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Research on the Technology Development of Intelligent Connected Vehicles Based on the Background of Economic Globalization

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Abstract: In the context of economic globalization, this paper examines the technical competition situation in the field of intelligent networked vehicles (ICV) among global countries represented by the United States, the European Union, and Japan, with the goal of providing a reference for domestic ICV technology and industrial development. This paper provides opinions and suggestions on improving China's competitiveness in the global intelligent networked vehicle market based on systematically combing the concept, connotation, and industrial chain of ICV from the perspectives of technology R&D trend, competition area, subject, and market value.

1. Introduction

An increase in the need for transportation is a result of the processes of globalization and urbanization, which calls for finding solutions to the problems of the stability and security of the transportation system. Sustainable cities, encompassing planning, transportation, and green building, are one of the priority areas whose demand for development is brought on by urbanization's negative effects, the economy's real sector expansion, as well as, frequently, unjustified detrimental human impacts on the environment (UNEP, 2020).

Many businesses joined this rapidly expanding trend as autonomous driving technology advanced. For instance, in 2013 the Mercedes Benz S-Class S500 INTELLIGENT DRIVE replicated the first automotive cross-country excursion [33]. Conditional automation was achieved in 2014 by the Tesla Autopilot for the Model S. Numerous other automakers and academic institutions, like Ford, Chana, Baidu, University of Michigan, and Audi are all working on building their own intelligent vehicles. The advantages of the intelligent car are unquestionably at their height today.

2. Definition and Reltive Research

2.1. Definition

A new generation of vehicles known as "intelligent connected vehicles" (ICVs) integrates cutting-edge communication and network technology with advanced sensors, controllers, actuators, and other devices to enable intelligent information sharing and exchange between vehicles and X. (vehicles, roads, people, clouds, etc.). It can actualize safe, effective, comfortable, energy-saving driving and, in the end, replace people as the primary operator thanks to its capabilities of complex environment sensing, intelligent decision-making, collaborative control, etc. Intelligent networked vehicles can offer convenient, energy-efficient, safe, and ecologically friendly means of transportation, which is a widely acknowledged development direction and priority.

Both the United States and China have identified the intelligent vehicle (IV) as one of their respective countries' growing strategic sectors. The IV is a crucial means by which to increase traffic safety and advance the industrial sector. While China has developed top-level planning such China Manufacturing 2025, "Internet" + Artificial Intelligence and IVs Innovation Development Strategy, the US has released A National Strategic Plan for Advanced Manufacturing, Automated Vehicles Policies, among other things (Draff). Both countries have made aggressive preparations to aid in the development of IVs. China is the country that developed the idea of the intelligent networked car, where "intelligence" mostly refers to the vehicle's control system. The technology roadmap for "Made in China 2025" refers to "autonomous driving" and "unmanned driving" as a single concept known as "intelligent networked cars." It is clear from the definition of "Innovative Development Strategy of Intelligent Networked Cars" (draft) that the ideas of assisted driving vehicles, self-driving vehicles, and driverless vehicles are all included in intelligent networked vehicles. The aforementioned idea is the intelligent networked car that is discussed in this paper.

2.2. Relative Research

2.2.1. Domestic

Since the State Council published the "Industrial Policy of the Automobile Industry" in March 1994, numerous studies on the sector have been launched domestically, primarily from the following three angles.

First, it examines the policies, plans, and current issues relating to the growth of the automobile industry in China from the viewpoint of government management mode. According to Zhang Zhanbin, the government protects the Chinese automobile sector by regulation, which prevents factor competition and renders China's vehicle development uncompetitive for an extended period of time. The market system cannot be replaced by government regulation. China has a sizable domestic market and a strong overall capacity to develop the automotive sector. It is advised that we utilize all of our advantages and adopt a huge country open competition approach as a result. Yu Jing investigated the causes of China's automobile industry policy's failure and came to the conclusion that local state integration and rent-seeking were to blame for the divergence of policy goals and the development of the vehicle industry. While social control is definitely insufficient, according to Chen Qingtai, the government has been granted far too many economic control functions. Industry management could be improved through social control measures including technology, environmental protection, and safety.

