Development Strategies of Drop and Pull Transportation Based on SWOT Analysis

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Abstract—With the rapid development of economy, the demand of road transportation is increasing day by day. On the other hand, with the continuous progress of road conditions and vehicle technology, drop and pull transportation, an advanced form of freight transportation organization, is getting more and more attention from government departments and transportation enterprises. Based on the SWOT analysis, the development status and problems of China’s drop and pull transportation were researched deeply. Combined with the advantages of China’s Information and Communication Technology and big data technology, some reasonable suggestions were put forward for the development of drop and pull transportation from the aspects of vehicle technology, freight source organization and informatization. It is hoped that drop and pull transportation will become more intensive, efficient and environmentally friendly.

1. INTRODUCTION
Drop and pull transportation uses a tractor that does not have cargo capacity as power device. Through the connection between the traction saddle, the traction pin and the electrical equipment, the trailer with the cargo space can be mounted. The separation of the tractor and the trailer is free, which can improve the efficiency of the tractor. After the tractor transports the trailer to the destination, the tractor can use the loading and unloading time of the trailer to carry out the next task. It is also called TSRP (Tractor and Semitrailer Routing Problem) [1]. This is a recognized and leading transportation organization method. Through allocating the transportation resources intensively, it can effectively improve the organization level of road freight transportation, accelerate the construction of an intelligent platform of road freight transportation organization, and promote the transformation of the road freight transportation industry. And it is of great significance to promote the development of the logistics industry and related industries [2].

2. SWOT ANALYSIS OF CHINA’S DROP AND PULL TRANSPORTATION DEVELOPMENT

2.1 Strengths
China has provided favorable conditions for the development of drop and pull transportation in terms of policies, vehicle levels, road conditions, and supply of freight source.
• Strong policy support. Since 1986, China has promulgated a number of policies (Tab. 1), which have supported and consolidated the development of drop and pull transportation in terms of operation management, vehicle standardization, and preferential policies.

| Time  | Policy and Content                                                                 | Content                                                                 |
|-------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 1986  | "Notice on Carrying out the Test Line of Direct Container Drop and Pull Transportation by Highway" | Attempt to develop drop and pull transportation in China                |
| 1996  | "Notice on Launching Drop and Pull Transportation of Container Tractors"          | Simplify the enterprise handling process, support and encourage enterprises to carry out container transportation |
| 2009  | "Notice on Promoting the Development of Drop and Pull Transportation"            | Adjust trailer tolls, promote the standardization of vehicle equipment, and increase capital investment in the construction of hub stations, etc. |
| 2012  | The central government supplements another 600 million RMB for drop and pull transportation | Give strong financial support |
| 2013  | Determine the first batch of drop and pull transport pilot projects and stations list | The list contains 26 pilot projects and 42 stations                       |
| 2016  | "The 13th Five-Year Development Plan of Comprehensive Transportation Services"   | the plan requires that the towing ratio is not allowed to be lower than 1:2 |
| 2018  | "Promoting the high-quality development of road freight must be driven by innovation" | Vigorously develop advanced transportation organization forms such as drop and pull transportation and trailer sharing |
| 2019  | "Interim Measures of the Operation and Management of Road Freight Transport on Internet Platforms" | Article 5 of Chapter 1 mentions encouraging the use of drop and pull transportation and other transportation organization modes |

• Improvement of vehicle conditions. China’s vehicle equipment technical requirements of drop and pull transportation can basically meet the requirements. In terms of the number of vehicles, as of 2019, China had 237.67 ten thousand tractors, an increase of 14.70% over 2017, and 248.76 ten thousand trailers, an increase of 17.20% over 2017, and it will grow further in the future [3]. In terms of vehicle portfolio, if companies purchase tractor and trailer according to the model recommended by the state. Its interchangeability and compatibility can basically meet the requirements. In terms of ensuring
the utilization rate of tractors, the performance of vehicles produced by China’s automobile manufacturers can be comparable to the same type of imported products [4]. In terms of quality and speed of cargo transportation, various central axle trailers and other advanced transportation equipment are gradually purchased and used.

