



**UNIVERSITY OF LEEDS**

Leeds University Business School

This document is associated with Economics and Management course (2019-2020) from Leeds University Business School. It is about research and study of economics and management regarding Battery Electric Vehicles. It consists of 2 projects:

The first part: Management

The second part: Economics



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## I. Introduction

Nowadays, the pollution caused by conventional fuel vehicles has caught public eyes. New Energy Vehicle (NEV), consisting of battery electric vehicles (BEV) and Plug in Hybrid Electric Vehicles (PHEV) have been invented successfully. That's why many foreign countries have legislated laws for banning to sell conventional fuel vehicles in future (2017), the time is shown in fig 1. For instance, Netherlands won't allow to sell fuel vehicles in 2025.



Netherlands: 2025



Norway: 2025



Germany: 2030



India: 2030



France: 2040



UK: 2040

*Figure 1: Time of foreign counties' ban to sell fuel vehicles*

By December 2019, there have been over 325 million cars in China. (2019) The rapid growth of the car creates a lot of problems. Firstly, the car fume is one of the most important factors in the air pollution which causes serious impact. Besides, the large number of oil consumption makes a challenge to the energy security of China. In this situation the development of the new energy is the trend of time. In this report the advantages and disadvantages of BYD Don DM, belonging to PHEV in China, will be analyzed by the model like the Boston Matrix, PEST, SWOT and Porter's Five Force.

## I. Environment

### 2.1 Politics

In recent years, China has become the biggest market of NEV in the world thanks to the supportive policies, which benefit many fields including manufacture and consumption of electrical vehicle. The policy of fiscal subsidies is the most effective way among them.

The policy of fiscal subsidies aims to supply consumers with discounts on buying electrical vehicle and was initiated in 13 pilot cities in 2009. (Cheng,2019)

In 2019, with the wane of the policy of fiscal subsidies, more policies set to promote technology and quality. It is reasonable to believe the sale of BYD Don can be decreased in a short time. At the same time, it also indicates the resolution of government to upgrade the whole industry.

Some local governments also advocate NEV by making the vehicle license plates more accessible. Annual quota of license plate for passenger vehicles in Beijing will be 0.1 million, 40% for ordinary vehicles and 60% for NEV in 2019. Almost 3 million applicants have to lottery conventional fuel vehicle's license plates. (2019)



Figure 3: Government aims to facilitate the use of NEV.



Figure 2: Fiscal subsidies for NEV.

Moreover, unlike PHEV who are banned to be used in one workday according to respective last number in license plate, BEV can be operated everyday thanks to The People's Government of Beijing Municipality Regulation (2019), which aims to facilitate the use of BEV.

## 2.2 Economics

The economic situation is not in favor of electrical car in the domestic market. The rate of inflation high and at the rate of 3.8% CPI in October 2019 (An, 2019). The increase in the price of daily commodities can make public short of money and unwilling to purchase something irrelevant to their physiological needs.



Figure 4: CPI

Besides, the cost of labor is on the rise. The average wage of manufacture industry has risen from 12671 Yuan in 2004 to 59470 Yuan in 2016. (Yang, 2019). The rising cost of labor will decrease the profit of BYD company.

## 2.3 Social

In China, the development of electrical car is hindered by the number of charging station. If the number of charging station is insufficient, the owners will feel inconvenient to find a place to charge their car. Although China possessed DC charging stations up to 49 thousand in 2015, it is a weak number compared with 583.2 thousand electrical cars. (Zhao,2019). In addition, the charging station resources are not well utilized because they are often occupied by fuel vehicles, which aggravates the public desire to purchase NEV.

But the situation will be improved, National Development and Reform Commission (2015) announced the decision to construct 12 thousand centralized electrical changing stations and 4.8 million distributed charging piles by the end of 2020 to meet the need of 5 million electrical cars.



Figure 5: Technical personnel

The development of NEV can be boosted due to the higher education, which brings up many technical personnel and skilled workers. And relative courses and researches spring up in Chinese universities, ensuring

ongoing progress in technology.

## 2.4 Technology

After 3 5-year plan scientific and technological breakthroughs, China has mastered the whole vehicle technology of new energy commercial vehicles and realized the transformation from hybrid power to pure electric drive. In the aspect of key parts, lithium ion vehicle power battery technology and motor drive system technology have made great progress. In terms of public platform technology, NEV standard system and vehicle, battery and motor test platform have been established. (2016)

At present China's NEV charging infrastructure is imperfect, relatively long time of car charging is a important factor. If it is a pure electric version of the electric vehicle and used for quick charging, the charging time will be about 3-4 hours. (Qi, 2019)



Figure 6: Charging station of NEV

Moreover, battery technology needs a breakthrough. First, power batteries have a low energy density. According to the statistics of electric vehicle resource network, the 46 passenger cars in this batch of recommended list have the power battery system energy density of most models ranging from 140 (inclusive) to 160Wh/kg (2018). Under the condition of keeping the weight of traditional cars and NEV, its driving range is only about 160 kilometers, less

than conventional fuel cars.