Second, it examines the components that will help the Chinese automobile industry become more competitive from the standpoint of global enterprise organization form. The whole-to-zero supporting system with a high degree of vertical integration between vehicle enterprises and parts enterprises, according to Luo Yuanqing, has led to domestic auto parts manufacturers having a small scale and a limited capacity for innovation, which has reduced China's auto industry's ability to compete internationally. For the whole vehicle and components automotive industry, a system of labor division and cooperation is recommended, as well as the formation of a strong strategic partnership among businesses. According to Lu Feng, businesses should increase their ability for independent innovation and the power of their own independent intellectual property rights to help the automobile sector flourish. According to Liu Ligang's analysis of the global automobile industry's trend toward modularization and systematization, major automakers should establish a horizontal joint design development model based on shared technology, and they should also strengthen the role of suppliers in the creation and design of automobiles.

Thirdly, research the issues facing China's manufacturing sectors, particularly the automotive and other manufacturing industries. It is clear that domestic auto manufacturing is developing unevenly. Wei Kangbo noted that although Chinese automakers produce and sell the most globally, the sector is still at the level of local competitiveness, and there is currently no well-known national Chinese automobile brand on the global stage. Future strategies are advised to concentrate on the high-end vehicle sector and the high-end connections of the industry in light of the development reality that China's automobile manufacturing began at a low level.

The opportunities and difficulties of intelligent networked automobiles are mostly studied by domestic experts. First off, academics have a generally positive outlook on the importance and future benefits of the development of smart cars. According to Xu Changming, the government has prioritized the development of smart cars, and other factors that are helpful for this development include the rapid growth of internet plus, the creation of relevant Industry-University-Research political institutions both at home and abroad, the involvement of businesses with an Internet-based history, and the revivification of consumers. The fight for driverless cars has, according to Wang Jin, founder of Jing Technology, turned into a national conflict. The sharing economy, new energy, and driverless cars as the three main developments,In this round of competition, China has the good fortune to have a favorable opportunity. Second, experts list issues that are impeding the advancement of smart cars. China's smart automobiles have had challenges in the process of ground-breaking technical innovation, and more so are the drawbacks of technology-driven and market-driven, Shao Yunfei noted. For instance, important technologies like the advanced assisted driving (ADAS) system and the fundamental algorithms of electronic products are open to human interference, and it is unclear how well different scientific research organizations, Internet companies, and automobile manufacturers are cooperating in the market. Wang Jing and others noted that local businesses lack the technologies and patents necessary to compete with foreign rivals, as well as a lack of understanding of the layout of smart car technology patents. They need to increase their own degree of innovation because their competitiveness is low. According to Wu Yunqiang, some laws and provisions relating to things like the right to drive on public roads and the initial inspection and assessment of autonomous vehicles are still being developed. China has had certain special issues with the administration of smart car safety, according to Wang Hui, who proposed updating the relevant rules and regulations as well as developing implementation strategies. Based on the value chain theory, Zhao Fuquan examined the impact of intelligent networking on each link in the automotive industry's value chain. As the industry transitions from traditional automobiles to intelligent networked automobiles, Zhao Fuquan found that, he created upgrade routes and direction recommendations for various forms of independent businesses. The industry is in agreement that domestic policy backing provides the smart car business confidence. According to Liu Junfeng of the Daxunfei Company, as automotive intelligent technology matures, traffic laws and regulations will be further enhanced, and the standard of road design and construction will increase proportionally. Automobile intelligence will undoubtedly arrive soon.

2.2.2. Overseas

The following categories of research are relevant to foreign countries: Theoretical study concentrating on American autonomous driving and other relevant policies makes up the first group. U.S. Secretary of Transportation Zhao Xiaolan underlined that the goal of this policy is to support technical advancement, promote the growth of the self-driving car sector, and uphold the United States' advanced competitiveness while maintaining public safety. The Autopilot Policy Guide, according to Regina Hopper, president of the American Intelligent Transportation Association, points the way in the right direction for the advancement of autonomous driving technology, establishes roles for both the government and the industry, and fosters trust in its application. and requested that businesses be given permission by the federal government to set up large-scale testing facilities and demonstration zones. The second type of research summarizes the United States' experience implementing policy to support the development of sophisticated autos. Including government-funded R&D, which is used to support fundamental research in universities and national laboratories and set up a strong scientific fund, Daniel Sperling, Dean of Davis School of Transportation, University of California, appreciates California's clean car development policy. The government also supports the display of advanced cars. Business leaders will invest in this technology when they share the stage with government officials. It is recommended that China adopt a more progressive strategy and fully support local government initiative.

