

# Tesla's Supply Chain Vulnerabilities in the Chinese EV Market

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## Abstract

We seek to find Tesla's vulnerabilities in the Chinese new energy vehicles market by identifying Tesla's specific weakness in its supply chain management and Tesla's competitors' situation in China recently. First of all, this paper provides an overall introduction of Tesla and other new energy vehicle companies with their inventory situation. We then specialize the cause and effects of Tesla's inventory shortage, including battery components shortage, charging infrastructure, government subsidies, and its market positioning. Business analysis tools such as PEST, SWOT, BCG Matrix, and PORTER'S 5 FORCE are also utilized to describe and analyze Tesla's position in the industry. The result of the analysis demonstrates that Tesla's shortage in inventory is specifically caused by the shortage of lithium elements. By analyzing Tesla's market positioning in the Chinese NEV market, it could be concluded that Tesla's marketing strategy positioned itself in an awkward place because Tesla is a question market that has a high growth rate but low market share. Additionally, the SWOT analysis provides a comprehensive overview of Tesla's advantages and disadvantages in the Chinese NEV market. In the end, the conclusion establishes an integration of Tesla's main vulnerabilities.

## Keywords

**Tesla's Competitors; Chinese New Energy Vehicle Market; Inventory; Shortage; Main Vulnerabilities; Marketing Strategies.**

## 1. Introduction

Tesla is an American electric vehicle and clean energy company based in Palo Alto, California. The company was founded in 2003. It mainly focuses on electric vehicle manufacturing, battery energy storage from home to grid-scale, and solar manufacturing. Besides, Tesla plans to set up its factories to manufacture components of cars, batteries, gearboxes, electromotor, and parts[1]. Therefore, Tesla achieves a comprehensive manufacturing process, and this was the core strategy of Tesla's supply chain management. Plus, Tesla employs solar collector technology during the manufacturing process, which could additionally reduce electric costs. Tesla also arranges its corporate partners to the manufacturing department to reduce time costs.

What is more, Tesla uses technology from suppliers worldwide to guarantee its products' properties. In Tesla's manufacturing process, the entire procedure would be accomplished in its factories, which could further ensure the quality of the products[2]. One of the significant advantages of Tesla is that Tesla does not have third party retailers in the market, which means that Tesla could directly make a connection with the buyers to satisfy their wants and needs. Hence, the company looks like other Original Equipment Manufacturers (OEMs) that include managing logistics and supply chain. Tesla also ships products digitally such that its operating system is automatically updated over the cloud. The company has manufactured vehicles with

new capabilities to sell to existing customers. Tesla not only sells information features such as GPS enhancement, entertainment, features, or gauges but also involves in selling physical add-ons like braking and speed. In some ways, Tesla sells a giant smartphone. Most importantly, although Tesla claims their unique supply chain management, including vertical integration and integrated strategy, could efficiently guarantee its manufacture through the market demand, our research and analysis prove that Tesla cannot meet the market demand sufficiently[3].

To explore Tesla's supply chain vulnerabilities in the Chinese new energy vehicle market in recent years, this paper properly establishes an overall understanding of the Chinese NEV market and all of the NEV companies' inventory situation in China. The following information is Tesla's competitors in the Chinese new energy vehicle market.

Byton is a Chinese electric vehicle company incorporated in Hong Kong founded by BMW and Nissan Motor executives. The company is currently running a trial shop at its Nanjing headquarters, where drivable prototypes are built[4]. It plans to introduce its M-Byte SUV model first, with the start of production scheduled for late 2019. Byton also plans to extend to European Market at the end of 2020. However, in June 2020, Byton suspended its production for reorganization for a planned six month period because of the Coronavirus[5]. Therefore, Byton has an inventory shortage at the moment.

ZOTYE is a vehicle manufacturing enterprise, mainly devoting to vehicle research and development, manufacturing, and sales. It has set up vehicle production bases in Zhejiang, Hunan, Hubei, Shandong, and Chongqing. Their product line covers Sedan, SUV, MPV, New Energy vehicle, and other market segments. Its marketing network covers large and medium-sized cities in China and the third and fourth-tier markets. United States, Russia, Algeria, Chile, and other countries and regions are the big importers of ZOTYE[6]. ZOTYE plans to sell its vehicles in the United States before the end of the next year. ZOTYE's inventory in China is currently in a surplus because of the Coronavirus[7].

