel services to meet people's increasingly diverse travel needs. The core of smart manufacturing is precisely mass customization, which builds a data-driven interconnected intelligent system, showing the essence of manufacturing: that is, to meet customers' individualized needs with lower cost, faster speed and better quality [11]. In this context, automotive enterprises need to actively adopt the mass customization model, change the existing production and marketing model, realize the customer's personalized needs as a driver, and seek to survive and develop in the era of intelligent manufacturing.

1.3.3 Cross-border integration

The new automobile industry is undergoing a profound transformation of cross-border integration. Different technical fields and industrial categories are intertwined, jointly shaping a new ecology of diversified and integrated automobile industry. At present, the global automobile industry is undergoing a comprehensive reconstruction driven by a new round of scientific and technological revolution, and the impact of the Internet revolution and the intelligent revolution is particularly significant. This change has led to major changes in the industrial structure, presenting new characteristics of "multi-party participation, competition and cooperation, and mutual integration". In addition to traditional vehicle companies, suppliers and dealers, information and communication technology companies, new software and hardware technology companies, operators, service providers and infrastructure companies have all been integrated into the automobile industry, making the original vertical linear industry value chain gradually evolve into a cross-network travel ecosystem.

Affected by this, the scope of the automobile industry continues to expand, the boundaries are increasingly blurred, and many different participants have become an indispensable and important part of the smart car industry ecology. However, no one or one type of company can possess all the capabilities required for the development of future smart cars alone. Therefore, in the process of restructuring the automobile industry, cross-border cooperation has become the norm and integrated development has become inevitable.

In order to seize the strategic opportunities of this round of industrial transformation and realize the rapid development of smart cars, it is crucial to build a new industrial ecosystem that integrates across industries, performs its duties, effectively divides labor, collaborates and innovates, and cooperates for win-win results[14]. In this context, the "building of a cross-industry integrated smart car industry ecosystem" proposed in the Development Strategy has forward-looking strategic significance. It not only accurately grasps the development law of smart cars, but also closely fits the evolution of the global automotive industry competition pattern. The development of the smart car industry also depends on the construction of key component industry clusters and the promotion and application of intelligent systems. Through the technical research and product industrialization of high-precision on-board sensors, automotive-grade chips, intelligent operating systems, on-board intelligent terminals, and intelligent computing platforms, a key component industry cluster supporting the development of smart cars has been formed. At the same time, based on the accelerated promotion and application of intelligent systems, independent smart car brands featuring intelligent products, services and experiences have been cultivated. This not only highlights the important role of new intelligent hardware involved in smart cars, but also foreshadows the future development trend of "software-defined cars".

1.3.4 Low-carbon environmental protection and energy saving

The concept of low-carbon, environmental protection and energy conservation will be deeply integrated into the entire life cycle of automobile products and even the entire automobile industry chain. At the industry level, carbon reduction actions not only focus on the zero-emission characteristics of automobile products themselves, but also extend to the entire process of raw material supply, production and manufacturing, and after-sales service.

Specifically, in the research and development stage, by increasing modular design, carbon emissions in the disassembly and recycling stages can be effectively reduced. In the production process, green, environmentally friendly renewable materials are used, and a number of environmental protection and energy-saving technologies are applied to reduce carbon emissions. In addition, vehicle manufacturers have put forward higher carbon emission index requirements for upstream and downstream suppliers to promote carbon emission reduction in the manufacturing process of parts.

Globally, many multinational companies such as Daimler, Volkswagen, BMW, Volvo, General Motors, Ford, Toyota, Nissan, Bosch, etc. have clearly put forward carbon neutrality goals and actively implemented carbon emission reduction measures in multiple links such as production, sales, and use [15]. For example, Volkswagen MEB factory has achieved a significant decrease of 20% in five key environmental indicators, including energy, water, carbon dioxide, volatile organic compounds and waste, through 27 environmental protection and energy-saving technologies such as photovoltaics, cogeneration, and waste heat recovery. Tesla's 4680 battery production line has achieved excellent results of 70% energy consumption reduction and 96% waste recycling rate through technological innovation.

In summary, low-carbon, environmental protection and energy conservation have become an important trend in the development of the global automotive industry. Major companies are jointly promoting the automotive industry to

develop in a greener and more sustainable direction through all-round carbon reduction actions.

1.3.5 Comfort, convenience and efficiency

The quality of automobile products and travel service levels are constantly improving, and people's car travel has become more comfortable, convenient and efficient. If the theme of the automobile industry transformation in the past 10 years is electrification, then intelligence will become the theme of the automobile industry transformation in the next 10 years. A key technical guarantee for the implementation of intelligence is temperature control, that is, how to achieve effective, timely and accurate temperature control of many electronic components. These are precisely the advantages of the application of automotive thermoelectric semiconductor technology, which truly reflects high efficiency, energy saving, green and environmental protection. In the future, automotive thermoelectric semiconductor technology will inevitably develop in the direction of miniaturization, modularization and integration, so as to truly achieve accurate temperature control, timely temperature adjustment and intelligent temperature control. By equipping advanced on-board sensors, controllers, actuators and other devices, and integrating modern communication and network technologies, the intelligent information exchange and sharing between the car and X (car, road, person, cloud, etc.) can be realized, and it has the functions of complex environment perception, intelligent decision-making, collaborative control, etc., which can realize safe, efficient, comfortable and energy-saving driving.

1.3.6 Ecological sharing of travel.

Car sharing will make full use of idle resources, effectively alleviate the urban transportation capacity load, and form a new green and efficient travel ecosystem. Car sharing: that is, multiple people share a vehicle, only have the right to use the car, not the ownership of the car. Car sharing is an efficient way of resource allocation, and it is also a sharing of people and wisdom, achieving integration and win-win. Due to the increasing social and consumer demand, the

shared travel industry will also develop rapidly. Sharing is a prospect, an ideal state, and a step-by-step work. This work requires the mutual coordination of all sectors of society, including complete vehicles, OEMs, dealers, operators and consumers. Car sharing is also a social ecology, a new state of high integration between industries.

1.4. The Process And Structure of Automobile Industry Transformation

1.4.1 The process of the transformation of the automobile industry

First, the automobile industry is gradually developing from a vertical and single mechanical industry to an integrated industry with cross-border integration in multiple fields. The connotation of the automobile industry is constantly enriched and the extension is constantly expanding. At the same time, the transformation of the automobile industry has caused the adjustment and reconstruction of the industrial value chain. The industrial value has gradually shifted from R&D, design, production, manufacturing and other links to marketing, maintenance, travel, service and other links, and automobile companies have transformed into system integrators and travel service providers. The corresponding automobile innovation chain has also adjusted and shifted, from the innovation model dominated by the manufacturing end to the cross-border integration and travel service end, triggering the reconstruction of the innovation chain. With the continuous development of the automobile industry, the technological level of the automobile industry has continued to improve. Ultimately, the automobile industry chain will adjust and reconstruct from low-end repetitive production and manufacturing to high-end complex and diversified innovation. In addition, the means and methods of global cooperation in the automobile industry are becoming increasingly rich, and a global high-level R&D and production system is constantly taking shape. The new form of open cooperation in the automobile industry will continue to be popularized and deepened [4].

1.4.2 The framework of automobile industry transformation

New materials. New materials play a fundamental supporting role in the development of automobiles. Automobile materials widely cover hundreds of types such as steel, glass, rubber, ceramics, grease, plastic leather, etc. With the advancement of material technology, new materials are constantly applied to the automotive industry, significantly improving the quality and performance of automobiles.

Taking body materials as an example, they have developed from single ordinary steel to high-strength steel, carbon fiber, composite materials and other high-performance materials. These materials reduce the weight of the body and improve safety and economy. Automobile material innovation has a significant driving effect on the overall innovation of automobiles. In the future, exploring the application of new materials with excellent performance in automobiles will be an important innovation direction.