In other words, the study of this subject is a completely new area of study for the entire world in the context of economic globalization. Domestic experts have recognized the strategic importance of the development of smart cars, identified China's development prospects and challenges, and provided policy interpretation, analysis, and solutions to the current issues. Relevant analysis and reasoning have been consistently emerging, especially after 2017, with some degree of zeal. Although the American government lacks a clear strategy or established industrial policy for the automobile sector, this does not imply that it "does nothing." The primary means of fostering its development in the United States are laws and regulations, market intelligence, and car initiatives. In the United States, technical theory for intelligent vehicles got its start early. The Autopilot Policy Guide and the Autopilot Act, which are the results of policy study, can be seen as the wisdom of the American government crystallized in a way that can serve as a model for the development of intelligent vehicles in China. In general, the theories of automobile industry policy and technological innovation serve as a solid research framework for the research on smart car policy both domestically and internationally. But it also highlights some flaws. There is a lack of comparative studies of policies in various countries (regions) and stages of the intelligent vehicle industry's growth, as well as a lack of thorough analysis and demonstration of the policy research that is relevant to intelligent vehicles. In order to better pinpoint the global axes of China's smart car growth and seize the window of opportunity for timely policy change, we can further intensify our comparative analysis of American and Chinese policy.

3. Analysis on the Status and Prospect of Intelligent Networked Vehicles in Various Countries

3.1. Status

The two primary technology axes of the world's intelligent networked cars are intelligent networking. On-board sensors are the foundation of the intelligent technical approach, which enables the vehicle to sense, decide, and control motion independently. The ability of an automobile to sense its environment, make judgments, and manage movement based on communication connections is referred to as networked cooperation. Both intelligence and networking will be fully incorporated in the finished product of intelligent networked automobiles. Europe, America, Japan, and other nations have advanced significantly in terms of intelligence.

3.1.1. American

In order to actualize vehicle networking and to advance vehicle automation, the United States must implement five strategic themes. The first is to make cars and roads safer by enhancing vehicle safety systems and road infrastructure. The second is to investigate management techniques, enhance the effectiveness of the road system, and enhance traffic flow; The third is to optimize driving speeds, traffic flow, and congestion, address issues with vehicles and roads, and lessen environmental effect; Fourthly, to advance intelligent transportation system technology while conducting cutting-edge research, and to broadly support technology research, development, and application to satisfy future demand for road traffic; Build an intelligent transportation system architecture and standard system, and use advanced wireless communication technology in cars, different infrastructures, portable communication interactive devices, etc. to encourage information sharing and exchange; Automobile automation, vehicle networking, extensive data collection and application, emerging applications, interoperability, and accelerated market application are six key development projects.

Between 1984 and 1989, the DARPA-funded Autonomous Land Vehicle (ALV) project in the US successfully demonstrated the first road-following maneuver by using light detection and ranging (LiDAR), computer vision, and autonomous robotic control technologies. Despite being created in the early 1960s, LiDAR was used for the first time on this occasion in an autonomous vehicle. A planar digital image was created by the LiDAR of the time, which was a multispectral laser range scanner with five channels. The global positioning system (GPS), which started operating in 1984, was also employed by the ALV vehicle to help with navigation. In 1987, Carnegie Mellon University (CMU) became a leader in the application of neural networks for steering and other forms of autonomous vehicle control. This work was based on the ALV project. The primary control algorithm of modern control techniques was based on the perceptron's 1958 design goal, and this study served as its foundation.