NIO is a Chinese electric vehicle company based in Shanghai, specializing in designing and developing autonomous electric vehicles. In November 2014, William Li found NIO. One of the products that NIO sells is NOMI, an artificial intelligence technology, claimed to be the first in-car AI system in production vehicles. NOMI can pull up the car's navigation and control the music[8]. NIO does not have its factories for the manufacturing process, and NIO inventory is showing a surging phenomenon in 2020, which has a total inventory of 136 million dollars in March 2020[9].

BYD is a major Chinese automaker based in Shenzhen, Guangdong Province. It sells vehicles and started as a battery maker and entered the automobile business in 2003. The company has been involved in different fields such as telephone assembly and solar cell manufacturing. BYD also engages in the research, development, manufacture, and sale of rechargeable batteries and photovoltaic business[10]. The company operates its business through four segments: Rechargeable Battery and Other Products; Mobile Handset Components and Assembly Service; Automobiles and Related Products; and Corporate and Others. The Rechargeable Battery and Other Products segment manufactures and sells lithium-ion and nickel batteries principally for mobile phones, electric tools, and other new energy products[11]. Its subsidiary corporation is DENZA, which was founded in 2010[12]. Denza's inventory is currently unpublished but we deduce that DENZA has a low inventory because Denza's sales are low in 2020[13].

Roewe is an automobile company created by the automaker SAIC Motor from China in 2006. Its representative series of vehicles are ROEWE360 and ROEWE950. It is preferred in many export markets outside China under the MG marque. Looking at Roewe's inventory situation, it lowered its inventories in March 2020, and the company also had a decrease of 12.4% in

sales[14]. Therefore, Roewe's inventory and dealer's pressure in the second half-year will still be significant.

BMW, which has the full name of Bayerische Motoren Werke AG, is a German multinational company that manufactures vehicles. The company was founded in 1916. Its automobiles are marketed under the brands BMW, Mini, and Rolls-Royce. In 2015, BMW was the world's twelfth-largest manufacturer of motor vehicles, with 2,279,503 vehicles produced in total. The company is headquartered in Munich and produces motor vehicles in many countries such as Germany, China, India, the United Kingdom, and the United States. Overall, BMW has good sales and normal inventory conditions because it has its own factories in China, and its supply chain management has not been changed for a long time. However, during the Coronavirus period, BMW started to have a surplus in inventory because of its low sales[15].

## 2. Review of Literature

### 2.1. Battery Component shortage

The market for electric vehicles was growing more significantly and more prominent in China. At the same time, some people who were driving the petrol vehicle thought ICEs had the edge over EVs, which was because of the higher price of EVs. One of the most important reasons why the price of electric vehicles was much higher than petrol vehicles was relevant to the batteries. Lithium-ion, a rare earth element, was the component of batteries that were used in the electric car manufacturing process[16]. However, it was found that among the EV industry, the consumption of rare earth elements was unsustainable under the present market conditions, as seen in the one published by Ballinger[17]. The rare earth element supply chain indeed influenced the EV market. Ballinger researched the risk of using rare earth aspects that were sourced from a taken over supply chain to obtain worldwide climate targets and figured out that the demand for the different components in 2025 wants if the supply was not significantly raised. There was still extreme uncertainty for traction battery innovation.

Curry mentioned that the looming shortage of separators was another problem that the whole EV market faced[18]. In their study on contracting separator manufacturing capacity and separator sales situation in the world, they found that the separator manufacturing capacity had increased six percent, and separator sales had increased fifty-one percent by comparing the growth rates between 2016 and 2017. The contrast of the two results showed that the separator market would not be able to meet demand. Making separators was a complex, low margin business, and the separator supply bottlenecks were created because of the EV sales growth in the Chinese market.

### 2.2. Charging Infrastructure

Another developing bottleneck that the EV market was facing was the charging infrastructure[15]. Their study on the purpose of the public infrastructure found that the number of public charging stations was more than 330 thousand in January 2019[19]. However, the amount of existing charging stations publicly was much more insufficient than the new energy vehicles ownership of nearly one million. Consumers got anxious because of the scarcity of charging stations in society. Zhang et al. also found this to be true in their study of the current dilemma of China's electric vehicles[20]. Zhang et al. found that private users' demand was not natural to predict in terms of infrastructure[21]. The large-scale development of EVs would lead to the predicament of disordered charging for the diversity of charging modes. Solving the charging infrastructure issue was not easier than settling the traction battery component shortage[16].