New structure. Structural innovation constitutes the core driving force of autonomous automobile innovation. With the continuous progress of design and manufacturing technology, automobile structure has been continuously optimized, and many novel and efficient structures have emerged. The emergence of these new structures not only enriches the diversity of automobile design, but also significantly improves the overall technical level of automobiles. Therefore, it can be said that the continuous advancement of structural innovation is a key factor in promoting automobile technology to a new height.

New technology. Automotive technology covers a wide range of technologies and methods used in vehicle manufacturing, specifically involving the entire chain of processes such as parts production and processing, assembly processes, and vehicle commissioning. Scientific and advanced process technology is crucial to improving the quality of automotive parts and even the performance of the entire vehicle, while also effectively improving production efficiency. At present, technological progress is profoundly changing and

partially subverting traditional automotive technology. With the vigorous development of smart factories, emerging new processes are continuously optimizing and improving traditional automotive production and manufacturing models, leading manufacturing technology to a higher level.

New equipment. New equipment occupies a fundamental position in the automotive industry and is the key to achieving innovative structures and processes. At present, automobile manufacturing equipment is constantly improving its intelligence, informationization and refinement, and its integrated mechanical, electrical control and information management functions are increasingly enhanced, and its complexity is also increasing, becoming an important factor in promoting the advancement of automotive technology. These advanced equipment can not only greatly improve production accuracy and quality, but also promote efficient use of resources and reduce costs. Looking to the future, the continuous improvement of new equipment will lay a solid foundation for the high-quality development of the automotive industry.

New energy. Driven by the energy and environmental revolution, the proportion of clean and renewable energy in the energy system continues to rise. Thanks to breakthroughs in automotive safety, large-capacity, long-life battery technology, and efficient and clean fuel cell technology, new energy vehicles are experiencing rapid growth. The traditional fossil-based automotive energy supply method is undergoing profound changes. The world is actively exploring the use of renewable energy such as light energy, water energy, wind energy, nuclear energy and biomass energy to power vehicles, and related technologies and their industrialization levels are constantly rising. In the future, efficient, clean, low-carbon and green energy supply will become the core development direction, and the advancement of new energy vehicle technology and industrial development will be the main trend.

New function. The basic function of automobile is to meet the needs of human transportation, and the demand for improving the quality of transportation

constantly promotes the progress and expansion of automobile functions. At one time, the expansion of basic functions such as anti-lock braking system (ABS), electric power steering system (EPS) and airbag made cars safer, more convenient and more reliable. The expansion of auxiliary functions represented by car audio-visual, entertainment and services has improved people's feelings of traveling. At present, all kinds of new functions of automobiles are springing up like mushrooms after rain, and the development of intelligence and sharing also enriches the functions of automobiles, which is expected to alleviate the problems of traffic congestion and frequent accidents to a great extent. In the future, the car is expected to become a mobile carrier integrating transportation, official business and life services, and serve people better and more. [4]

New mode. As an important catalyst for the industrialization of automobiles, new business models continue to emerge in the market economy environment. These include a new R&D model that uses powerful information processing systems to achieve personalized automobile manufacturing, an intelligent manufacturing model that shortens the R&D cycle with smart factories as the core, an automobile industry cloud platform that achieves information resource sharing throughout the life cycle through industrial collaboration, and a new travel model that emphasizes car sharing to enhance travel flexibility and convenience. These models will largely lead and determine the development direction of the automobile industry in the future.

Conclusion to Chapter 1

This study firstly analyzes the necessity of the transformation of the automobile industry, and then elaborates what is the transformation of the automobile industry from the three aspects of hardware, software and travel service, and lists six new features of the transformation of the automobile industry, i.e., the intelligentization of auto-connectivity, the customization of

production and use, the integration of cross-border fusion, the energy-saving and low-carbon environmental protection, the comfort, convenience and high efficiency, and the ecologicalization of sharing and travelling. At the same time, the transformation of the automobile industry is analyzed in depth in seven aspects, i.e., new materials, new structure, new technology, new energy, new equipment, new functions, and new modes, which together constitute the challenges and opportunities of the transformation of the automobile industry.

CHAPTER2: EUROPEAN AUTOMOBILE INDUSTRY TRANSFORMATION PROCESS

2.1. Driving factors for the transformation of the European automotive industry

2.1.1 Technological innovation is one of the important factors to promote the transformation of European automobile industry

With the increasingly serious air pollution and oil shortage, it has become a problem for people to replace traditional gasoline vehicles and diesel vehicles with hybrid vehicles and electric vehicles. Governments all over the world are promoting the research of hybrid and pure electric vehicles. The US Department of Energy predicts that by 2030, new energy vehicles will account for 28% of the total light vehicle and truck market, which will increase by 20% compared with 2005. Nowadays, the automobile industry is experiencing a revolution, and the automobile is developing rapidly in the direction of intelligence, comfort, energy saving and environmental protection [16].

With the continuous development of electrification, intelligence and networking technologies, the automotive industry is facing profound changes. For example, in terms of electrification, the continuous advancement of battery technology and the reduction of costs have led to the continuous improvement of the range of new energy vehicles, the improvement of charging facilities, and the gradual increase in consumer acceptance of new energy vehicles. Major automobile manufacturers have increased their investment in the research and development of new energy vehicles and launched a series of competitive new energy vehicle products. In terms of intelligence, with the rapid development of technologies such as 5G and artificial intelligence, automobiles are gradually becoming an important node of the mobile Internet. The application of technologies such as intelligent driving and vehicle-road-cloud integration has

not only improved the driving experience, but also laid the foundation for future autonomous driving.

2.1.2 Environmental pressure is one of the important factors driving the transformation of the European automobile industry

The EU plans to stop selling fuel vehicles by 2035, and automobile companies must also achieve emission reduction targets throughout the supply chain. In order to achieve this goal, European automobile companies have to increase their investment in the research and development of new energy vehicles, improve the efficiency of steel use, use clean energy to make steel, etc., to reduce carbon emissions[7]. For example, Daimler signed an agreement with Swedish Steel Group, which will produce low-carbon emission steel for Daimler; Volvo has begun to purchase "HYBRIT" low-carbon emission steel products; BMW has invested in low-carbon emission steelmaking startups in the United States.

In addition, traditional European automakers are also facing competitive pressure from countries such as China and the United States in the process of electrification transformation. The rapid development of Chinese automakers in the field of new energy vehicles has not only dominated the domestic market, but also gradually emerged in the global market. For example, in 2023, the top ten global power battery installed capacity will be occupied by companies from China, Japan and South Korea, and Chinese companies will occupy six seats, namely CATL, BYD, Sinotruk, Guoxuan High-tech, EVE Energy, and Xinwanda. American automaker Tesla also occupies an important position in the global electric vehicle market. In order to cope with competitive pressure, traditional European automakers have to accelerate the pace of electrification transformation and improve product competitiveness.

2.2 New Energy Vehicle Policy Orientation of European Government.

The EU and European governments' policies to guide and promote new energy vehicles are mainly reflected in three aspects:

1) Implement strict vehicle exhaust emission regulations, especially for CO2 emissions;

2) Set a goal to ban the sale of fuel vehicles (i.e. zero-emission vehicles);

3) Provide high subsidies and preferential measures for new energy vehicles during a specific period.

2.2.1 The European Union has formulated strict regulations on automobile CO2 emissions

At the end of 2013, in preparation for the Paris Climate Conference, the European Commission and the European Parliament reached an agreement to establish strict CO2 emission targets for passenger cars and light commercial vehicles: starting from 2020, the average emission of passenger cars shall not exceed 95g/km, requiring 95% to meet the standard by 2020 and full compliance by 2021; light commercial vehicles shall not exceed 147g/km, making Europe the region with the strictest requirements for automobile CO2 emissions in the world[19].