3.1.2. European Union

The "European Digital Agenda" and the "White Paper on Integrated Transport in the EU" were proposed as part of the "EU 2020 Strategy." The goals are to cut greenhouse gas emissions by 60 percent from 1990 levels by 2050 and gradually lower the number of fatalities resulting from traffic accidents in order to reach "zero deaths" by that year. Focus: management of traffic safety, information technology, and intelligent vehicle safety. Information security, dependability, and large-scale application and verification are key technologies. First, the communication and safety applications among cars, autos, and roads should be strengthened, according to the European Union's Future Transport Research and Innovation Plan; Third, quicken R&D and implementation of transportation system informatization. The second is to encourage the development of road safety and emergency rescue system with the integration of people, cars, and roads, and promote the speed of industrialization. HORIZON2020 the Plan for 2020: The market application level in 2020 will be established based on the advancement of autonomous driving technology. Accelerate the development of the cooperative IIS system while also promoting the networking, standardization, and industrial application of networking research in the automotive industry, the standardization and security of communication networks, and the integration of European transportation.

3.1.3. Japan

In 2017, the marketization of the semi-automatic driving system was accomplished under Japan's national strategic innovation initiative, "R&D of Self-Driving Vehicles"; Less than 2,500 people will die in car accidents in 2018; recognize the early 2020s as the commercial introduction of highly autonomous driving systems; Fully automated driving will be commercialized in late 2020.

The semiconductor industry began by depending on government assistance to outperform the United States in some disciplines, but it gradually fell as a result of American suppression and poor business acumen. The establishment of the VLSI Research Association by the Japanese government and five corporations—NEC (Japan Electric), Hitachi, Mitsubishi, Fujitsu, and Toshiba—led to the growth of Japan's semiconductor sector. Japan has surpassed the United States in DRAM thanks to a number of technological advances and 600 patents that have been successfully applied for thanks to the joint investment of the government, businesses, and division of research and development. However, when the U.S. and Japan Semiconductor Trade Agreement was signed, by reducing production, lowering prices, increasing market openness, and using other strategies, Japan progressively lost its market. Since then, the U.S. government has persisted in suppressing, engaged in intellectual property litigation, and miscalculated the arrival of the PC era, which has cost Japan its G-port entry into the processor market. Japan totally left the DRAM market in 2012. Japan has assumed the top spot in the market for semiconductor materials and equipment thanks to the combination of "production and management" for national fundamental research. Even though Japan missed the market for DRAM memory, processors, etc., it has developed a top-tier industry for semiconductor materials and equipment by integrating "production management" and other national-level basic research.

3.2. Developmental Opportunities of Intelligent Connected Vehicles under the Background of Economic Globalization

3.2.1. The Pandemic Impact

In many nations, particularly in industrialized nations and areas, "unmanned" technologies—such as unmanned distribution and intelligent disinfection—have been implemented in the context of epidemic situations. In the fight against pandemic situations, the intelligent networking technology with automated driving and vehicle-road coordination as its core has shown some success. First of all, small-scale applications of autonomous driving technology include the distribution of medical supplies, the prevention of epidemics, and other anti-epidemic activities. Secondly, the vehicle-road collaborative information technology has been used in fields such as AI temperature measurement, ETC vehicle identification, and others. It has been crucial in the information management of people, traffic, and logistics, including the tracking of epidemics, personnel backtracking, and material distribution. In dealing with societal issues like an epidemic, intelligent network technology will play a more prominent role in the future. First, the ability of society to respond to societal catastrophes like pandemic situations can be considerably improved by self-driving cabs, self-driving trucks, and other industries; when it comes to dealing with public catastrophes like an epidemic crisis, road-to-road coordination technology has a lot of potential applications. It has the ability to monitor vehicle tracks, regulate traffic flow for both people and cars, and concentrate on isolating and sanitizing long-term vehicles in epidemic areas.

3.2.2. The Growing Market

Currently, the intelligent networked automobile has formally entered a new stage of rapid technological development and accelerated industrial layout, which has become a crucial strategic direction for the transformation and upgrading of the automotive industry and a crucial starting point for businesses to improve the competitiveness of their products.

Data from iMedia Research shows that the connected automotive entertainment market has been growing since 2016 and will reach USD 13 billion by 2020.