The charging pile was a kind of more convenient charging equipment than the charging station. It did not require extra cost, and the construction cost and the artificial cost were pretty low.

However, it took six to eight hours to fully charge an EV using the charging piles, much longer than using the charging station (Zhang et al., 2014) [20].

### 2.3. Government subsidies

Before 2017, electric vehicle sales in China had benefited from subsidies and policies. However, the sales went into a sudden fall because of the diminishing subsidies. Furthermore, there was a shortfall in the new energy vehicles market at the beginning of 2017[21].

Zhang et al. studied small EVs (or low-speed EVs), a kind of no "identity" EV car in China, which couldn't enjoy the state's subsidies[20]. The research found that compared with general EVs, these EVs had the advantage of a lower price, about  $\frac{1}{5}$  of the price of general EV. In recent years, small EV had been developing quickly in some Chinese counties and towns. Nevertheless, through low-speed EVs were warm sales, they walked the edge of nationwide legislation and planned to identify embarrassment. Due to a lack of associated plans and technological standards, some low-speed EV manufacturers went into the market with an illegal standing. Moreover, the lack of administration systems brought about no certification, low quality, and also low security of low-speed EVs. Ultimately "warm market" deals with "cold policy."

### 2.4. Market positioning

Tesla had positioned itself as the brand which offered pure electric, impeccably designed vehicles. In Musonera and Cagle's study, they found that Tesla's toughness was its second-to-none brand recognition as well as an increasing number of sales at a global level[22]. Most significantly, though, was its Supercharger network, which had no competition and was the functional matching of GM having every filling station. Tesla's weak points were enhancing operating expenses as well as the manufacturing prices along with immense and also enhancing competitors from various other carmakers. Additionally, it had yet to satisfy the criteria of being profitable regularly. Its CEO had come to be unstable as well as something of a rolling publicity catastrophe for the business.

Li and Meng constructed a diamond model of a competitive positioning strategy for a company[23]. Their research found that market positioning must adhere to the advancement of the tactical positioning of the program, program measurement of each specific step required to complete the core task. As one of Tesla's competitors, BYD was a leader in China's brand-new energy lorries, located in the field of public transportation. BYD's goal of introducing two models in main public transportation, energy-saving, and environmental management bus righted into the bus system. As Tesla's other competitor in the EV market, Toyota's primary hybrid pushing automobile, was the best globe's crossbreed innovation cars and trucks, as well as also the top of the brand-new power modern technology professional. Hybrid power was not just a buffer for pure electrical modern technology; it was more vital because he altered the method of individuals using auto and energy acquisition.

## 3. Research Methodology

### 3.1. Introductory Paragraph to Methodology

Since the research topic was "What is Tesla's Supply Chain Vulnerability in Chinese Market," This work carefully reviewed recently published papers that argued related topics. The research group focused on four main issues that Tesla currently holds. First was the disruption of the supply chain due to a shortage of essential materials[17]. The second was Tesla's marketing positioning that weakened its performance in the Chinese EV market. The third was Tesla's unique B2C model that lacked a precise computation of EOQ (Economic Order Quantity), which led to the last problem, that Tesla had an inventory management issue.

This study was highly descriptive and analytical. The following section will describe the research's methodology in terms of 5W1H (why, what, where, when, who, and how).

### 3.2. Qualitative Analysis

#### 3.2.1. Analytical Tools

Business analysis tools such as PEST, SWOT, BCG Matrix, and PORTER'S 5 FORCE are used to describe and analyze Tesla's position in the industry. The SWOT analysis indicated that Tesla's complicated production undermined its high-volume production. What was more, Tesla's unique B2C model caused it unable to meet demand, which affected the brand value. The PORTER'S 5 FORCE analysis concluded that market competition was expected to intensify, and Tesla was facing substitute products that were provided by its counterparts in the Chinese market. The BCG Matrix concludes that Tesla was a question market that had a high growth rate but low market share.



Figure 1. Tesla PORTER's 5 Analysis

#### 3.2.2. The methodology of Tesla's inventory Analysis

This work started by gathering all of the inventory information of Tesla's competitors in the Chinese NEV market. Then each EV company's inventory situation with their causes and effects in recent years are analyzed in the work. Secondly, this work analyzed Tesla's inventory based on the information we gathered. Additionally, the causal relationship between Tesla's inventory and its vertical integration selling mode, which is that Tesla's inventory is changing based on market demand, is found, and the market demand is being perceived by vertical integration. Finally, the work concluded that Tesla's vertical integration selling has a specific vulnerability because they cannot react to the market demand sufficiently.