To strengthen enforcement, the EU has implemented severe fines since 2021: if automakers exceed the standard, they will be fined 95€ for every 1g/km exceeding the standard, and up to 950€ for every 10g/km exceeding the standard[19], forcing automakers to accelerate the transition to low-carbon or zero-carbon emission vehicles.

On December 17, 2018, the three major EU institutions reached a further agreement to set stricter CO2 emission targets for 2025 and 2030: passenger cars must reduce their emissions by 15% from the 2021 standard to 81g/km (NEDC conditions) in 2025, and by another 37.5% to 59g/km in 2030; light commercial

vehicles must reduce their emissions by 15% and 31% respectively during the same period [19]. This series of measures demonstrates the EU's determination to promote emission reductions in the automotive industry.

On February 14, 2023, the European Parliament voted in Strasbourg to pass the "2035 European Zero Emission Agreement for Newly Sold Fuel Cars and Vans". The agreement was reached by the European Commission and the European Council, marking that from 2035, Europe will completely ban the production of new fuel vehicles. By then, any new car with an internal combustion engine, including traditional fuel vehicles, hybrid electric vehicles (HEV), plug-in hybrid electric vehicles (PHEV), etc., will not be allowed to be sold. Only pure electric vehicles and hydrogen fuel cell vehicles can meet the sales requirements [8].

This move is aimed at achieving the EU's environmental protection goals: by 2030, fuel cars and small trucks will reduce emissions by 55% and 50% respectively compared with 2021; by 2035, fuel cars and small trucks will achieve a 100% reduction in emissions. Industry analysts believe that this decision means that the European market will completely bid farewell to the new era of fuel car and small truck sales.

The EU has set a lower limit for the share of new energy vehicles in the European market through strict automobile CO2 emission standards and severe fines, and has also forced all European car companies to transform and embark on the road of new energy vehicle development.

2.2.2 Europe leads the world in setting zero-emission vehicle targets

All countries in the world are actively promoting clean and sustainable development in the field of transportation and energy. Many countries have successively introduced policies to restrict fuel vehicles and set the development goal of zero-emission vehicles. European countries are always in the forefront of the world in terms of restrictions and zero emission targets. For example, Britain, France and Spain, the five major automobile markets in Europe, have decided to

ban the sale of fuel vehicles from 2040, and Norway has advanced the ban on fuel vehicles to 2025.

Some cities and local governments have also introduced more stringent restrictions on the prohibition of fuel vehicles.For example, European cities such as Paris, London,Milan, Barcelona and Stockholm will ban fuel vehicles in 2030. The introduction of these laws and regulations in Europe, such as restrictions on travel and sales, will force the entire automobile industry to accelerate the transformation to electrification, and electrification of automobiles will become a legal necessity.

2.2.3 Europe's New Energy Vehicle Incentives Drive Market

In Europe, due to the relatively advanced environmental awareness, governments of various countries realized the importance of new energy vehicles at an early stage and formulated fiscal incentives and subsidy policies to promote their development. Especially in the early stages of the development of the electric vehicle market, the government's fiscal and tax incentive policies played a vital role.

Take Norway as an example. Since 2001, the government has implemented a series of incentives. Buying a plug-in car can enjoy a 25% VAT exemption, and at the same time, it is exempt from registration fees, annual fees, etc., making the price of plug-in cars and ordinary gasoline cars reach the same level. In addition, plug-in cars in Norway are also exempted from highway tolls and public parking fees. In places such as the capital Oslo, the high tolls make this policy particularly attractive, saving car owners thousands to tens of thousands of kroner each year. Municipal parking lots also provide free parking for plug-in cars, and some parking lots even provide free charging services, further reducing the cost of use for car owners. At the same time, the government also encourages the construction of fast charging piles and provides financial subsidies to companies that build charging piles or charging stations. Plug-in cars are also allowed to use

bus lanes. These strong incentives have jointly pushed Norway to become the country with the highest penetration rate of new energy vehicles in the world, with a sales share of plug-in cars reaching 58% in 2019.

In 2020, the COVID-19 pandemic had a severe impact on the European automotive industry. In order to alleviate the crisis and promote the development of electric vehicles, European governments have introduced new electric vehicle subsidy programs with very generous conditions. The 27 EU countries plus the UK (except Lithuania) all provide preferential policies for the purchase of electric vehicles. Stimulated by these policies, the production and sales of new energy vehicles in Europe achieved rapid growth in 2020, with sales increasing by 137% year-on-year [8].

2.3 Transformation of European Automobile Industry to Low Carbon and Environmental Protection

2.3.1 The proportion of European automobile production in the world shows a downward trend

In 2021, 21.1% of all passenger cars produced in the world were made in Europe. In 2010, the proportion of passenger cars produced in Europe was as high as 28.1%, and the production decreased by about 7 percentage points in ten years (as shown in Figure 1). After the production of passenger cars in Europe exceeded 19 million in 2017, it began to decline year by year. In 2021, the production of passenger cars decreased by 22% due to the epidemic, with only over 13.3 million. The market share of European automobile industry is declining [18].

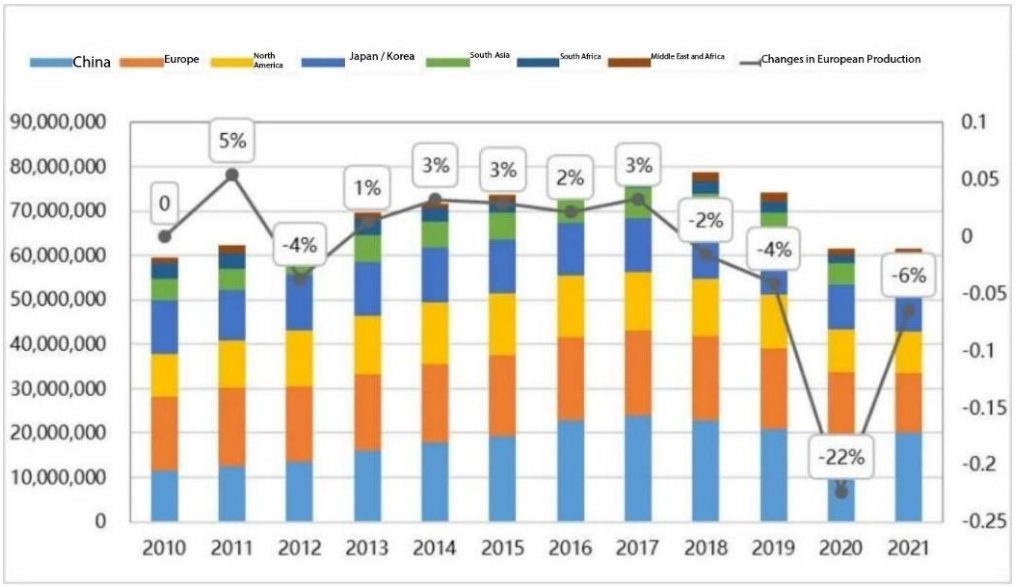

Fig. 1 changes of passenger car production in global automobile production in Europe from 2010 to 2021

2.3.2 CO2 emissions and energy consumption in the process of automobile production in the EU are on a downward trend

In 2020, the carbon dioxide emission of passenger cars in the EU is 6.66 million tons, which is about 49% lower than that of 12.95 million tons in 2005. From 2005 to 2020, the total carbon dioxide emissions and the year-on-year decline (%) of bicycles in the production process of passenger cars in the EU are shown in Figure 2 below [18].

