Analysis of TuSimple's Investment Value

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Abstract. TuSimple is the first global automatic driving stock listed in the United States. At present, it is in the growth stage. It is a truck technology company founded by core members such as Chen Mo, Hou Xiaodi, and Wang Naiyan. Its core products are an L4 automatic semi-trailer truck, TuSimple path system, and Autonomous Freight Network (AFN) terminal network. However, due to the limitations of current talents, technologies, and algorithms, TuSimple's AFN solution will take a long time to make great progress. As a high-tech company, TuSimple also faces the problem of profitability. When to turn a loss into profit can be the biggest problem for TuSimple in the future. TuSimple's future value is AFN technology, which can be used not only in the field of trucks but also in other fields of transportation. However, with the current technology and talents, it is difficult to fully improve the role of this technology. At present, TuSimple wants to have higher achievements in IPO and automatic driving. This ideal is very rich, but the reality is very cruel.

Keywords: Autonomous trucking · Autonomous freight network · Investment value analysis

1 Introduction

1.1 Background

TuSimple is a listed driverless truck company and is currently the first share of automatic driving in the world. The original intention of TuSimple establishment is to empower the global logistics and transportation industry with L4 level (SAE standard) driverless truck technology. They are mainly involved in the automotive field in the AI industry, in which the main research field is the unmanned car. The future founders and key personnel of TuSimple are Chen Mo, Hou Xiaodi and Wang Naiyan. Due to their excellent management and practical experience, TuSimple will master more than 240 core technology patents for automatic driving in the future. TuSimple has won six honors and $650 million in financing in only six years from its establishment to March 2021 and

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has also created a world-class partner ecosystem during this period. For example, freight fleet owners, OEMs, and third-party service providers. However, Tu currently focuses on the production model, such as developing proprietary core independent software. TuSimple's existing solution in the future is AFN (autonomous freight network).

AFN can realize automatic driving distribution between hub centers and complete first/last-mile transportation between customers and hub centers. Moreover, in the process of automatic driving distribution, TuSimple will track the status of goods in real-time through monitoring in the future to ensure the transportation safety of goods. The best five core technologies are perception, motion planning, control, machine learning, and mapping in this solution. TuSimple has created three main products based on AFN: the L4 automatic semi-trailer truck, the TuSimple path system, and the AFN terminal network. The best of AFN is five core technologies: perception, motion planning, control, machine learning, and mapping. But there are still many deficiencies: the distance in perception can be further achieved, the speed of the exercise plan can be higher, and the control can be optimized.

The research analysis is aimed at the research field of the TuSimple industry. The best solution for TuSimple's future goal, AFN, can realize automatic driving, but there are still many improvements because automatic driving will be accompanied by many risks. Therefore, this research focuses on the field of AI automobiles by reviewing the history of AI algorithms, studying and predicting the future potential and peak value of AI algorithms. From there, this research finds that the AI algorithm still has a lot of room to improve. Due to TuSimple haven't been able to make the brain give full play to its effectiveness, the improvement of AI is very slow. This research also studies the risks of automatic driving from the driver's perspective. The improvement of AI will often bring many dangers and threats to people. Therefore, TuSimple also hopes that the improvement and optimization of AI will bring convenience to mankind and guarantee human security.

1.2   Related Research

This research focuses on the state of autonomous trucking technology(like the description of levels of automation, for example, automated and connected vehicle technologies in on-road heavy-duty trucking, Estimated costs for examples of autonomous and connected truck technologies and technology applications, Fuel savings demonstrated in example truck platooning projects, Potential fuel savings of nonplatooning trucking applications), societal acceptance and the benefits and drawbacks of autonomous trucking. In conclusion, this research is an overview of the technologies and development of autonomous trucking. Besides, it also proclaims the essence of autonomous trucking [1]. This study examines the potential for cost and carbon emission reduction for autonomous trucks to adopt lower peak speeds than today's human-driven trucks, where the hourly cost of the driver remains a significant trade-off. Adopting lower speeds presents an indirect savings opportunity in addition to savings associated with the removal of the driver. In a nutshell, this study is quite technical [2]. Among nearly a dozen companies developing autonomous driving, San Diego–based TuSimple is trying to get ahead by combining unique technology with a series of strategic partnerships. Working with truck manufacturer Navistar as well as shipping giant UPS, TuSimple is already conducting

test operations in Arizona and Texas, including depot-to-depot autonomous runs. These are being run under what's known as "supervised autonomy," in which somebody rides in the cab and is ready to take the control of the system if needed. Sometime in 2021, the startup plans to begin doing away with human supervision, letting the trucks drive themselves from pickup to delivery without anybody on board [3].