- Improvement of road conditions. In recent years, the total mileage of highways in China has been increasing (Fig. 1) and the proportion of high-level highway has been also increasing (Fig. 2). As of the end of 2018, the total mileage of roads constructed in China has reached 484.65 ten thousand kilometers, which is firmly in the forefront of the world. And in the total mileage of 484.65 ten thousand kilometers, 446.59 ten thousand km of roads have reached level four and above which account for 92.1% of the total road mileage, and 64.78 ten thousand kilometers are in second level. The level of highways above the national level accounts for 13.4% of the total mileage, and the expressway mileage reaches 14.26 ten thousand kilometers, accounting for 2.9% of the total highway mileage. It can be seen that China has not only increased the total highway mileage, but also the overall highway grade level has been greatly improved [5].

Figure 1. Total highway mileage. (data source: National Bureau of Statistics)

Figure 2. Total mileage of different level highways. (data source: National Bureau of Statistics)
The sufficient supply of freight sources. According to statistics, China’s road freight volume was 19.17 billion tons in 2008, and as of the end of 2018, the national road freight volume was 41.61 billion tons, an increase of 138.75% in ten years (Fig.3). And the road freight volume is still increasing rapidly. With the development of economy and the growth of transportation demand of goods, Road freight volume will increase continuously.

![Figure 3. Road freight volume in China. (data source: National Bureau of Statistics)](image)

2.2 Weaknesses
The development of drop and pull transportation has high requirements for vehicle standardization, station standardization, informatization, and organization of freight resources, but China is relatively backward in these aspects, which is not conducive to the development of drop and pull transportation.

- Incomplete vehicle equipment. On the one hand, the number of domestic trailers is relatively small, and the towing ratio is low. As of 2019, the ratio of tractors to trailers is only 1:1.05. On the other hand, the degree of vehicle standardization is low. According to statistics, there are 717 tractor models that meet the national standards, involving 2295 configurations [6].
- Backward station construction. Most of China's freight yards are ordinary yards, whose functions are mainly general cargo transportation and warehousing. The standards of related storage facilities are not uniform and complete, and it is difficult to carry out cargo handling operations, which is not conducive to the improvement of efficiency [7].
- Low degree of informatization. First, it is still unable to provide customers with safe, efficient, and visual information services. Second, satellite positioning systems have not been well applied. Third, many transportation companies do not have internal information management systems, and traditional methods, which include paper and telephone, are still used to communicate information mainly.
- Poor organization of freight resources. Due to the imbalance of supply and demand, the amount of goods that need to be transported varies greatly between various regions [8]. Coastal areas have more developed economies, so freight resources are sufficient. In contrast, inland areas are relatively scarce. Even in the same province, this problem still exists. For example, the coastal areas of Shandong Province have developed rapidly and have an abundant supply of goods, while the economy of the central and western regions is relatively backward, so the shortage of goods is more serious. It leads the lack of stable two-way supply of goods for drop and pull transportation, which is likely to make vehicles don’t have sufficient goods on the return journey, and it will waste vehicle transportation resources and reduce economic benefits [9]. Therefore, freight resources organization has become a big obstacle on the way to developing drop and pull transportation.

2.3 Opportunities
Autonomous driving technology and big data technology provide opportunities for the development of drop and pull transportation in China.
• The development of autonomous driving technology. With the advancement of vehicle technology and communication technology, autonomous driving technology is gradually maturing and entering our lives. As of 2020, many companies have achieved mass production of L3 level autonomous vehicles. Level 3 is defined as conditional automation. The system completes all driving operations. When there is a demand, the system will remind humans to intervene the vehicle. It can basically realize the automatic driving of the vehicle [10]. However, it has not yet been applied to the vehicle of drop and pull transportation. If the vehicle is equipped L3 or higher-level autonomous driving technology, it will produce many benefits. First, it can reduce traffic accidents and ensure the safety of vehicles. Second, it can reduce the cost of hiring drivers and improve the economic benefits of enterprises. Third, autonomous driving technology does not require rest time, which is more suitable for long-distance transportation. Fourth, the tractor, which is equipped autonomous driving technology, can quickly respond to various dispatches of the command center, making the transportation process more informatized.

