Empowering New Productive Forces in the Intelligent Connected Vehicle Industry with Data Element

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Abstract. New productive forces as a product of the integration and development of technological innovation and industrial transformation, are the main characteristics of the digital economy era. Data as a new factor of production, has become a key engine for promoting new quality productivity. Intelligent connected vehicle data can be divided into three parts: user personal information, vehicle data, and external data. This article analyzes the empowerment of new productive forces in the automotive industry from multiple scenarios, they are automatic data collection to provide decision-making basis for intelligent driving; Data security interaction provides strong support for communication authentication; Intelligent data analysis to provide platform services for smart transportation; Internal data interoperability provides tool support for digital management; Data green advancement provides inexhaustible power for low-carbon transformation; Industry circulation and providing a bridge for cooperation in the industrial ecosystem. This article proposes three suggestions for the future development of intelligent connected vehicle data elements: improving the automotive data infrastructure system, constructing automotive data infrastructure, and establishing a mechanism for automotive data ownership.

Keywords: New Productive Forces, Data Element, Intelligent Connected Vehicle, Future Development

1 Introduction

New productive forces as a product of the integration and development of technological innovation and industrial transformation, are the main characteristics of the digital economy era. Recently, Xi Jinping published an article Developing new quality productive forces is an inherent requirement and important focus for promoting high-quality development, aiming to promote the rapid development of new productive forces from five aspects: promoting technological innovation, industrial innovation,

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development mode innovation, institutional mechanism innovation, and talent work mechanism innovation. The core element of new productive forces is technological innovation, and data element is an important engine of technological innovation, which has become the key to empowering new quality productivity.

2 Overview of the Development of Data Elements in China and Abroad

Mainstream countries are continuously strengthening the fundamental role of data elements and encouraging innovative applications [1]. The United States actively promotes the development and utilization of data elements, which have been widely applied in various fields such as finance, government affairs, agriculture, energy, and transportation. The EU strictly protects data security by issuing laws and regulations such as the General Data Protection Regulations, the Data Protection Enforcement Directive, the Implementation Regulations of Data Protection Rules, and the Data Act, promoting the circulation and use of data within the EU domain. Saudi Arabia has issued the Data Center Services Regulations, aimed at promoting the development of the data element industry and promoting the country's digital transformation. Japan vigorously advocates for trustworthy data circulation, signs the EU Japan Data Sharing Agreement with the EU, and promotes cross-border data circulation; At the same time, a data market element system has been established with "data banking" as the core, forming a public dataset covering 17 fields such as national economy, medical services, judicial security, education and training, and population environment.

China's comprehensive layout of data element development. In November 2019, the Fourth Plenary Session of the 19th Central Committee of the Communist Party of China first included data elements in production factors, establishing the fundamental and strategic role of data elements. In 2022, the Opinions of the Central Committee of the Communist Party of China and the State Council on Building a Data Infrastructure System to Better Play the Role of Data Elements were released, clarifying the basic structure of the data infrastructure system. With the official establishment of the National Data Administration in 2023, the construction of data infrastructure and basic systems has reached new heights, and the data industry ecosystem is increasingly growing.

3 Development of Data Elements in the Intelligent Connected Vehicle Industry

Intelligent connected vehicle industry as a leading and fundamental industry in China, is an important experimental field for promoting digital transformation. With the continuous upgrading of automotive intelligence and networking, data will provide core support for the development of the Internet of Vehicles. According to public data statistics, a single intelligent connected vehicle generates 150 parameters every few seconds, with a daily data volume exceeding 10TB. With the acceleration of the pene-

tration of new generation information technologies such as artificial intelligence, industrial Internet, blockchain, and privacy computing into the automotive industry, the supporting role of data elements has become increasingly prominent.

In 2021, various competent departments jointly issued the "Several Provisions on the Management of Automotive Data Security (Trial)" to continuously improve the management of automotive data security. The General Office of the Gansu Provincial Government has issued the "Implementation Plan for the Three Year Action of" Data Element X "in Gansu Province (2024-2026)". In terms of data element X transportation, it is proposed to promote the construction and operation of comprehensive testing and application demonstration bases for smart transportation and intelligent connected vehicles, and to build a database of open road testing scenarios for intelligent connected vehicles.