The development of the automotive sector will increasingly rely on intelligent networking technology in the modern day. The advancement of the system functions under intelligent networking technology and the promotion of the development of self-driving automobiles will be made possible by computer, communication, network, and other technologies, propelling the industry's rapid growth. Even so, there are still certain development drawbacks with the intelligent networked car despite its advancements. Future intelligent networked vehicles in China should gradually advance in the direction of intelligence and modernisation in order to meet the actual needs of economic and social growth.Intelligent infrastructure, roadways, and network environments are provided for smart automobiles by automotive networking and intelligent transportation systems. The simultaneous development of intelligent transportation systems and car networking is necessary as the intelligence of automobiles increases. According to the National Research Center for Industrial Information Security Development report "Fission of Automobile Industry under AI Intelligence: Report on the Convergence and Development of Chinese Automobile Enterprises and New Generation Information Technology," new intelligent networked vehicles are predicted to be adopted at a penetration rate of 51.6 percent by 2020, with 13 million smart cars expected to be sold in China. The number of intelligent networked cars on the market will increase to 17 million by 2025.

3.2.3. ICV and the Smart City

The "Tenth Five-Year Plan" and even in the future, collaborative development of smart cities and intelligent networked autos is a key task of urban construction. Cities with intelligent infrastructure are needed to support the operation of intelligent networked cars, which have an impact on the development of public space. To upgrade the traditional industrial system (i.e., the urban construction industry, the automobile industry, and the information technology industry) with independent cities, cars, and networks to a modern industrial system (i.e., new infrastructure, new energy vehicles, internet-big data-artificial intelligence), Tsinghua University's Interdisciplinary Future City Research presents a vision of the future of urban street space (i.e., intelligent municipal infrastructure, intelligent networked cars and urban information model).

A potential future route for urban construction is really provided by the collaborative development of smart cities and intelligent networked automobiles as well as the creation of a smart travel platform car city network. Cities are the origin of human progress historically speaking, and people depend on cities to have healthier, safer, and richer lives. Humans have begun to co-evolve with cities since they first appeared 5,000 years ago, and "planet urbanization" has since emerged. Environmental deterioration, resource shortages, spatial disarray, traffic congestion, health issues, and other issues are, nevertheless, starting to take center stage in urban expansion. Resources, the environment, space, facilities, and other factors have all put restrictions on the development paradigm that solely relies on increment to meet demand. Urban information space is evolving as a result of recent technological advancements, overlapping and fusing with the physical and social spaces already in place and creating new possibilities for the resolution of challenging issues. The

Notice of the General Office of the State Council on Printing and Distributing the Development Plan of the New Energy Automobile Industry (2021-2035) on October 20, 2020 made it abundantly clear that the urban infrastructure system needed to be improved, and that the management platform and pertinent standards for the intelligent construction and transformation of urban road infrastructure needed to be promoted in order to support the coordinated development of smart cities and smart cars. The collaborative development of smart cities and intelligent networked vehicles can encourage the formation of new connections between traditional industrial systems, which are independent of cities, vehicles, and networks, and modern industrial systems, which include new infrastructure, new energy vehicles, Internet-big data-artificial intelligence, and smart city systems.

3.3. Developmental Chanllenges of Intelligent Connected Vehicles under the Background of Economic Globalization

3.3.1. Inadequate Automatic Driving Application Scenarios and Unpaved Road

Small-scale applications are currently exclusively used in enclosed areas such as ports. For example, in Wuhan and other epidemic places, there is no automatic technology road section building, so autonomous driving cannot play an effective role. The United States was the first country to encourage self-driving car testing on public roads. Since it passed the first state legislation allowing road testing in 2011, many countries around the world have been actively promoting self-driving road testing, spending vast sums of money to build test demonstration areas, guiding the formulation of industrial standards and norms, and promoting the development of self-driving technology by resolving technical road testing problems in order to seize the industry's dominant position. The United States, Europe, Japan, and other nations or regions have enacted supporting laws and regulations for self-driving road testing in the last year, and there is no shortage of ice-breaking methods to boost road testing. The European Commission issued "The Road to Automated Travel: Future Travel Strategy of the European Union" in May 2018, announcing the timetable for the promotion of autonomous driving, clearly stating that Europe should be at the forefront of networking and autonomous driving, and calling on member states and automobile companies to adopt uniform rules on the safety of autonomous driving, the division of accident responsibilities, and so on, and to strive to work together.