• The development of big data technology. In recent years, Internet of Things technology (IoT) has continued to develop, and the data obtained by IoT has indirectly promoted the development of big data technology [11]. In the traditional process of organizing the freight resources of drop and pull transportation, due to the certain gap in economic development between different regions, it often leads to one-way transportation of goods, and no goods are available for transportation on the return journey. Or due to insufficient goods on the one-way route, goods need to wait for an uncertain period of time before they can be transported with other goods. After applying big data, the system will intelligently allocate all freight resources information and vehicle information in the system to make the process of organization more reasonable.

2.4 Threats
Long-term and stable capital investment is necessary for developing drop and pull transportation. Therefore, for most companies, government funding is particularly important. In addition, companies must ensure corporate information security. China faces greater threats in both aspects.

• Insufficient funding. In order to ensure the efficient operation of drop and pull transportation, it is necessary for various transportation companies to jointly formulate unified industry standards. Therefore, the vehicle and freight yard of companies should be transformed, which requires companies to invest a lot of money for a long time. In the early stages of development, enterprises can use government of subsidies to construct, but in the later stages of government subsidies weaken, it will be difficult for enterprises to continue to invest in related facilities and equipment.

• Information security threats. With the continuous development of information technology, the source of goods and vehicle locations of various drop and pull transportation companies has become more and more important. In China, most transportation companies use traditional paper or simple electronic forms for information management, lacking a unified information management platform, and information security cannot be guaranteed.

3. DEVELOPMENT STRATEGIES
Based on the above SWOT analysis, and overall consideration of strengths, weaknesses, opportunities and threats faced by the development of drop and pull transportation, the following suggestions are given from the aspects of informatization, intelligence and organization of freight resources.

3.1 Promote System Construction Informatization
In order to make the management of drop and pull transportation more informatized and ensure that transportation resources can be used reasonably, a comprehensive informatization construction is required, which can be started from the aspects of Electronic Data Interchange (EDI) technology, Radio Frequency Identification (RFID) technology, satellite positioning system and enterprise information management system.
• Speed up the application of EDI technology. EDI technology is to electronically transmit information of vehicles to the information control center of drop and pull transportation companies [12]. Compared with the paper-based form of information transmission, this technology can transmit information more efficiently, accurately, and safely, and improve the informatization level of data exchange in the industry.

• Speed up the application of RFID technology. RFID technology can obtain relevant detailed information of vehicles and goods without contact, and can also automatically verify goods in trailer, which improves the efficiency of vehicles entering and exiting freight yards and reduces the error rate of statistical information. At the same time, Freight yard equipped with RFID systems can dynamically track vehicles and provide relevant data on trailers and goods for enterprise dispatch management at any time.

• Speed up the application of satellite positioning system. Taking into account factors such as data security, the BEIDOU Satellite Navigation and Positioning System (BDS) can be used to track and manage the transportation process, so as to finish the loading and unloading of the trailer before the tractor arrives at the freight yard, realize the trailer full of goods waiting for the tractor, and improve the utilization of towing vehicles rate. At the same time, real-time tracking can eliminate driving problems such as unauthorized transportation, fatigue driving and speeding, which ensures the safety of vehicles to a certain extent [13].

• Speed up the application of the management system. This type of system can input goods information and vehicle scheduling information provided by drop and pull transportation companies, and analyze the collected data. On the one hand, it can regulate the work process of vehicles through the collected monitoring information, and make full use of the enterprise’s transportation resources. On the other hand, it can provide customers with information on the location of their goods and improve the service level of enterprise [14].

3.2 Promote Intelligent Infrastructure

Intelligence is the development direction of the future transportation industry. In order to keep up with the development of the times and improve the efficiency of transportation, the intelligence of drop and pull transportation should be noticed. It can be started from the three aspects of freight yard, trailer pools and autonomous driving.