Shahandashti et al. researched how autonomous trucking affected Dallas-Fort Worth's truck industry, and the new infrastructure exchange meant caused by it. Their research includes part of investigating the autonomous trucking industry and investigating local truckers and truck companies. At last, their investigation concluded various fields of effects caused by the autonomous trucking industry and provided recommendations [4]. Schoettle and Schoettle's research gives the background of the autonomous trucking industry in the United States. The research analyzes the technology behind autonomous trucking. It also concludes the advantages and disadvantages of the technology. It specifically states the risks of auto-driving [5]. Viscelli's research stated the potential economic issues of the development of autonomous trucking. The two arguments are working conditions varied in the trucking industry and that automation might cause job loss. The research briefly talks about the industry, then puts its focus on how auto-trucking could cause job loss and low quality. Lastly, it provides policies for the trucking industry, which can or will prevent that situation from happening [6].

Felipe Jimenez draws a conclusion by reviewing the safety accidents caused by human behavior and accident factors in the past, Then analyzing the comparison of various human driving styles and using an AI algorithm to evaluate safety risks. Felipe Jimenez believes that the following four driving styles are worth evaluating. Firstly, Aggressive driving. Secondly, Inattentive driving style. Thirdly, Drunk driving style. Fourth, Normal driving. At the same time, Felipe Jimenez believes that there are still many deficiencies in the behavioral application realized by using the current AI algorithm, but these can be solved in the continuous development and progress of the algorithm in the future. Jimenez's following views are worth referring to. The algorithms of particular interest in future research are fuzzy logic, inference system, HMM, and SVM implementation [7]. Tubaro and Casilli take the artificial intelligence of the automotive industry as an example. By studying the background of artificial intelligence, the human factors in its data-intensive algorithm basis, and reviewing the history of artificial intelligence, Tubaro and Casilli find the importance of micro workers in the production of artificial intelligence and the impact of artificial intelligence. Tubaro and Antonio Casilli turn around through some methods, The Internet and the diversity of people draw some conclusions from the background of artificial intelligence. The demand for microwork is not temporary, but structural and sustainable. Meanwhile, Tubaro and Casilli also found through research that the problem of stealing our work does not lie in the technical allocation of tasks to people and machines themselves, but the basic allocation of rights. Therefore, Tubaro and Casilli believe that when AI is not fully deployed in many markets, enterprises should take care of and pay attention to the affected workers [8]. Kong et.al studied the safety of intelligent vehicles. The author concluded by testing and developing various vehicle safety technologies. It also combines a security risk assessment framework established by taking the GMITS model as an example to assess threats and vulnerabilities [9].

This research was focused on the AI stock, this one provides a solution called Stock-AssIstant that models the reliability of stock commentary by taking into account a variety of factors such as stock price movements, commentary content, and analyst performance. They did some useful experiments and also provided some data tables to support their method [10]. This research is focused on short-term price prediction on the general stock using time series data of stock price, the model in the past is very dependent on artificial data and not fully artificially intelligent, this study proposes more accurate algorithms and reduces the reliance on humans [11]. This research shows the human analysis and the AI, and their advantage and disadvantages of them. AI is more profitable for larger companies because AI is a big investment and smaller companies may struggle to survive the big early investments. Although human brain computing still dominates in the current financial terms, the addition of AI scientific algorithms is also dismantling the position of the human brain a little. And as the accuracy of AI algorithms improves, the status of AI is slowly improving [12].

1.3   Objective

This paper mainly analyzes the investment value and current situation of TuSimple, which is a technology company focusing on the field of intelligent driving. Firstly, the second chapter introduces the research methods of this paper, and then the third chapter mainly uses the POCD framework to analyze the company's basic situation. The fourth chapter analyzes and forecasts the company's financial indicators. The fifth chapter analyzes the valuation and future risks.