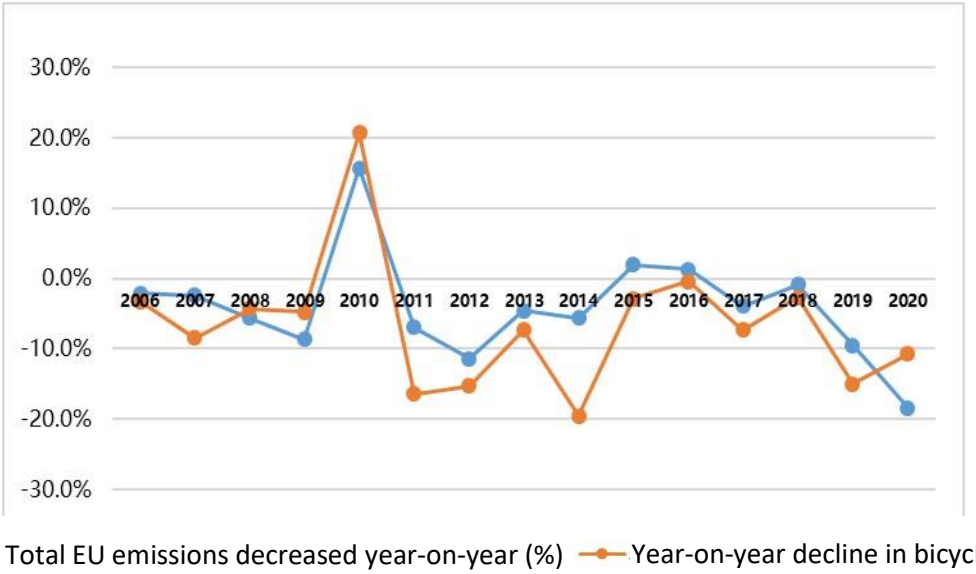

Figure 2: Year-on-year change of CO2 emission in passenger car production in EU from 2005 to 2020 (%)

Since 2005, European passenger car manufacturers have reduced the total energy consumption in the production process by 28%. The total energy consumption of passenger car production in the European Union has dropped from 42.21MWh in 2005 to only 30.34MWh in 2020, and the energy consumption of single car production has also dropped from 2.72MWh in 2005 to 2.54MWh. See Figure 3 below for the energy consumption during the production of passenger cars in the EU from 2005 to 2020 [18].

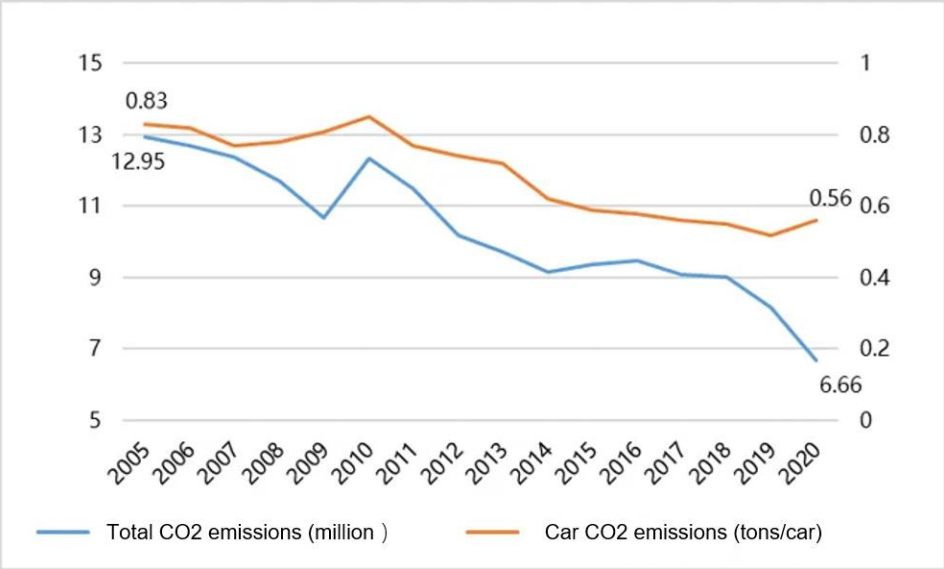

Figure 3: CO2 emissions from passenger car production in the EU, 2005-2020

In 2020, the average CO2 emission of new passenger cars in EU is 108.2gCO2/km, and that of new passenger cars in EU+UK+Iceland+Norway is 107.8gCO2/km. The three countries with the largest decline are Norway 38.2%, Iceland 29.8% and Sweden 22% respectively. The Netherlands has the lowest average CO2 emission (82.3gCO2/km), followed by Sweden (93.4gCO2/km) and Denmark (95.3gCO2/km).

Through the above data analysis, the transformation of European automobile industry has two characteristics: first, the market share is facing the impact of emerging markets, and the market structure dominated by Europe in the past is about to change; Second, the automobile industry needs to be upgraded and transformed into low-carbon and green, and new energy vehicles will become an important part of the European automobile industry in the future.

Generally speaking, both the change of EU's relevant policy orientation and the influence of the global market on the European automobile industry will drive the automobile industry to transform to low-carbon environmental protection and reduce energy consumption. Therefore, facing new challenges under the new situation has become an era issue that Ukrainian automobile industry needs to consider.

2.3.3 European countries vigorously develop electric vehicles and their ancillary facilities

According to relevant statistics, in 2020, the sales of new electric vehicles and plug-in hybrid vehicles in Europe increased by 45% to 1.25 million units, with a market share of nearly 10%. The European Commission has launched a new smart transportation proposal to accelerate the EU's green and digital transformation goals in the transportation sector. According to the proposal, the EU plans to achieve a zero-emission vehicle ownership of at least 30 million by 2030, build 3 million public charging stations, and introduce a carbon trading mechanism in the transportation sector. The EU also plans to launch new motor vehicle carbon dioxide emission standards in June this year [13].

EU countries have also increased policy support for the development of new energy vehicles by levying carbon emission taxes and providing car purchase subsidies. The French government previously announced a plan to revitalize the automotive industry with a total of 8 billion euros, providing electric car consumers with financial subsidies of up to 12,000 euros and promising to completely stop the sale of traditional energy vehicles by 2040. Germany will extend the purchase subsidy for electric vehicles to 2025, and set up a special fund to encourage the green transformation of the automotive industry. Italian government recently stated that it will provide a total of 120 million euros in special funds for new energy vehicle subsidies, and provide users who purchase new energy vehicles with a maximum reward of 8,000 euros [13].

Major European automakers plan to build super battery factories in Germany, France, Poland, Hungary and other places starting in 2021. According to LMC AUTOMOTIVE's forecast, by 2032, there will be about 25 battery production plants built in Europe, with an average annual production capacity of 24 gigawatt-hours. Analysis points out that in the future, by further realizing the vertical integration of the entire electric vehicle supply chain, the average cost of electric vehicles in the EU can be reduced by more than 10%, effectively improving their market competitiveness [13].

In October 2022, after the European Union reached an agreement on the 2035 "ban on fuels", the German government took action and approved a plan to spend 6.3 billion euros (about 6.74 billion US dollars) to expand the number of charging stations across the country, and accelerated the approval of charging station construction.

At present, supporters of the European 2035 "ban on fuels" proposal believe that it provides a clear timetable for European automakers, stimulating European automakers represented by Volkswagen, Mercedes-Benz, BMW, Stellantis, Renault, etc. to shift production to zero-emission pure electric vehicles by 2035, thereby driving investment and enhancing the competitiveness of European automakers.

2.3.4 Transformation Trends of the European Automotive Industry

In terms of energy and power, it is gradually moving towards electrification. As the EU sets strict carbon emission targets (such as achieving net zero emissions by 2050), member states have introduced incentives to encourage the production and consumption of electric vehicles (EVs). This includes providing purchase subsidies, building charging infrastructure, and tax reductions [19]. The electrification strategy has been updated, and pure electric vehicles will be fully penetrated by 2030. Automakers have responded positively and announced that they will gradually phase out fuel vehicles in the next few years and invest in the

research and development and production of electric vehicles. For example, Volkswagen Group's "Transform 2025+" strategy clearly puts forward the goal of electrification transformation.