4 Application Analysis of Data Elements in the Intelligent Connected Vehicle Industry

4.1 Intelligent Connected Vehicle Data

Considering factors such as the business domain, generation scenario, and inherent attributes and characteristics of data, intelligent connected vehicle data can be divided into user personal information [2], vehicle data, and external data [3]. The classification tables 1 & 2 are as follows:

Table 1. personal information

First level	*Second level*	*Example*
Personal information	Basic information	Name, date of birth,age, gender, family relationship
	Identity information	ID card, passport
	Biometric information	Facial features, fingerprints, gait, voiceprints, genes, iris
	Property information	Asset, credit records
	Education and Work Information	Education, degree, workplace, work experience
	Communication information	Communication content such as SMS and email
	Device information	Hardware serial number, device MAC address
	Other personal information	Sexual orientation, marriage history, religious beliefs

Table 2. Vehicle data and external data

First level	*Second level*	*Third level*	*Example*
Vehicle data	Basic vehicle data	Vehicle identification data	License plate, vehicle identification number
		Vehicle attribute data	
		Core component identification	Vehicle mounted sensors, domain controllers, EDR, DSSAD software and hardware models
		Vehicle identification data	Passwords, certificates
	Perceived data	Sensor data	Lidar data, millimeter wave radar data, camera data
		Map data	Road information, lane information, real-time road conditions
		Fusion data	Natural condition data, road attribute data
	Decision data	Driver operation data	Gear information, changing accelerator pedal opening, operating instructions
		Remote operation data	Remote start or parking
		System decision data	Adjusting gear, lateral acceleration
	Operational data	Vehicle status data	Power on status, control mode, real-time vehicle speed, lateral or longitudinal acceleration
		System and component status data	Airbag status, Global Navigation Satellite System (GNSS) operation status, Inertial Sensor (IMU) operation status, Driving Automation System operation status, Camera Like the running status of the head
		Security log data	Security incidents
		Automotive charging interaction data	Charging station category, number
External data	V2X data		Traffic lights, signs, target objects, and other messages obtained through V2X

In addition, internal data such as research and development, production, operation, and management are closely related to the operation of intelligent connected vehicle enterprises, and such data is particularly important.

4.2 Analysis of New Productive Forces Scenarios in the Intelligent Connected Vehicle Industry Empowered by Data Elements

Automatic Data Collection to Provide Decision-Making Basis for Intelligent Driving.

Data collection is the foundation for realizing the perception and decision-making of intelligent connected vehicles[4]. By using data acquisition systems such as cameras, LiDAR, millimeter wave radar, and ultrasonic sensors, environmental information such as pedestrians, other vehicles, obstacles, and road conditions can be observed to understand the relative position and speed with other vehicles and pedestrians, providing a basis for autonomous decision-making of intelligent connected vehicles.

Data Security Interaction Provides Strong Support for Communication Authentication.

There are many subjects involved in the interaction of the Internet of Vehicles. In the scenario of IoV interaction, it mainly involves four types of communication interactions: Vehicle to Vehicle, Vehicle to Infrastructure, vehicle to Network, and Vehicle to Person[5]. The collected data is transmitted to other vehicles or platforms through onboard communication devices to achieve information sharing. Due to the characteristics of low latency, high reliability, and wide coverage, the main communication method for vehicle networking in China is cellular vehicle networking (C-V2X).

To ensure the authenticity and effectiveness of communication, electronic authentication services based on public keys provide security guarantees for data exchange in the Internet of Vehicles (Fig. 1), and have been widely recognized in the industry. By using the Chinese commercial cryptographic algorithm SM2 and using pseudonym certificates and application certificates to provide digital signature services for communication data, the security and integrity of data elements are ensured.

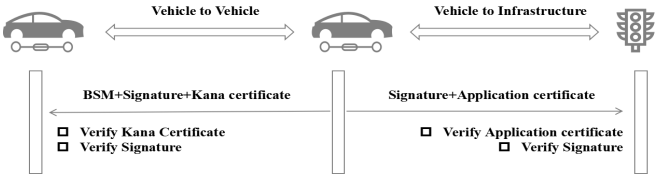

Fig. 1. Certificate of V2V and V2I

Intelligent Data Analysis to Provide Platform Services for Smart Transportation.

The aggregation of vehicle data to the monitoring platform can fully assist traffic management departments in real-time monitoring of traffic flow, further optimize traffic routes, reduce accident rates through intelligent analysis, and empower intelligent transportation and smart city construction. Storing vehicle data on cloud servers will generate aggregation value, thereby leveraging the multiplier effect of data elements. The development of technologies such as automated annotation and transportation big data modeling has significantly improved the efficiency of data processing.

The data collected from vehicles is processed through labeling, cleaning, filtering, and other processes to form an effective dataset. Through processing, analysis, and modeling, the inherent patterns of the data can be analyzed, generating new value.

Internal Data Interoperability Provides Tool Support for Digital Management.

Through the comprehensive interconnection of people, machines and things, and the comprehensive connection of all elements, the whole industry chain and the whole value chain, the industrial Internet accelerates the digital transformation of the automobile industry. As the core component of the industrial Internet, the identification resolution system of the industrial Internet realizes the interconnection of data elements across departments, enterprises and industries by giving physical objects or virtual resources a unique "identity code".