2   Method

POCD framework is a kind of environmental analysis that is a method to identify the risks of specific enterprises. Based on the systematic analysis of the external and internal environment faced by the enterprise, it is a method to identify the risk and potential loss that the environment may cause to the enterprise. The external environment of the enterprise mainly includes the situation of raw material suppliers, capital sources, competitors, customers, government managers, and so on.

The internal environment of an enterprise includes its production conditions, technical level, personnel quality, management level, and so on. While analyzing all aspects, the key consideration is their interrelated characteristics. By analyzing the relationship between these factors and their results, as well as the possible consequences once the factors change, we can find the risks and potential losses.

Enterprise risk managers can find risk factors and possible losses by analyzing the role and impact of internal and external environmental conditions on enterprise business activities. Similarly, investors can also judge the investment risk and the investment value of the enterprise through analysis. Adopting the environmental analysis method, firstly, we should comprehensively and systematically analyze the external and internal environment of the enterprise, as well as the impact of environmental changes on the production and operation of the enterprise; Secondly, we should analyze the relationship and stability between the enterprise and the internal and external environment. Hence,

the POCD framework offers a great example for us to judge a company not only from its internal but also its external environment.

POCD framework was created by Professor William. A. Sahlman in Harvard business school. He specifically introduced the content and importance of the POCD framework in his note. The disparity between his view and the implicit in the business plan feeding frenzy was rooted in over fifteen years of field research and personal experience in the world of entrepreneurship. The rest of his note developed a conceptual framework for understanding entrepreneurial venture creation and management, which was based on studying hundreds of successful and unsuccessful companies. The goal was to give the reader insights into sensible entrepreneurial management, and, by implication, into the business plan used to describe a venture. In his framework, there are four dynamic components of any entrepreneurial processor venture: the people; the opportunity; the external context; and, the deal.

By people, he means those individuals or groups who perform services or provide resources for the venture, whether or not they are directly employed by the venture. This category encompasses managers, employees, lawyers, accountants, capital providers, and parts suppliers, among others. By opportunity, he means any activity requiring the investment of scarce resources in hopes of future returns. By context, he means all those factors that affect the outcome of the opportunity but that are generally outside the direct control of management. Examples of contextual factors include the level of interest rates, regulations (rules of the game), macroeconomic activity, and some industry variables like the threat of substitutes. Finally, by the deal, he means the complete set of implicit and explicit contractual relationships between the entity and all resource providers. Examples of deals range from contracts with capital suppliers to the terms of employment for managers.

3   Pocd Framework

3.1   People

Mo Chen: Executive Chairman and Co-Founder. Co-founder of TuSimple Technology with 10 years of experience and has founded and led three companies.

Xiaodi Hou: Co-founder, Technical Director. Ph.D. in computer science and neural systems from California Institute of Technology. He has published many papers over the past 10 years and has had a significant impact on the field of computer vision. He is currently a reviewer for almost all major journals in computer vision.

Nayan Wang: Principal Investigator. He received his Ph.D. from the Hong· Kong University of Science and Technology, participated in Google's Ph.D. program in 2004 (38 in total worldwide), and was the first in the world to apply deep learning to target tracking, and his paper was included in the 2013 NIPS.

3.2   Opportunities

TuSimple Holdings Inc is focused on Global autonomous driving, which is a completely new idea in China, the technology is not yet mature. Autonomous driving is a new

technology for all of us, this company was the first to market with the L4 self-service semi-trailer truck. The truck is one of the most important modes of freight transportation in the United States. Trucks represent approximately 80% of the U.S. freight market, with 2.3 million trucks currently operating in the U.S. Compared to other modes of transportation, road transportation is characterized by high flexibility, cost consolidation, and speed. Also concentration of truck routes: long-distance freight transport usually takes place on a few cross-border motorways. These highways are mainly located along several commercial corridors in the United States.

The top 10 percent of commercial corridors carry 80 percent of all freight and connect the 100 largest metropolitan areas. The concentration of corridors allows automated vehicle manufacturers to capture a larger share of the freight market by concentrating on individual routes.

3.3   Context

The traditional truck freight market in the United States is worth 800 billion dollars. From 1990 to 2018, the annual mileage CAGR (compound annual growth rate) was about 3%. At the same time, the traditional truck freight market is fragmented, and 95% of freight lessors operate less than 20 semi-trailer trucks, which is difficult to generate a scale effect. In terms of safety, the number of deaths from truck collision accidents increased by 40% from 2009 to 2019, resulting in an insurance premium of about 5% CAGR from 2012 to 2018.