In terms of vehicle technology, the European automotive industry is moving towards highly automated driving (AD) and the Internet of Vehicles (IoV). By integrating advanced sensors, algorithms, and big data processing technologies, vehicles can achieve functions such as autonomous navigation, emergency braking, and traffic congestion assistance. At the same time, information sharing between vehicles and interconnection with the outside world, such as through V2X (Vehicle-to-Everything) communication, improves road safety and travel efficiency [20].

The supply chain structure of automobile companies is being restructured towards localization. In view of the vulnerability of the global supply chain, especially under the influence of the COVID-19 epidemic and geopolitical tensions, European automobile manufacturers have begun to reassess and optimize the supply chain structure, tending to shorten the supply chain distance and enhance local production capabilities. This includes not only the local production of key components (such as batteries), but also the sustainable procurement of raw materials. For example, many European governments have cooperated with enterprises to invest in the construction of battery manufacturing plants to reduce dependence on the Asian market.

The production system of the automobile industry is moving towards flexibility and efficiency. In order to cope with the rapid changes in market demand and improve production efficiency, the European automobile industry is adopting a more flexible production system, such as modular platforms and intelligent manufacturing technologies (such as the application of the concept of Industry 4.0). This transformation not only improves production efficiency, but also enhances the ability to respond to personalized customization needs.

Conclusion To Chapter 2

This chapter mainly explains the driving factors of the transformation of the European automobile industry, the new energy vehicle policies of the European government, and the trend characteristics of the transformation of the European automobile industry. Through analysis, it is believed that European countries are currently vigorously developing electric vehicles and their ancillary facilities. Europe's share of global automobile production, as well as CO2 emissions and energy consumption in the automobile production process are all on a downward trend, and it is at the forefront in terms of traffic restrictions and zero-emission goals.

CHAPTER3: OPPORTUNITIES BROUGHT TO UKRAINE BY THE TRANSFORMATION OF EUROPEAN AUTOMOBILE INDUSTRY

3.1. Current situation of the Ukrainian automotive industry.

Ukraine is an important industrial base of the former Soviet Union. Under the planned economy system, it has formed an industrial system that focuses on the development of heavy industry and defense industry, with a complete industrial chain and strong production capacity. Ukraine's automobile industry was also established during the Soviet period and was an important part of the Soviet automobile industry until the disintegration of the Soviet Union. The first Ukrainian automobile brand was born in the late 1950s. After independence, Ukraine was the only Soviet republic other than Russia that produced various types of automobiles and auto parts, with an annual output of more than 200,000 vehicles. However, at present, the automobile industry has become a "bottleneck" in the country's industrial sector. According to relevant statistics, in the past five years, various indicators of the industry have shown a regrettable trend, especially in the production of automobiles, trailers and semi-trailers [21]. These data show that the development of Ukraine's automobile industry faces severe challenges and it is urgent to take effective measures to improve it.

3.1.1 Ukraine's automobile industry is at the low end of the global value chain

Due to Ukraine's automobile industry policy and other restrictions, multinational companies mainly use joint ventures in Ukraine to make Ukraine an important part of their global strategy and incorporate joint ventures into the global division of labor system. In the division of labor in the global industrial chain, the Ukrainian automobile industry is mainly in the assembly link and parts manufacturing link, while the brand operation, vehicle and parts design and development, key and core parts manufacturing and other links are mainly

controlled by multinational companies such as Mercedes-Benz, General Motors, and Toyota, which greatly reduces the added value of the Ukrainian automobile industry.

3.1.2 The market share of independent brands is declining

From the perspective of brand competitiveness, independent brands have a big gap with international brands and joint venture brands in terms of popularity and reputation, as well as satisfaction, products, brand support, and model sales. The cost advantage that independent brands now have based on low prices and thin profits is actually a disadvantage that is not conducive to brand promotion. The models produced in Ukraine are mainly trucks, buses, trolleybuses, etc. In terms of passenger cars, CKD assembly or imported cars are currently the mainstream, and the brands come from Europe, South Korea and Ukraine. In recent years, Ukraine's economy has been in decline. The Ukrainian Association of Automobile Manufacturers (hereinafter referred to as Ukrautoprom) stated in April 2018 that the production capacity of the Ukrainian automobile industry was only 2% of the total, and automobile production had decreased by nearly 98% compared with March 2008. The latest data from Ukrautoprom shows that Ukrainian domestic brands produced 8,153 vehicles in 2021, a year-on-year increase of 64.7%. Among them, the production of sedans was 7,342, a year-on-year increase of 74.7%. In addition, in January 2022, the sales volume of first-hand new cars of international brands in Ukraine was 5,323, a year-on-year decrease of 7.2% [22].

3.1.3 Lack of core and key technologies

Although Ukraine has always focused on independent research and development of automobiles, the foreign parent company firmly controls important links such as brand operation, research and development, design, key technologies and key parts production. The Ukrainian joint venture only controls the production links such as assembly and non-key parts, resulting in a long and

difficult road to independent research and development. The lack of core technology restricts the development of Ukraine's automobile industry from low-end to high-end. Multinational companies have a market share of 90% in key parts such as automotive electronic fuel injection systems, engine management systems, and gearboxes. Due to the lack of design, research and development and manufacturing capabilities for core parts, although Ukrainian independent brand automobile companies have gained a certain market share, they can only obtain a small part of the profit [22].

3.1.4 Insufficient independent research and development and innovation capabilities of local enterprises.

Ukrainian local automobile companies have long relied on joint venture models and technology input from multinational companies, lacking the practice of independent innovation, resulting in a lack of development experience, insufficient accumulation of database resources, and an imperfect information research and development platform. In particular, in the research and development and mastery of key core technologies such as electronic control and engines, there is a big gap with multinational companies. In terms of the choice of independent research and development model, vehicle integration, body and chassis are mainly introduced, acquired and independently developed, but in terms of key technologies, they are still mainly developed by hiring mature foreign automobile design companies. The intellectual property rights of independent brands are mostly controlled by foreign parties, and they are not strictly local independent brands. When foreign parties master mature product technologies, the cost and risk of developing new products for developing markets are high, and the motivation for innovation is not strong. Enterprises focus on product introduction and neglect product technology digestion and absorption, and have not formed a virtuous cycle of "introduction-absorption-trial production-independent innovation". Enterprises seriously lack the motivation

for independent innovation and development of independent brands. The independent brands launched by joint ventures are mainly products developed for the domestic low-end market and second- and third-tier cities in Ukraine. Product development is still mainly based on vehicle model improvement, lacking innovation in key technologies.

3.1.5 Lack of high-quality technical talents

Among the employees in the Ukrainian automotive industry, technical talents account for about 8%, while in developed countries in Europe and the United States, the proportion is as high as more than 30%. In Ukraine, R&D institutions with more than 500 people are considered large, while Audi's R&D institutions have reached 8,000 people. Ukraine is not only short of talent in terms of quantity, but also lacks top talent to take on the responsibility of automobile design, and also lacks a strong R&D team to tackle core R&D technologies. The quantity and quality of R&D talent cannot meet the needs of independent R&D and innovation[22].

3.2 Opportunities for Ukraine in the Transformation of the European Automotive Industry

As the birthplace of traditional fuel vehicles, the determination of the European "ban on fuel" timetable indicates that this huge and mature automobile industry chain has accelerated the process of transformation. The arrival of the new energy era has become a reality that the global automobile industry must accept, and traditional automobile giants have to make adjustments in all aspects to adapt to the new era. The automobile industry is an important pillar industry of the global economy. In the great transformation of this large industry, whether it is technology upgrading or pattern reshaping, it affects the adjustment of the global industrial cluster, which undoubtedly brings opportunities for the development of the Ukrainian automobile industry.