According to the schedule, Europe will have automatic driving on expressways and low-speed automatic driving in select metropolitan areas by 2020. By 2022, all new cars will have "car networking" mode, and by 2030, it will have entered a completely automated driving society. At the same time, EU governments are supporting extensive road testing. France, for example, launched an auto-driving network car test service at Madrije Science and Technology City in the Rouen region in the fourth quarter of 2018, with users able to create a car via a smartphone application. The topic qualification, test site and time, license implementation circumstances, test driving requirements, traffic accident handling, and responsibility attribution of applying for autonomous road test are all specified in "Processing Standards." Furthermore, in order to stimulate and standardize self-driving technology public road testing, Japan's Cabinet Office declared that from September 2017 to March 2019, self-driving car testing will be undertaken on some motorways and special test roads in China.

In contrast, strengthening road infrastructure in China is the foundational effort required to ensure that road testing proceeds smoothly. At the moment, China's transportation infrastructure lacks connectivity and intelligence, and supporting facilities are lacking. There are several issues in specified test portions in various locations, including as confusing signage and markings, as well as irregular traffic lights, which cause vehicle-mounted cameras to fail to identify lane lines. At the moment, the coverage rate of networked roads in China is limited, and networked equipment has not yet covered all test sections, making networked road testing challenging for test subjects. Furthermore, China has yet to build a typical domestic automatic driving scene database, which cannot solve the problems of high cost and insufficient automatic driving road test scenes. Furthermore, data from collisions, loss of control, and departures from the autonomous driving state during the testing process are crucial in explaining the current technical maturity of the autonomous driving system and reducing the incidence of similar mishaps. However, there is currently no framework in place in China for analyzing and sharing such data.

3.3.2. Insufficient Road Test Policies and Standards

At the national level, China has not yet established an ideal system of road test policies and regulations, and there are numerous policy, regulatory, and mechanism impediments to the development of the autonomous driving industry, such as traffic safety management, traffic accident identification, data management, surveying and mapping restrictions, and so on. Although many cities have issued local road test management regulations, there are different requirements for tester qualifications, test vehicle requirements, test mileage in closed areas, and test scenarios, as well as a lack of coordination mechanism and different certification standards among the regulations. Various places, for example, demand different test mileage, such as 5,000 kilometers and 2,000 kilometers, or possibly no mileage at all. Some cities are expected to pass 20 test scenarios during the testing procedure, while others are not. There is a lack of uniform road test procedures in different regions, and these different regulations result in the failure of mutual certification of road test findings, which is not beneficial to the industry's healthy development.

3.3.3. Data Supervision Necessitates Cross-border Collaboration

With the global wave of personal data protection and data governance, multinational automakers must develop a multi-jurisdictional data compliance system. At the national level, the establishment of a cross-border white list of low-risk data, participation in the formulation of international data standards to gain the right to speak, the gradual establishment of multilateral trade rules dominated by China, and the formation of a global data flow circle in accordance with national security and industrial interests will assist Chinese automobile manufacturers in participating in cross-border industrial cooperation and balancing cross-border data secrecy. According to research, a self-driving test vehicle can create up to 10TB of data each day. According to Zhang Taolve, director of Tongji University Law School's Internet and Artificial Intelligence Legal Research Center, the data collected by intelligent networked cars is complex, with overlaps between personal information, enterprise technical data, and important data, and the boundaries are unclear.

CNCERT collaborated with the Zhilian Travel Research Institute (ICMA) to examine outbound data from 15 mainstream models from August to November 2021. The results show that there were more than 7.32 million times of communication between domestic and overseas automobile data during the analysis period, including 2.62 million times of outbound automobile data, a 145.3 percent increase compared to May to August of the same year, and the maximum number of outbound automobile data in a single day exceeded 170,000 times. Personal information and geographical location information such as ID number (driving license number), driver's license file number, mobile phone number/fixed line, latitude and longitude are included in certain car data leaving the nation.The cross-border data of intelligent networked automobiles will be one of the new year's regulatory objectives.

4. Conclusion

As the concept of a Community of Shared Future for Mankind becomes clearer, global information technology and intelligent development face new opportunities and problems in the production chain, enterprise cooperation, cross-border management, and other areas. To make a long-term contribution to the development of human intelligent technology in the context of economic globalization and the development of intelligent networked vehicles, countries must make explicit their unique advantages and cultivate the awareness of learning from each other's strong points.

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