### 3.3. Quantitative Analysis

The research done on product price indicated that Tesla appealed to high-end customers and Tesla was in a monopolistic competitive market. The average price of Tesla's product (Model S, Model 3, Model X, and Model Y) was ¥ 539,389 and it outstripped 78% of its competitors' average price, as we found and calculated all the prices from official websites of Tesla's competitors[24].

The data of Tesla's production and delivery from 2018 Q3 to 2020 Q2 showed that the year-over-year growth in delivery had a downward trend overall. According to the Tesla share in the Chinese EV market, Tesla's market share had significant growth in 2020.

## 4. Result and Analysis

### 4.1. Tesla's inventory shortage analysis

Having looked at the overall inventory situation of Tesla's competitors in China's new energy vehicle market, the research analyzed the causes and effects of those inventory conditions in 2020. BMW, NIO, and ZOTYE have a surplus in their inventory, while ROEWE, BYTON, and BYD have a shortage in their inventory. At last, the research identifies Tesla's inventory issue and its supply chain management vulnerability.

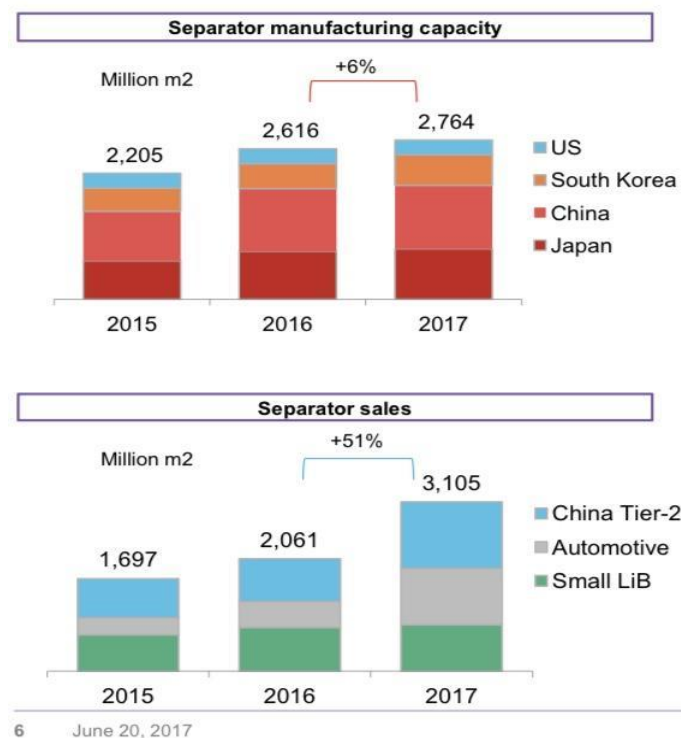


Figure 2. Separator Manufacturing Capacity & Separator Sales

First, the causes of the surplus inventory of NIO, BMW, and ZOTYE are analyzed. Taking BMW as an example: they have had a low selling of their electric cars "BMW5 Phev" since the Coronavirus pandemic[25]. According to the statistics, BMW has only sold 12986 BMW5 from January to July this year, ranked at the bottom of the list[14]. During the Coronavirus period, BMW did not turn inventory and sales fast enough to generate cash, and the accounts were stretched. Elevated inventories continued to tick up. Manufacturers could not pay dealers on

time, and dealers had not been able to meet sales targets that determined the rebates they got[26]. ZOTYE was also affected by the Coronavirus. They plan to sell their vehicles in the United States before the end of the next year. However, ZOTYE's inventory in China is currently in a surplus because the company postponed its expansion plan due to the Coronavirus[6]. However, NIO is quite different from the other two. Its inventory shows a surging phenomenon in 2020, which has an increase of more than 200%, and its total inventories are 136 million dollars in March 2020[9]. At the same time, NIO's sales quadrupled in 2020, but this did not change the fact of its surplus inventory[27].