3.2.1 The development of low-carbon new energy vehicles is the general trend

At present, climate change is a major global challenge facing mankind, and carbon peak and carbon neutrality are the inevitable way to cope with climate change. As an important country on the Eurasian Continental Bridge, Ukraine will play an indispensable role in the development of the automobile industry. At the same time, under the dual influence of new energy subsidies and European carbon emission policies, the sales of new energy vehicles in Europe have grown rapidly, and the popularity of electric vehicles in Europe and around the world has become increasingly higher. In 2021, the sales of new energy vehicles in Europe will reach 2.3 million, accounting for 19% of new car sales, and the penetration rate is the highest in the world. In July of the same year, the EU passed the Carbon Reduction 55 Act, proposing a 55% reduction in carbon emission standards from 2030. Zero emissions of automobiles will be achieved from 2035 [23], that is, the comprehensive transformation of automobile electrification, which will provide strong support for the EU's green energy and low-carbon economy roadmap, and also provide unprecedented opportunities for the development of Ukraine's new energy automobile industry.

New energy vehicles have become a key direction for the green development and low-carbon transformation of the global automobile industry. After the successful transformation of the European automobile industry to the field of new energy vehicles, Ukraine is facing a major choice. If Ukraine cannot adapt to the development trend of the times, it will be ruthlessly eliminated by the times. It can be seen that new energy vehicles are a strategic choice for Ukraine's automobile industry to achieve high-quality development. Ukraine's automobile industry must seize the opportunities of the times, follow the trend of the times, actively respond to the strong call for low-carbon new energy, and vigorously invest resources to develop local new energy industries, so as to gain a firm

foothold in the great trend of global automobile industry transformation and achieve sustainable development. .

The rapid development of electric vehicles in Europe will trigger digital transformation, providing opportunities for Ukraine to develop high-tech products such as automotive chips. Electric vehicles will also have a unified operating system. In addition to managing the core hardware of the car, this system will also define the interactive experience on the car and lay the foundation for the development of third-party applications to improve efficiency. Electric vehicles need to be equipped with various new sensors to adapt to the needs of future software upgrades [25]. This provides opportunities for Ukraine to vigorously develop high-tech industries such as 5G communications, cloud computing, IOT, AR/VR, AI and AI chips. At the same time, the European automotive industry has been impacted by emerging automotive industries represented by China, Japan and South Korea, and its share in the global market has been decreasing year by year. The Ukrainian automotive industry can only keep up with the pace of development by striving to innovate and achieve overtaking.

3.2.2 Independent brand research and development is the only way

For a long time, the brand image of Ukraine's own brand passenger cars has been labeled as "low quality and low price", and it is difficult to improve the brand image, so consumers' recognition of their own brands is not very strong, especially the second car change basically does not consider their own brand models. In addition, the domestic consumer demand in Ukraine has also changed greatly. With the improvement of people's living standards, the requirements for the quality, safety and comfort of automobiles have been significantly improved. This forces Ukraine to accelerate the pace of upgrading its own brand cars, strive to increase the added value of automobile products, take the road of independent

research and development, and strive to get a share in the transformation of European automobile industry.

The transformation and development of European automobile giants will trigger a chain reaction. In the end, powerful car companies will independently develop power batteries, and at the same time, after expanding production capacity, they need a large number of supporting products such as tires and polymer materials. This provides opportunities for Ukraine to vigorously develop supporting industries such as batteries, tires and mineral products.

3.2.3 High-quality human resources will be promising

In the automobile industry, many jobs will be cut, but at the same time, more jobs will be created. In addition to a large number of software engineers, a large number of product managers will be vacant, requiring a large number of product operators, business BD personnel, and even content service personnel, and the business model will undergo earth-shaking changes [22]. This provides opportunities for high-quality labor in Ukraine.

3.3 Ukraine's Countermeasures to Cope with the Transformation of the European Automotive Industry

The automobile industry has always been a pillar industry of the national economy. Its contribution to economic development is second only to real estate. The number of jobs driven by the industrial chain is also close, but the technological content is far greater than that of real estate. It is very suitable as an engine for new infrastructure. Its upstream can drive industries such as steel, non-ferrous metals, petrochemicals, and plastics. Midstream production can drive the development of machinery, electronics, new materials, and information technology. The downstream links are inseparable from logistics, finance, insurance, sales, advertising and other service industries. Therefore, Ukraine's development of its own automobile industry with the help of the general trend of Europe's automobile transformation has positive significance for the national economy.

3.3.1 Increase cooperation with European companies and innovate and develop to improve the technological level of Ukraine's automobile industry

Electrification, intelligence, networking and sharing are gradually becoming the mainstream trends in automobile development. In order to adapt to this trend, major automakers are increasing their investment in the field of electrification. For example, Volkswagen has clearly planned to build six battery factories in Europe by 2030, with a total investment of more than 20 billion euros, aiming to meet the production demand of 3 million electric vehicles per year. So far, Volkswagen has built three battery factories in Salzgitter, Germany, Valencia, Spain, and St. Thomas, Canada, with planned production capacities of 40GWh, 40GWh, and 90GWh, respectively [23]. Against this backdrop, Ukraine, as a key country in the supply of automotive wiring harnesses to Europe, is particularly important. According to a Wells Fargo report, Ukraine will have 17 wiring harness factories in 2022, second only to Romania and Morocco among

low-cost countries. Ukraine's exports of automotive wiring harnesses account for about 7% of Europe's total imports, and have a 10-15% influence on Europe's automobile production[26]. Therefore, Ukraine can make full use of its advantages in automotive wiring harness production, actively adapt to the transformation needs of the European automotive industry by expanding production capacity and improving technology, and thus promote the export of its own automobiles and related parts, expand its share of international trade, and occupy a more important position in the European automotive supply chain.

In short, if the Ukrainian automotive industry wants to take advantage of the transformation of the European automobile industry to achieve a leap forward, it must always maintain strategic focus, follow the general trend, and insist on strengthening the system and doing a good job in innovation. On the one hand, we should deeply learn the successful experience of traditional European automobile giants, including their automobile industry system, process management, business methods and user thinking, and strive to make Ukrainian local automobile enterprises bigger and stronger and enhance their international competitiveness. On the other hand, the Ukrainian automobile industry should actively provide strong support for the transformation of the European automobile industry, such as supplying key supporting equipment such as new energy batteries, and cultivating skilled industrial workers to meet the European market's demand for high-quality supporting services and talents. Through these two efforts, the Ukrainian automobile industry will be able to occupy a place in the tide of the transformation of the European automobile industry and achieve its own leapfrog development.

3.3.2 Based on the actual situation of the country, Ukraine's automobile industry should take the road of independent development

In today's world, scientific and technological revolution and industrial transformation are advancing at an unprecedented speed. Electrification, intelligence and networking are profoundly reshaping the long-standing

automobile industry, bringing unprecedented development opportunities to the Ukrainian automobile industry. In the face of the wave of transformation of the European automobile industry, if the Ukrainian automobile industry wants to achieve leapfrog development, it must closely combine with the actual situation of the country, dare to explore and innovate, and open up three new paths for the innovative development of the automobile industry.

At present, the automobile industry is undergoing profound changes: the traditional fuel vehicle product system is being replaced by a low-carbon, intelligent new energy vehicle matrix; the traditional sales model is gradually changing to a new retail model centered on customer experience; the traditional relationship between OEMs and upstream and downstream is also evolving towards a flatter and more efficient ecological interaction model [23]. In the face of this ever-changing situation, if the Ukrainian automobile industry wants to get a share of the transformation of the European automobile industry, it must be based on reality, dare to break the convention, insist on scientific and technological innovation, and promote the three major changes in quality, efficiency and power. Only by taking advantage of the situation and innovating and seeking change can we achieve the transformation from resource-driven external growth to innovation-driven internal development, explore a high-quality development path with "focusing on the main business, open cooperation, reform and innovation, reducing quantity and increasing efficiency" as the core, and promote the key transformation of the automobile industry from "small to large, from large to strong".

