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Commercialization of Self-driving Logistics and Freight Exploration Speeds Up

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Abstract: This paper sorts out the current status of industrial development in the field of autonomous driving logistics and freight, it summarizes and refines the four existing business models, analyzes the technical challenges, and finally puts forward three conclusive suggestions for industrial implementation.

Keywords: Autonomous Driving, Logistics and Freight, Commercialization.

1. Introduction

In November 2023, the Ministry of Industry and Information Technology (MIIT), the Ministry of Public Security (MPS), the Ministry of Housing and Urban-Rural Development (MOHURD), and the Ministry of Transportation (MOT) jointly issued the Notice on the Pilot Work on the Access to and Passage on the Road of Intelligent Networked Vehicles (INVs), which, through the implementation of the pilot work, guides the intelligent networked vehicle producers and the main body of the use of the intelligent networked vehicle to strengthen the capacity building, effectively promotes the iterative optimization of the industrial ecology, and accelerates the process of the industrialization of the intelligent networked vehicle [1]. This will undoubtedly bring new kinetic energy for the development of intelligent vehicles, and inject a strong needle into the intelligent networked industry [2].

Trunk logistics refers to the transportation of large quantities of goods over long distances using the main roads between cities. The route of trunk logistics is fixed, and the driving area is mainly on the highway. It is a transportation line across provinces, districts (cities). The traditional trunk logistics industry is facing problems such as difficulties in recruiting and retaining drivers, long service years, and high labor costs [3]. At the same time, the competitive pressure in the industry is also increasing. However, autonomous driving technology can not only help logistics enterprises save labor costs but also use algorithms and vehicle control to enhance vehicle driving proficiency, bringing it closer to the level of experienced drivers and reducing fuel consumption [4]. Furthermore, trunk logistics has a large market space, which is also the reason why autonomous driving companies are attracted to participate in this scenario [5].

2. Industry Development Status

(1) The road freight market is fragmented and poses safety risks; Autonomous driving is expected to improve overall efficiency.

Trunk logistics is the backbone of the road transportation network, it is growing steadily with the total freight volume. The main problems are the scattered transportation capacity, low concentration and high driving risks for truck drivers. The safety issues need to be solved urgently. As an important battlefield for the commercialization of autonomous driving, the logistics industry is expected to achieve business restructuring and connectivity through intelligence and digitization, reduce costs, increase efficiency, and improve safety from the ground up.

(2) Policies are actively promoted to establish an efficient, safe, intelligent, and environmentally friendly logistics and transportation system.

Road freight is an important link in transportation and a booster of national economic development. The country attaches great importance to the application of autonomous driving technology in the field of road freight. In recent years, it has issued a number of supporting documents to create conditions for the commercialization of autonomous driving in the field of road freight. In September 2019, the State Council issued the “Competitiveness in transport sector”, proposing to strengthen the research and development of intelligent connected vehicles and establish an independent and controllable complete industrial chain. By 2035, the country will have developed into a transportation powerhouse, and the "Global 123 Express Cargo Logistics Circle" will have been established. In November 2022, the State Council issued the “New NEV development plan(2021-2035)”, proposing that by 2025, highly autonomous intelligent connected vehicles will be commercially available in limited areas and specific scenarios, and large-scale applications will be achieved by 2035. In July 2021, ten ministries including Ministry of Industry and Information Technology jointly released the "5G Application "Sail" Action Plan (2021-2023)", proposing to accelerate the exploration of business models and application scenarios, support the creation of national-level Internet of Vehicles pilot zones, etc. In August 2022, the Ministry of Transport publicly solicited opinions from the public on the "Autonomous Vehicle Transportation Safety Service Guidelines (Trial)" (Draft for Comment) on the Ministry of Transport website.

(3) The market is accelerating its layout and is continuing to penetrate and progress on a city-by-city basis.

Currently, there are over 1,000 autonomous driving freight vehicles in the country. The road tests and demonstration operations of autonomous driving freight vehicles in different locations are presented in Table 1.