Due to the aging of drivers and other problems in the industry, the shortage of drivers is becoming more serious. It is expected that the shortage of drivers will expand by 2.6 times by 2028. At the same time, labor costs have accounted for 43% of operating costs per mile, 79% higher than the second most --fuel costs. The labor shortage has become one of the most important problems in the development of the truck freight industry. However, 10% of the routes account for nearly 80% of the freight volume, which provides an opportunity for the application of automatic driving technology.

In terms of the regulatory environment, 43 states in the United States have allowed L4 automatic semi-trailer truck testing, of which 24 states allow commercial deployment. In terms of safety and transportation efficiency, automatic driving can break the legal limit of daily driving time, allocate driver resources to the first and last-mile delivery, improve efficiency, alleviate the shortage of drivers, and reduce the number of accidents caused by distraction, so as to reduce insurance costs.

EU billion think tank estimates that the total cost of social logistics in China will be 14.9 trillion yuan in 2020, accounting for 14.67% of GDP. The scale of China's road freight market may reach 5.85 trillion yuan in 2021. Although China's road freight market has a trillion scale, 60% of its transport capacity is in the hands of small fleets and individual retail investors.

In terms of safety, according to the G7 big data platform, as of 2019, there were 3.7 accidents per million kilometers in China, causing an average economic loss of more than 70,000 yuan per accident, and the mortality rate of truck drivers is about 1% all year round. Compared with 1.3 accidents per million kilometers in various States in the United States, there is a long way to go to improve the safety management of China's road freight industry.

Due to the high work intensity, high safety risk, and difficulty in ensuring social status and welfare, the employment satisfaction of truck drivers is low and the new forces are insufficient. In 2020, 53.40% of truck drivers in China were over 40 years old, and the group aging phenomenon is obvious.

The largest cost of road freight transportation is fuel cost, accounting for 22.36%. The labor cost increased by 10% every year from 2009 to 2018. Now, the labor cost accounts for 21.05% of the total cost of road freight transportation.

According to the data, China pays more attention to safety than technology. We think this is the reason why TuSimple will be listed in the United States in the future. However, our research shows that TuSimple's AFN project still has many defects and potential safety hazards. From the current algorithm, coupled with the unstable factors of the market, no company can completely improve and perfect the rectification algorithm. Even if TuSimple implements this technology, it takes more time than many people can afford. Therefore, whether it is long-term or short-term, we think it is not suitable for investment. In addition, the truck industry in the United States has been hit hard by the epidemic, which will greatly reduce the number of truck companies buying AFN project products.

3.4 Deals

The company created a world top tier partnership system, which includes shippers, carriers, freight brokers, fleet asset owners, OEMs, tier 1 component suppliers, and third-party service providers. The company itself has low assets, and its job is to combine its software with the hardware. The company focused on developing its software or program. It has two world top-tier OEM partners: Navistar and TRATON. They planned to manufacture a series of L4 autonomous semi-trailer trucks in the coming years. Their cloud service is provided by Amazon Web Service(AWS). Despite these OEMs, the company is also working with other hardware manufacturers: chip supplier Nvidia, lidar partner AEVA, Electronic Control Unit(ECU), steering system, and millimeter-wave radar partner ZF, brake system partner Knorr-Bremse, tire partner Goodyear, etc.

From the financial report, the PE of TuSimple is 3.81, earnings per share: - 3.30, net profit: - 733 million, and gross profit margin: - 97.56%, which is negative. In addition, TuSimple's research and labor costs consumed a lot of money, resulting in overall losses. From a technical point of view, although their technical concept is very good and they have obtained five rounds of financing, the technical barriers of the project are very high, and the existing knowledge and algorithms can not be realized.

4   Financial Analysis

4.1   Revenue and Costs

TuSimple's revenue has doubled year after year. The revenue from 2019 to 2021 is $710,000, $1,843,000, and $6,261,000 respectively, and it is expected to double continuously. The revenue will achieve $15,180,000 and $34,980,000 in 2022 and 2023 according to Wind's consensus expectation (Fig. 1).