Scientific and technological innovation capabilities have become the core cornerstone for achieving high-quality development and maintaining the security of the industrial chain. In order to achieve overtaking on the curve, the Ukrainian automobile industry must be committed to scientific and technological self-reliance, guided by high-quality development, focusing on the two strategic directions of green and low-carbon and digital intelligence, and injecting vitality

into the beautiful automobile life pursued by consumers through continuous scientific and technological innovation.

The key to the competition in the smart electric vehicle industry lies in the innovation and application of core technologies, which cannot be separated from the strong support of financial capital. Therefore, the Ukrainian government needs to give more support to independent smart electric vehicle brands and technology-based innovative enterprises at the financial capital level, encourage large-scale investment in financial capital, and promote the high-quality development of these enterprises. To this end, we must not only play the guiding role of policies, continuously optimize the direct financing environment and listing conditions, and promote more technology-based innovative enterprises to go public for financing; we must also play the driving role of the market, encourage large-scale investment of social capital, and use the bank's investment and loan linkage mechanism to jointly promote the growth of technology-based innovative enterprises.

In the field of new energy vehicles, Ukraine needs to increase its R&D efforts to promote the healthy and rapid development of the industry. Specific measures include: First, continuous innovation and consolidation of the industrial foundation. Enterprises should play a leading role, accelerate breakthroughs in key core technologies, and at the same time strengthen the innovation of product and service models to provide high-quality supply; second, coordinated promotion and construction of a complete automobile industry development system. With automobile manufacturers as the core, we will link dealers, jointly safeguard consumer rights, strengthen regional cooperation, advocate fair competition, regulate market order, and ensure common development; third, open cooperation to achieve win-win results. The government should increase its openness, introduce more preferential policies, attract and introduce foreign new energy vehicle companies to settle in, and help improve Ukraine's automobile industry. In the face of the current situation, if Ukraine's automobile industry

wants to achieve long-term development, it must introduce foreign capital, learn from each other, exchange experiences, achieve common progress, and jointly respond to future challenges.

3.3.3 Based on reality, vigorously develop automobile industry supporting enterprises such as batteries, tires and mining

Ukraine occupies an important position in the global supply chain, especially in the supply of key raw materials. With rich reserves of scarce metals such as lithium and nickel, Ukraine has the opportunity to embed itself in the emerging green supply chain and become a key partner of European automakers. Ukraine is not only the supplier of more than 70% of neon in the world, an indispensable raw material in the production of semiconductor chips, but also, together with Russia, influences the global supply of nickel and palladium, which are essential for the production of electric vehicle (EV) batteries and catalytic converters [27]. With the rapid development of the electric vehicle industry, the demand for battery metals has increased dramatically, and the threat of supply shortages has prompted automakers to actively invest in mining projects. Sam Riggall, CEO of CleanTeQ Holdings Ltd, said that given the automotive industry's astonishing forecasts for future raw material demand, automakers' direct investment in mining operations may be the best solution. In the face of this opportunity, Ukraine should increase investment in mineral product enterprises, develop from ore mining to mineral product processing, lengthen the industrial chain and enhance the value of the industry. The government should take comprehensive supporting measures to promote the deep processing of mineral products and optimize the economic structure of the mining industry. This includes making deep processing a precondition for the approval of mining rights, scientifically formulating plans, setting necessary entry barriers, and implementing incentive and support policies to improve the level and level of development of the mining industry.

In the procurement of battery raw materials and parts, Ukraine should give full play to its own advantages and actively integrate into the European automotive industry supply chain. By increasing cooperation with well-known car companies, attracting world-renowned car companies to settle in, and striving to settle more automotive supporting products in Ukraine. At the same time, Ukraine should rely on its superior geographical conditions to vigorously develop industries such as wind and photovoltaic power, new energy equipment, and new energy batteries, accelerate the integration and development of new energy and equipment manufacturing, and lay the foundation for the development of new energy automobile industry and the transformation of the European automobile industry.

In addition, Ukraine should also actively promote the construction of new energy bases, new energy industry integration development demonstration zones, local consumption zones, and new energy peak-shaving centers, build first-class battery material supply and battery production bases, and cultivate and expand new energy equipment manufacturing industries. By attracting investment, more well-known car companies will be attracted to take root in Ukraine, which will bring new market opportunities to the entire automotive supply chain, including the tire market. If tire companies can successfully obtain supporting orders, it will help to increase brand awareness and influence, thereby driving revenue growth in the tire replacement market and upstream and downstream industries.

Looking ahead, electric vehicles will require a large amount of battery metals and specialty materials. It is predicted that by 2030, nickel demand will surge more than 15 times, while demand for graphite, lithium, copper and aluminum will also grow significantly. BNEF pointed out in the report that lithium producers will need about $25 billion to $30 billion in financing in the next decade to meet demand. Therefore, Ukraine should continue to strengthen investment and cooperation in the field of key raw materials to seize the development opportunities brought by the electric vehicle industry.

3.3.4 Increase education and training efforts, and strive to cultivate high-quality talents adapted to the development of the electric vehicle industry

Ukraine should actively comply with the zeitgeist of the transformation of the European automobile industry, make full use of the advantages of high-quality domestic human resources, and increase the cultivation of high-tech talents. Specifically, efforts should be made to cultivate engineers and skilled workers who can adapt to the changes in the automobile industry, and at the same time emphasize the cultivation of talents in key positions such as product operation, business development (BD) and content service, so as to comprehensively respond to the challenges brought about by the transformation of the European automobile industry and seize the opportunities for development therefrom.

Conclusion To Chapter 3

This chapter firstly describes the current situation of the development of the Ukrainian automobile industry, then analyzes the opportunities brought by the transformation of the European automobile industry for the Ukrainian automobile industry, and on this basis, puts forward a series of countermeasure suggestions on how Ukraine can actively and effectively cope with these challenges.

Summary of the Research

Based on the purpose of the study, this paper systematically collects and analyzes relevant data, summarizes in depth the policy background of the transformation of the European automotive industry, the current situation and its development process, and aims to find countermeasure strategies for the Ukrainian automotive industry to help the Ukrainian automotive industry actively respond to the challenges of the transformation. These recommendations include:

increasing cooperation with European enterprises, adhering to the road of independent research and development to enhance the level of innovation and development, vigorously developing key supporting industries such as batteries, tires and mining, and strengthening education and training to meet the needs of industrial upgrading. Through these measures, the Ukrainian automotive industry will be able to better grasp the opportunities brought by the transformation of the European automotive industry and realize its own sustainable development.

CONCLUSIONS:

As an important pillar of national economic development, the automotive industry is a key indicator of a country's industrialization level. However, the global economy has entered a downturn stage due to the double impact of the new coronavirus epidemic and the conflict between Ukraine and Russia. Against this background, the international environment, especially the transformation of the European automotive industry, is both a serious challenge and a valuable opportunity for Ukrainian automotive enterprises. In the face of the upcoming new pattern of competition in the automotive industry, the wave of digitalized economy is driving the rapid development of new energy and intelligent Internet-connected vehicles, which will bring many opportunities for Ukraine in terms of employment, industrial upgrading and innovative development of the automotive industry. In order to take the lead in this change, Ukraine needs to base itself on its own reality, actively respond to the challenges of the digital economy, combine the introduction of foreign advanced technology with independent research and development, and work hard to build an automotive brand with its own characteristics, so that it can take the initiative and win the future in the increasingly intelligent and automated automotive industry.

REFERENCES

1. CHERVIAKOVA, Valentyna, and Tetiana CHERVIAKOVA. "Value Opportunities for Automakers under the Conditions of Digital Transformation in the Automotive Industry." Journal of Applied Economic Sciences 13.8 (2018).