Table 1. The road tests and demonstration operations of autonomous driving freight vehicles in different locations (partial listing)

Serial Number	Province/City	Test Area	Number of Freight Vehicles	Technology Companies	Is a Test License Required
1	Shanghai	A total of 40 kilometers of self-driving freight vehicle test roads are open from Shanghai Yangshan Port to Donghai Bridge	39	TuSimple UTOPILOT	Yes
2	Shenzhen	Shenzhen Qianhai Ma Wan Smart Port	38	Zhongke Spruce	Yes
3	Beijing	Opening of the Beijing section of the Beijing-Taipei Expressway, the Daxing Airport Northern Expressway and the Daxing Airport Expressway, 50 km in both directions	7	PonyTron, Trunk, DiDi, SKYTECH, DeepWay	Yes
4	Tianjin	Tianjin Dongjiang comprehensive free trade zone intelligent networked vehicle test roads open to the entire region (Closed Park)	110+	Trunk	Yes
5	Ningbo	Ningbo Zhoushan Port (closed park)	70+	Trunk, Fabu	Yes
6	Xinjiang	Xinjiang Tianchi Energy Southern Open Pit Coal Mine	203	EACON	
		Xinjiang Tianchi Energy General Gobi No. 2 Open Pit Coal Mine (Closed Park)	33	EACON	No
		State Energy Hami Dananhu No. 2 Mine (closed park)	4	China Energy	No
		Guoneng Xinjiang Jundong Open Pit Mine (Closed Park)	10+	I-Tage	No
7	Inner Mongolia	Guoneng Beidian Shengli Energy - No. 1 Open Pit Coal Mine (Closed Park)	35	I-Tage	No
		Huaneng Yimin Open Pit Mine (Closed Park)	8	WayTous	No
		Inner Mongolia Baiyinhua Haizhou Open Pit Coal Mine (Closed Park)	2	I-Tage	No
		Guoneng Baozhixil Open Pit Coal Mine (Closed Campus)	32	WayTous	No
		Heidaigou Open Pit Coal Mine Truck Driverless Project	18	WayTous	No
8	Shandong	Honghe Baili Teal Mine Unmanned Mine Card Demonstration Operation Project (Closed Park)	20	EACON	No
9	Jiangsu	TCC Jurong Plant Mining Area (Closed Park)	14	CiDi	No
10	Guangdong	China Resources Cement Dapai Sand and Gravel Aggregate Mine (closed park)	38	I-Tage	No
11	Hunan	Zhangjiajie Luojiayu Mine Unmanned Mine Cart Project (Closed Park)	6	CiDi	No
12	Guangxi	China Resources Cement Hezhou Industrial Park Green Intelligent Mine (Closed Park)	4	Mengshi Tech	No
13	Shanxi	Yuanjiacun Iron Mine (Closed Campus), Lanxian, Taiyuan, China	10	WayTous	No

3. Four Business Models for Technology Companies

At present, in the field of freight logistics, the business models of autonomous driving technology companies are mainly categorized into four types, including the provide solution, provide transportation capacity service, provide software + transportation capacity, and selling intelligent vehicles.

In terms of commercialization progress, the relationship is as follows: provide transportation capacity > provide solution = providing software + transportation > selling intelligent vehicles. Provide capacity service mode is easier to get freight orders in the early stage, and the cash flow is not much, but it is relatively easy to realize capital income. Provide solution mode, can cooperate with domestic commercial vehicle traditional OEMs, can quickly create joint products between the two sides. Provide software + capacity model, as it involves provide solution and transportation capacity at the same time, its commercialization progress is basically equal to that of provide solution model. Selling intelligent vehicles mode, due to the entire vehicle forward development is from 0 to 1 process, pre-molding, production line construction, vehicle development and other slow progress, the overall commercialization will be slower.