TuSimple's cost of revenue is also rising. The cost of revenue from 2019 to 2021 is $1.595 million, $5.293 million, and $12.37 million respectively (Fig. 2).
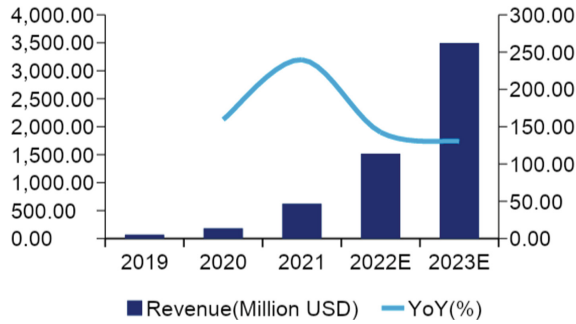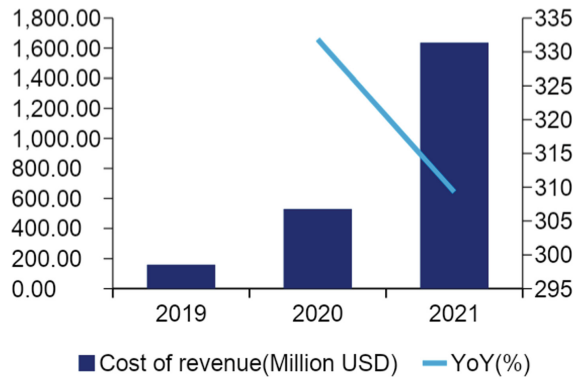
Fig. 1. TuSimple's revenue

Fig. 2. TuSimple's cost of revenue

4.2 Net Loss

At present, the company is still in a state of loss. The net loss from 2019 to 2021 is $84.88 million, $177.87 million, and $732.67 million respectively. The net loss will achieve $597.44 million and $728.61 million in 2022 and 2023 according to Wind's consensus expectation (Fig. 3).

4.3 Operating Expenses

The sum of expenses is increasing, and the contribution of R & D expenses is outstanding. The R & D expenses from 2018 to 2021 are $32.278 million, $63.619 million, $132 million, and $287.17 million respectively, accounting for 70.9%, 73.6%, 77.4%, and 70.86%, which become the highest proportion of all the expenses and show a rising trend (Fig. 4).

R & D expenses: As a Technology company that grows rapidly, TuSimple attaches great importance to R & D investment and continuously strengthens artificial intelligence, algorithms, and software research and development. As of December 31, 2020, the company has 839 employees, of which 673 are engaged in R&D, accounting for 80.2% (Fig. 5).
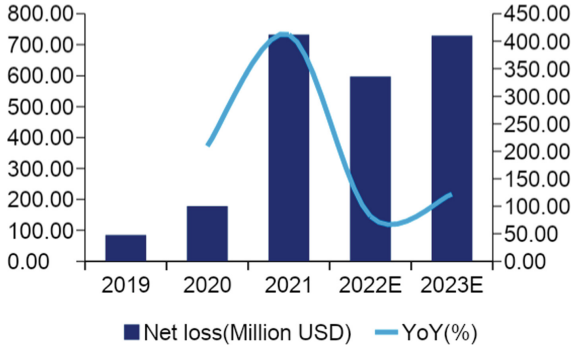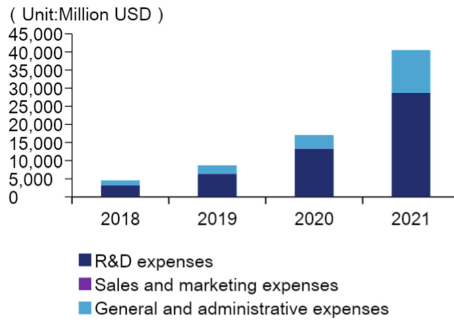
Fig. 3. TuSimple's net loss

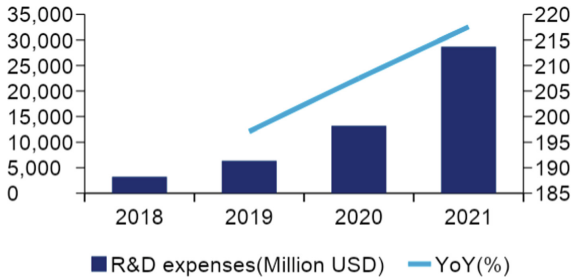
Fig. 4. TuSimple's operating expenses

Fig. 5. TuSimple's R&D expenses

Sales and marketing expenses: The company's research and development of L4 automatic semi-trailer are getting closer to commercialization and AFN technology is growing. It needs to invest resources in sales activities to start the brand. The selling expenses account for the least proportion and have little change (Fig. 6).