2. Starostina, AO, TV Nagachevska, and MM Soroka. "Development of Mechanisms for International Strategic Economic Partnerships in the Ukrainian Automotive Industry" (2020).

3. Deryabina, G., and Trubnikova, N. (2021). The Impact of Digital Transformation in the Automotive Industry on Changing Business Models of the Industry. Fourth International Conference on Science and Practice. Retrieved from https://dl.acm.org.

4. Qiao Yingjun, Yan Jianlin, Zhong Zhihua, Zhao Junwei, et al. (2019). Research on the Transformation and Upgrading of China's Automotive Industry. China Engineering Science 21(03), 41-46.

5. Rusnák, Jaroslav, Nina Bučeková, and Ingrid Bučeková. "Exports, Economic Complexity, and Growth in Peripheral Regions Integrated into the European Automotive Industry." Post-Communist Economies (2024): 1-25.

6. Starostina, AO, Nagachevska, TV, & Soroka, MM (2020). Development of Mechanisms for International Strategic Economic Partnerships in the Ukrainian Automotive Industry.

7. Hanzl-Weiss, Doris. "The Automotive Industry in the EU-Central and Eastern European Countries: Challenges and Opportunities" (2022).

8. Wang Shanjin, & Cheng Yuan. (2021). Status Quo and Development Trends of Renewable Energy Vehicles in Europe. Journal of Automotive Safety and Energy 12(02), 135-149.

9. Strötzel, M., & Brunkhorst, C. Managing the Transformation of the German Automotive Industry [J]. Towards Just Transition: Coal, Cars, and the Labour World, 2019: 243-273.

10. Staron, M. (2021). Automotive software architectures. Cham: Springer.

11. Zhang Guofang, Xu Wenshuo, & Xu Wenshuo. (2020). Research on Strategies for Mass Customization of Automobiles Oriented to Customer Demand. China Economic & Trade Herald (Theoretical Edition). (06) 113-116.

12. Muratori, M., Alexander, M., Arent, D., Bazilian, M., Cazzola, P., Dede, E. M., .& Ward, J. (2021). The rise of electric vehicles—2020 status and future expectations. Progress in Energy, 3(2), 022002.

13. Zheng Bin, People's Daily Correspondent in Belgium. (2021.01.15). European Auto Industry Recovery Better Than Expected (International Perspective). People's Daily.

14. Zhao Fuquan, Liu Zongwei, Hao Han, & Shi Tianze. (2018). Characteristics, Trends, and Opportunities in the Transformation of the Automotive Industry. Journal of Automotive Safety and Energy, (03), 233-249.

15. Yin Zongyi. (2022). The Impact of Carbon Trading Systems on the New Energy Vehicle Industry under the 3060 Background. Automotive Parts (01), 101-106.

16. Poorani, S., & Krishnan, L. R. K. (2024). Technology Trends Revolutionizing the World of Work-Auto Industry Perspective. Revista de Gestão Social e Ambiental, 18(1), e05532-e05532.

17. "ANSYS White Paper" (Electronic Resource) https://www.ansys.com/zh-cn/resource-center

18. Jin Yuefu. Overview of the Automotive Industry in Europe and EU Countries from 2010 to 2020. Clean Transportation Partnership (Electronic Resource) https://mp.weixin.qq.com/s/wgifcrEaWQ6KsU0UR9vgXA

19. In-depth Report on the European New Energy Vehicle Market: EU Carbon Emission Upgrades Accelerate the Transformation of Automakers

(Report Publisher: Huachuang Securities)I. The Enactment of the "Fit for 55" Policy Accelerates the Comprehensive Electrification Transformation in Europe...

20. Manfu Technology. A Detailed Explanation of Autonomous Driving V2X Connected Vehicle Technology. November 18, 2020. https://blog.csdn.net/manfukeji/article/details/109779889

21. Savelyev, Yevhen, et al. "Transformation of the Ukrainian Automotive Industry in the Context of Electric Vehicles: Lessons from the Visegrad Countries." SHS Web of Conferences. Volume 100. EDP Sciences, 2021.

22. Bacho, R., Róbert, B., Nina, P. N., & Nina, P. N. (2023). Automotive industry in the regions of Ukraine: key approaches to assessing labor market and business perspectives. Monograph.

23. Pavlínek, P. (2023). Transition of the automotive industry towards electric vehicle production in the east European integrated periphery. Empirica, 50(1), 35-73.

24. Schade, W., Haug, I., & Berthold, D. (2022). The future of the automotive sector: emerging battery value chains in Europe. ETUI Research Paper-Report.

25. Abedsoltan, H. (2024). Applications of plastics in the automotive industry: Current trends and future perspectives. Polymer Engineering & Science, 64(3), 929-950.

26. Іванов, Є. (2022). EVALUATION OF EXPORT DIVERSIFICATION IN UKRAINE. Економіка та суспільство, (41).

27. Kumar, A., & Kumar, R. Conflict And Commerce in A Post-Pandemic World: Unraveling the Impacts of The Russia-Ukraine War on Global Supply Chains.

28. Nina, P. N., Bacho, R., Nina, P. N., & Róbert, B. (2022). Analysis of the automotive industry development trends in Ukraine.

29. Cherviakova, V., & Cherviakova, T. (2018). Value Opportunities for Automotive Manufacturers in Conditions of Digital Transformation of the Automotive Industry. Journal of Applied Economic Sciences, 13(8).

30. Deryabina, G., & Trubnikova, N. (2021). The impact of digital transformation in automotive industry on changing industry business model. In IV International Scientific and Practical Conference. Retrieved from https://dl.acm.org

31. Rusnák, Jaroslav, Nina Bučeková, and Ingrid Bučeková. "Export, economic complexity and growth in the integrated periphery of the European automotive industry." Post-Communist Economies (2024): 1-25.

32. Organized by China National Intellectual Property Administration Academic Committee. (2019.07). Industrial Patent Analysis Report, Volume 68, Key Technologies of Artificial Intelligence, Intellectual Property Press.

33. Starostina, A. O., Nagachevska, T. V., & Soroka, M. M. (2020). development of the mechanism of international strategic economic partnership for ukrainian automotive industry".

34. Winkelhake, U. (2019). Challenges in the digital transformation of the automotive industry. ATZ worldwide, 121(7), 36-43..

35. Jia Peng, & Zheng Xixi. (2014). Analysis on the development status and promotion countermeasures of automobile enterprises in China. Science and technology and economy in Inner Mongolia (23)3-4+7.

36. Belgian correspondent of People's Daily, Zheng Bin. (January 15, 2021). European auto industry recovered better than expected (international perspective). People's Daily.

37. Zhao Fuquan; Liu Zongwei; Hao Wei; Shi Tianze (2018). Characteristics, Trends and Opportunities of Automobile Industry Reform, Journal of Automobile Safety and Energy Conservation, (03),233-249.

38. ANSYS White Paper (Electronic Resources) https://www.ansys.com/zh-cn/resource-center.

39. Jinyov, 2010-2020 General Survey of Automobile Industry in Europe and EU countries, Clean Transport Partnership (Electronic Resources) https://mp.weixin.qq.com/s/wgifcrEaWQ6KsU0UR9vgXA

40. Prytula, K., & Pasternak, O. (2019). Features of the Formation and Functioning of Value Added Chains in the EU-Ukraine Cross-Border Area. Eurolimes, 27, 141-326.

41. https://www.autohome.com.cn/news/202205/1246968.html

42. https://new.qq.com/rain/a/20210728A0A3UM00

43. https://new.qq.com/rain/a/20220627A03SYW00

44. https://www.autohome.com.cn/news/202205/1246968.html

45. https://www.thepaper.cn/newsDetail_forward_15329408

46.https://www.ceicdata.com/zh-hans/indicator/ukraine/motor-vehicle-production