In terms of technological capabilities, the relationship is as follows: selling intelligent vehicle > provide software +

transportation capacity = provide transportation capacity > provide solution. Selling intelligent vehicles requires both the R&D capability of autonomous driving technology and the R&D capability of the entire vehicle. Provide software + capacity mode and provide capacity mode in the same technical reserves, in addition to the necessary autonomous driving technology research and development capabilities, but also need to complete a deep understanding of the relevant application landing scene data. Provide solution mode, although also need to have an understanding of the scene, but limited by not directly involved in the actual operation, so the collection of effective data will be relatively weaker than the provision of software + capacity mode and the provision of capacity mode, the mode of technical reserve direction is to polish the software capabilities.

In terms of resource input, the relationship is as follows: selling intelligent vehicle > provide software + transportation capacity = provide transportation capacity > provide solution. In the mode of selling intelligent vehicles, since it directly involves the production of the whole vehicle, it is necessary to invest part of the resources into the construction of production lines, testing of the whole vehicle, sales of the whole vehicle and other aspects of the construction. The mode of providing software + transportation capacity includes both light-asset operation and heavy-asset operation, which requires the deployment of two teams to meet the mode, and there will be a certain investment cost in the fleet size and team size. The model of providing transportation capacity mainly involves fleet construction, which will involve the recruitment of safety personnel, the acquisition cost of vehicles, and operation and maintenance costs. The main input for the provision of solutions model is R&D personnel, which will not involve much investment in fixed assets.

4. Technical Challenge

Perceived stability and safety. Commercial vehicles need a longer sensing distance to ensure that the vehicle can brake within a safe range. The ideal sensing distance needs to be maintained at about 500 meters. Existing sensors on the market sensing distance, sensing angle, resolution need to be further improved, and the cost still needs to be reduced to promote industrialization.

Vehicle-grade products. Front-loading mass production is a must for the maturity of autonomous driving technology. Only front-loading autonomous driving trucks can be allowed to drive on the road and operate commercially, and vehicle-specification-grade front-loading products have higher reliability and durability, while front-loading's forward development mode can satisfy the complex interaction of the whole vehicle system. Vehicle-grade mass production is the key to the long-term survival of self-driving companies.

Redundancy in the wire control chassis. Under the state of completely unmanned driving, vehicles need to make multiple redundancies in the wire control system to further ensure the safety of the vehicle. Vehicle enterprises are focusing more on the development of wire-controlled chassis, and the current chassis of commercial vehicles can basically realize wire control, but the wire-control technology (such as wire-control actuation, wire-control steering, etc.) fails to achieve complete redundancy. In addition, the increase in the penetration rate of new energy heavy trucks has promoted the chassis line control, laying the cornerstone for intelligence and network connectivity.

5. Recommendations for Industrialization on The Ground

(1) Police

Improve the policy system of self-driving freight vehicles, accelerate the process of road test permit unification, promote the accumulation of data and data closure of freight vehicles; strengthen the construction of road test management institutions, and refine the responsibilities of the regulatory authorities; the introduction of self-driving freight vehicles open road policy, so that the vehicle test demonstration road section continues to "expand", and constantly improve the software and hardware facilities required for road testing, enrich the test scenarios, so that the open test road for self-driving freight vehicles presents the good development trend of the city's cross-regional chain of good development of the road in various parts of the city in tandem.

(2) Business Model

The next two or three years will be a key point for freight unmanned driver break-even. Reduce the cost of hardware such as sensors and domain controllers, amortize the cost of software R&D, reuse the technology for the scenarios, rapidly realize commercialization migration, and complete self-supporting. Pay attention to overseas market synchronously and layout overseas pilot projects.

(3) Technology

Science and technology enterprises can realize the collection of data closed-loop work through assisted driving scale mass production, processed to form an effective data set, realize storage and transportation in the cloud server, and after algorithmic model training and verification, redeploy the vehicle-side model to get on the car to create an efficient data closed-loop program. At the same time, it is necessary to pay attention to the risk of data security in the whole life cycle of data collection, storage, sharing and utilization and exit, and to establish an internal regulatory system for the enterprise.

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