General and administrative expenses: (including personnel-related expenses related to the company's management and administrative activities, professional service fees, and other general company management expenses) The general and administrative
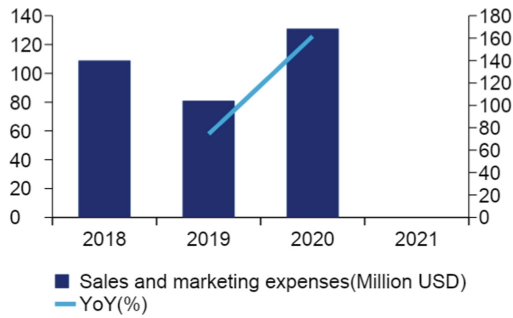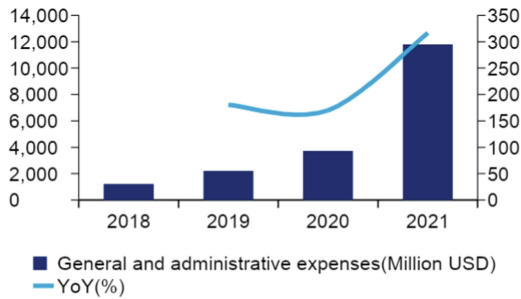
Fig. 6. TuSimple's sales and marketing expenses

Fig. 7. TuSimple's General and administrative expenses

expenses from 2018 to 2021 are $12.18million, $21.96million, $37.3 million, and $118.08 million respectively (Fig. 7).

5   Valuation and Risk

5.1   Market

5.1.1   Technology Scarcity and Leading Role in Shaping Performance

TuSimple was founded in 2015 by Chen Mo, Hou Xiaodi and Wang Naiyan. The company is headquartered in Beijing with two research offices in Beijing and the United States. In 2021, the company was listed in the United States and became the first driving stock in the world.

5.1.2   The Combination of Trucks and Electronic Products Reflects TUSIMPLE's Technology Scarcity

The combination of driverless and traditional truck industry experts is the source of TuSimple's advantages and the innovation constantly adopted in its service products. For example, TuSimple has its own unique ecosystem, AFN, and OEM. The most important one is AFN, and the company will realize full-automatic driverless in the future.

5.1.3   Based on Its Own Concept, Comprehensive Leading Technical Advantages

AFN products take the lead in the industry. According to TuSimple's internal data, the main sensing technology of AFN can sense 1000 m, and the airborne software can execute 600 trillion times per second. The exclusive national freight route map can control the route within the AFN and can be visualized, so as to improve the accuracy and reliability of the system. With high precision, you can fine-tune and generate a fine full 3D HD chart of 5cm or less.

5.1.4   PS Has Always Been an Important Valuation Reference in the Development of TuSimple in the Short Term

TuSimple has been on the market for a short time and is analyzed using quarterly data. Due to TuSimple's continuous loss of net profit and negative corresponding trap flow, the market generally believes that PE and P/CF are not suitable for its valuation. Due to the company's large fixed assets and large annual R & D expenditure, the market generally believes that EV/EBITDAR and P/b are applicable when EBITDAR and net assets are positive. In addition, the improvement of income and market penetration rate is also applicable.

5.2   P/S Method

Although TuSimple is a listed company, it is still a growth company at present. According to the actual situation, TuSimple's business will expand rapidly in the future, but its profitability is weak or even not profitable for a certain period of time. Therefore, we use PS for valuation. According to PS formula: share price/revenue -10.05/- 3.298, it can obtain -3.047.

6   Conclusion

According to the POCD analysis model, as long as TuSimple seizes the opportunity and breaks through technical barriers in the future, TuSimple is worth investing in. However, according to the research on financial status, valuation and risk, it is found that the risk of investing in TuSimple is particularly high because it is very similar to Tesla in some aspects. For example, it needs to invest a lot of research funds every year, but there is little return at present. Although high R&D expenses are common for high-tech companies, it inevitably brings many blows to TuSimple's project and continues to worsen TuSimple's three statements.

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