The causes of the other companies' low inventory situation are then analyzed. The inventory of BYD, Roewe, and Byton is currently in a shortage. One of BYD's electric cars is Denza, which has had a low inventory since the beginning[28]. Because BYD has good sales in gasoline vehicles, but the demand for electric vehicles remains weak after Beijing scaled back subsidies for all-electric vehicles and plug-in hybrids in June 2019[29]. That was the reason why Denza's inventory was in shortage. According to the auto news, Roewe lowered its inventories in March 2020[30]. The company also had a decrease of 12.4% in sales, and that led Roewe's inventory to a shortage[31]. Conclusively, Roewe's inventory and dealer's pressure in the second half-year will still be significant. The next target of the research is Byton. Byton had planned sales in America before, but the company suspended its production to reorganize the manufacturing process after being hit by the Coronavirus pandemic. Byton was also raising funds because they currently had unpaid employees. The suspension was going to last six months, which caused a shortage in the inventory[7].

Back to the topic, the next section of the analysis is to explore the causes of Tesla's low inventory in the market. The first reason is that the company is now having a component shortage, including batteries and separators for all of the Models except for Model 3 because the Model 3 is only manufactured in Tesla's Shanghai GigaFactory. The EV market is influenced by the rare earth element supply chain, which means some of the components that Tesla needs is in an uncertain situation[17]. One of the rare earth elements that Tesla needs is lithium-ion, an essential element used in Lithium-ion batteries. Lithium-ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications[32].

Additionally, Curry contracts the manufacturing capacity and sales' situation of the separators in the world, and they found that the separator manufacturing capacity had increased six percent and separator sales had increased fifty-one percent between 2016 and 2017, which means that the separators that Tesla needs do not meet the market demand[18]. The graph above clearly presents the supply and demand of the separators' market. This separators' comparison also attributes to the reason why Tesla has a low inventory in recent years.

The second reason is that Tesla is currently having issues in its supply chain management. Tesla's vertical integration is one of its most significant advantages. However, now Tesla could not effectively make specific reactions toward the market demand. One of the significant benefits of vertical integration is to let Tesla be in correspondence with manufacturers closely, which could guarantee the supply sufficiency for the market, but this advantage does not appear in Tesla. All in all, the evidence and analysis of Tesla's inventory shortage adequately supported the statement.

## 4.2. Tesla's Market Positioning

As the research mentioned, Tesla mainly appeals to high-end consumers. However, the literature pointed out that local low-end producers dominated the Chinese EV market[33]. Tesla's marketing strategy positioned itself in an awkward place. Our construction of the BCG Matrix shows us that Tesla is a question market that has a high growth rate but low market share.

The data of Tesla's production and delivery from 2018 Q3 to 2020 Q2 shows that the year-over-year growth in delivery has a downward trend overall. In 2020, Tesla's Q2 delivery quantity was 2.14 Million units down from last year's peak. Nevertheless, according to the data of Tesla's share in the Chinese EV market, Tesla's market share has a significant growth in 2020. Chinese government withdrew subsidies for the electric vehicle market, which had a significant influence on local manufacturers and foreign competitors[21]. The result demonstrates that Tesla targets high-end consumers because there is still a noticeable amount of demand regardless of decreasing government subsidies.

Compared with Apple, which also diversifies its products to meet various demands and targets high-end customers, Tesla holds a low market share and low amount of deliveries. A further exposed Tesla's issue in market positioning and supply chain management. Tesla has a high brand premium, as well as Apple. However, Tesla failed to build a concrete industry barrier, and its brand image highly depends on CEO Elon Musk, who has erratic behavior according to the SWOT analysis.

<b>Strength</b> <ul style="list-style-type: none"> <li>- Unique Position in the Auto Market</li> <li>- Robust Sale Growth</li> <li>- Strong brand</li> <li>- Innovative atmosphere</li> <li>- Engineering expertise</li> </ul>	<b>Weakness</b> <ul style="list-style-type: none"> <li>- Burning Through Cash/High debt loan</li> <li>- Manufacturing complication</li> <li>- Lack of high volume production</li> <li>- Limited battery supplies</li> <li>- Unable to meet demand, which affects the brand value</li> <li>- Elon Musk(erratic behavior) as Tesla's sole representation</li> <li>- High operational cost</li> </ul>
<b>Opportunity</b> <ul style="list-style-type: none"> <li>- Sale expansion in Untapped market</li> <li>- Less expensive products</li> <li>- Battery technology in-house</li> <li>- Autopilot</li> </ul>	<b>Threat</b> <ul style="list-style-type: none"> <li>- Product liability claims</li> <li>- Extensive sustainability</li> <li>- Disruption of supply due to shortage of materials</li> <li>- Usage of explosive lithium-ion</li> <li>- Government regulation</li> <li>- Currency and economy fluctuation</li> </ul>

Figure 3. Tesla SWOT Analysis

### 4.3. SWOT Analysis

#### 4.3.1. Strength-Opportunity

Tesla's robust growth and strong brand allow it to expand rapidly. Sale expansion in the untapped market such as India or second and third-tier cities in China. What is more, Tesla could utilize its innovative atmosphere to make less expensive products to meet various demands in less-developed areas.