According to statistics, the cumulative number of logo registrations in the automotive industry is nearly 500 million, and the cumulative number of logo resolutions is nearly 2 billion. The identification data elements have been fully applied in the entire lifecycle stages of automobiles, including research and development, production, manufacturing, sales, recycling, dismantling, and scrapping (Fig. 2). In the production stage, basic resources such as incoming raw materials, materials, components, and equipment are assigned unique identification to achieve intelligent management of production factors. In the sales phase, the vehicles and equipment sold will be given the industrial Internet Identification, which can effectively promote the information flow between auto dealers and buyers. During the scrapping and dismantling stages of automobiles, identifying and registering the automobile dismantling guidance manuals of various enterprises can help dismantling operators to query dismantling technical information in real time on the production line and improve production efficiency[6].

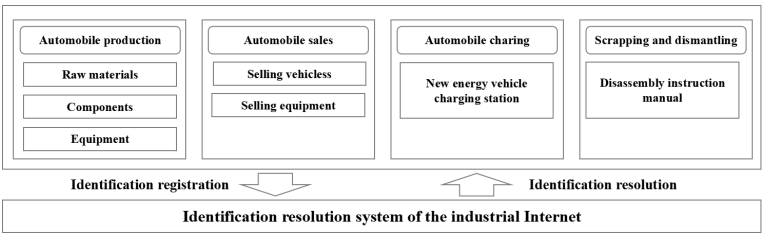

Fig. 2. Analysis and application of industrial Internet logo in automobile industry

Data Green Advancement Provides Inexhaustible Power for Low-Carbon Transformation.

Data is an important foundation for the vehicle industry to realize green transformation. By collecting and analyzing carbon data from the vehicle industry chain and life cycle, we can accurately grasp the carbon emissions of the vehicle industry and provide a scientific basis for formulating targeted carbon reduction strategies. In addition, the data can also promote to use digital technology in R&D, testing and other links to improve productivity and product quality, and reduce carbon emissions and

costs. At the same time, based on data elements, it can carry out statistical accounting of carbon emissions in different segments and at different levels, and develop multi-level carbon emission accounting methods and model libraries to provide strong support for the low-carbon transformation of the vehicle industry. Finally, the data can also support carbon emission monitoring and accounting, carbon footprint accounting, carbon footprint traceability, providing a scientific basis for carbon emission reduction decision-making.

The Circulation of Data Industry Provides a Cooperative Bridge for the Industrial Ecosystem.

Data circulation is a bridge to promote cooperation between upstream and downstream vehicle enterprises, as well as a key factor in improving industry service efficiency. Data circulation helps enterprises to share research and development data, testing data, etc., accelerate the product development process, and improve product quality. In addition, data flow can help upstream and downstream enterprises such as automobile manufacturers, component suppliers, and logistics service providers achieve supply chain collaboration. By sharing real-time data, enterprises can optimize inventory management, improve production efficiency, and reduce operating costs.

5 Conclusion

In order to promote development of Intelligent Connected Vehicle Industry with Data Element, This article proposes the following suggestions.

5.1 Improve the Basic System of Vehicle Data and Strengthen the Collaboration of Standard Systems

Currently, the institutional system for the circulation of data elements in China needs to be improved. Next, it is necessary to improve the basic institutional framework of vehicle data elements from the top-level design level, focusing on addressing key industry issues such as the scope of automotive data elements, classification and grading management, ownership confirmation, and transaction mechanisms.

Secondly, cross industry and standard system collaboration should be strengthened. Vehicle data elements involves multiple fields such as automotive, communication, and security. It is necessary to strengthen the overall coordination of relevant fields of automotive data elements, provide unified data formats and templates, jointly plan the development of automotive data elements, and promote interoperability of automotive data elements.

5.2 Building Automotive Data Infrastructure and Promoting Cross Subject Data Fusion

Building data infrastructure is the fundamental guarantee for the aggregation, circula-

tion, processing, and application of data elements. Data infrastructure covers multiple levels, including network infrastructure, computing power infrastructure, circulation infrastructure, and security infrastructure. The composition of data infrastructure and the Internet of Vehicles complement are consistent. New generation information technologies such as generative artificial intelligence, sustainable computing, blockchain, and privacy computing have put forward new requirements for the circulation and use of data elements. Establish a basic foundation for automotive data elements, relying on selecting typical cases, data application competitions, and other forms to effectively promote cross subject data fusion and data usage.

5.3 Establish a Mechanism for Automobile Data Rights Confirmation and Implement Data Trading Services

In August 2023, the Ministry of Finance issued the Provisional Regulations on Accounting Treatment of Enterprise Data Resources, and the entry of data assets into the balance sheet has been officially implemented. We need to deeply promote vehicle data elements in the table, and establish a trading system based on automotive data elements, relying on the exchange's rights confirmation registration, trading certification, and trading matching. Additionally, we need to clarify the ownership relationship of vehicle data elements, establish trading rules, establish trading platforms, and implement trading services to create a compliant, fair, efficient, and safe on exchange trading environment.

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