• Build intelligent standardized freight yards. For one thing, freight yards should be standardization. The government should let large enterprises to establish standardized freight yards, then it should subsidize some small enterprises to build smaller-scale freight yards with the same standard to realize the standardization of various stations [15]. For another thing, freight yards should be intelligence. Enterprises should build intelligent freight yards on the basis of standardized stations. The station should enable the storage of goods to be classified and zoned, and to be recorded dynamically, so that the goods can be used at any time. Besides, loading and unloading tools of different freight yards should be unified, and under certain conditions can load and unload goods automatically. There should be a standard vehicle loading and unloading location to avoid the uneven height of loading and unloading platform, which affects the speed of loading and unloading. At the same time, the unified vehicle dispatching and cargo organization capabilities of the station should be improved to accelerate the realization of the intelligent freight yards.

• Build an intelligent shared trailer pool. Enterprises can determine the distribution of cargo sources through market surveys, and select appropriate addresses establish a corporate public trailer pool for multiple transportation companies to rent. This measure can virtually increase the number of trailers and the tow-to-hang ratio which can solve the problem of insufficient trailers for cargo transportation companies. At the same time, because the vehicles in the trailer pool are all standard trailers, the standardization problem can also be solved to a certain extent. In the actual transportation process, the trailer pool can also carry out the collection and distribution of goods, reducing or even eliminating a series of problems such as cross transportation and empty driving.
• Promote the application of autonomous driving in tractors. Vehicle-Road Cooperative technology can be used to realize automatic driving, and it uses the terminal carried by the vehicle to communicate with roadside equipment or other nearby vehicles to understand the driving status of the vehicle, and then controls the vehicle. It can make the process of drop and pull transportation more efficient.

3.3 Application of big data for organization of freight resources

Source organization is one of the key things for transportation companies to carry out cargo transportation operations. Each type of cargo needs to be routed according to the origin and destination. Transportation companies in various regions should actively unite to share source information to a certain extent, and gather source information and vehicle information on a system platform so that when there is no vehicle running on the optimal route of transportation, the goods can be placed in the suboptimal route. It can avoid the empty driving situation of the vehicles on the optimal route, and improve the space utilization of the vehicles on the suboptimal route. The use of big data can also be used to predict seasonal changes in freight volume. According to the data of previous years and the market forecast of the year, the incoming and outgoing quantities of goods in different regions can be calculated, so that the capacity can be allocated in advance and the goods can be transported in a timely and reasonable manner.

4. Conclusion

In this paper, the SWOT analysis method was used to analyze the development of drop and pull transportation in China, and finds that China provides favorable conditions for the development of drop and pull transportation in terms of policies, vehicles, roads, and sources of goods, but it has great defects in informatization and freight yard construction. And it also faces opportunities in autonomous driving and big data, as well as challenges in funding and information security. By coordinating the strengths and weaknesses, and combining the challenges and opportunities, suggestions are made from many aspects:

a) Promote the informatization construction of enterprises by promoting the application of EDI technology, RFID technology, satellite positioning system and enterprise information management system.

b) Combining intelligence, sharing concepts and autonomous driving technology to promote the intelligent development of drop and pull transportation infrastructure.

c) Through the application of big data technology to organize the source of drop and pull transportation.

These suggestions can promote the development of drop and pull transportation to a certain extent, and make it more intensive and intelligent. In addition, it can promote the upgrade of transportation equipment and transportation systems in the entire transportation industry, and also promote the energy saving and emission reduction of vehicles in this industry, which responds to the sustainable development strategy proposed by the Chinese government.

From the perspective of the speed and level of China’s economic development, more and more goods are suitable for drop and pull transportation in the future, and the freight resources will become more and more stable. Merely using traditional truck can no longer meet the society’s transportation demand. However, the use of drop and pull transportation can effectively solve the problem of insufficient transport capacity. Therefore, it will become the development direction of the road freight industry in the future.

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