#### 4.3.2. Strength-Threat

Tesla has strong engineering expertise that should be able to remedy its product liability claim. Because Tesla set the factory in Shanghai, the Chinese government allows it to operate independently. Additionally, Tesla's Shanghai Gigafactory could buffer its supply shortage of materials by taking advantage of the existing supply web in the adjacent areas and have an efficient delivery in China.

#### 4.3.3. Weakness-Opportunity

Though Tesla employs a cash-burning strategy, the result is remarkable: Tesla indeed achieved a higher market share and it became profitable in recent years. Tesla's manufacturing



complication is partly a result of supply chain disruption such as battery supply. However, Tesla's in-house battery technology can increase the demand for batteries, and negotiate a better discount with suppliers with a larger scale order, which can further lower the production cost. Because of Tesla's unique selling model and low production scale, it is unable to meet the demand, which affects the brand value. Tesla's focus on innovation propaganda autopilot can hedge this downside. To build a strong brand in terms of innovation is Tesla's strength and opportunity.

#### 4.3.4. Weakness-Threat

Tesla could add intermedia dealers that allow consumers to get car delivery within days instead of months. The online customization should be preserved but only be preserved online. Customized products should be the only service that requires a long waiting time. Additionally, Tesla should use its cash economically and reduce debt loans to achieve long-term sustainability.

## 5. Conclusion

The first research question is why Tesla can't sell more cars. Found from the literature review, it is because Tesla is now having inventory shortage obstacles[16]. The coming question is why Tesla is having an inventory shortage. By qualitatively analyzing Tesla's supply chain management in the Chinese EV market, the conclusion is that Tesla's unique B2C model lacks a precise computation of EOQ that leads to the inventory management issue. What is more, the SWOT analysis shows that Tesla's complicated production undermined its high-volume production. A related question to this is how many inventories other companies hold. In the introduction part, this paper mainly established an overall understanding of the Chinese EV market and all of the EV companies' situation in China, including Tesla's and its competitors': Byton, BYD, and ROEWE are facing the same inventory shortage problem as Tesla is; Zotye, NIO, and BMW have an issue on the surplus of inventories. Besides, the question of how Tesla should improve its business strategy in terms of selling and stocking comes up. After doing the SWOT analysis, a few pieces of advice are drawn. Firstly, Tesla could enlarge its sales areas. Those Chinese third-tier cities and India are good examples. Second of all, the company could innovate some cheaper products to satisfy the varied demands in different developing areas. Thirdly, the requirement of battery life can be improved by its in-house battery technology, and get a bigger discount with the suppliers at the same time. Last but not least, Tesla could choose to use intermedia dealers so customers would get the car delivered as soon as possible.

Based on the analysis section, the vulnerabilities of Tesla are shown in some aspects. Firstly, Tesla is facing a lithium-ion battery shortage, a rare earth material that experts suspect that consumption is not unsustainable. Second, the Chinese government decided to decline subsidies on the EV market, so Tesla still requires its self-efficiency. Thirdly, Tesla is taken into an awkward market place due to its market positioning today: engaging with high-end consumers. Besides, Tesla is facing substitute product threats that are provided by its counterparts in the Chinese market.

## 6. Next Step (Recommendation)

any further research on this topic is recommended to consider the following steps. First, more accurate analysis of the EV market situation should be conducted by gathering a database that allows mathematical modeling. Researchers should collect all the products' prices in the market and use statistical approaches to determine whether the market is a monopolistic competitive market or an oligopoly.

What's more, a questionnaire for randomly selected customers that asks their waiting time for car delivery and their average daily maintenance cost is valuable.

Third, if possible, interviewing Tesla's staff and executives will be very helpful in terms of digging into the insight of inventory and supply chain management. Asking questions such as "what is the operational cost of this plant" is practical.

Lastly, making a decision tree for Tesla's supply chain will help researchers to understand the risk in different parts of the supply web. Furthermore, it will reveal how to improve supply chain management.

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