Thirdly, the batteries are short-lived. The service life of Chinese lithium battery is about 3 to 5 years or 1600 times, while the conventional fuel cars' is longer than 10 years.

## II. Firm

### 3.1 Introduction to firm

#### 3.1.1 Company profile

BYD, a Chinese high-tech company founded in 1995 with over 200,000 employees and is headquartered in Shenzhen, devoted to technological innovations for a better life. The company is producer of the automobile, rail transit, etc. There are over 30 industrial parks around the world

In the field of automobile, BYD implements 7+4 Full Market EV strategy to realize the coverage of the full field. Besides many core technologies of new-energy vehicles has been mastered by BYD like the batteries, electric motor, etc. (2018)

#### 3.1.2 State of business

There are three major businesses in BYD including automotive businesses, mobile phone parts and assembly business and secondary battery and photo-voltaic businesses. The whole revenue of BYD is about 59,215 million yuan in the first half of the year, up 14.06 % year to year. The details of three businesses' proportion is showed the figure 7 (2019). But it's worth noting that in the newest firm financial report there is 88.58% reduction of the net profit in the third quarter when the government began to reduce the subsidy of the new energy automobile compare to the last year's third quarter.



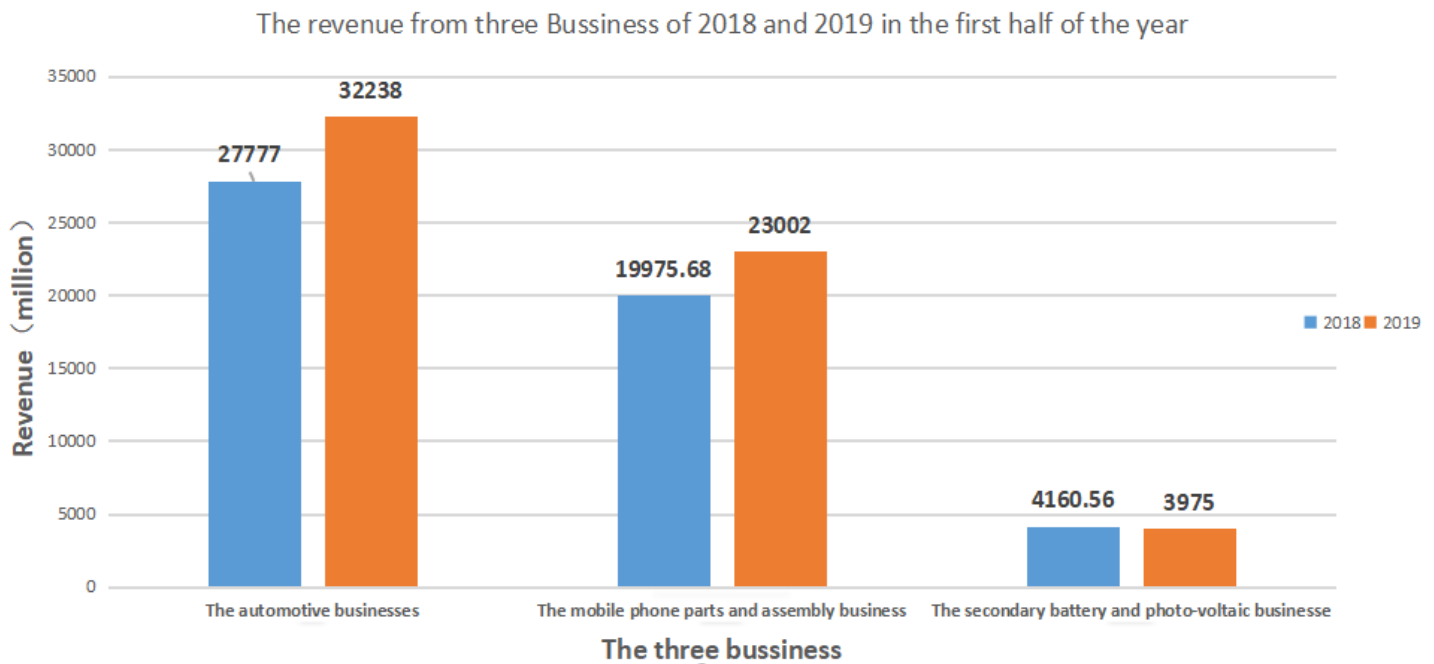


Figure 7: The revenue from three business of 2018 and 2019 in the first half of year

According to the data above and information from company's website, Boston Matrix shown in fig 8 can be used to analyze the products of BYD.

#### The Boston Matrix for BYD

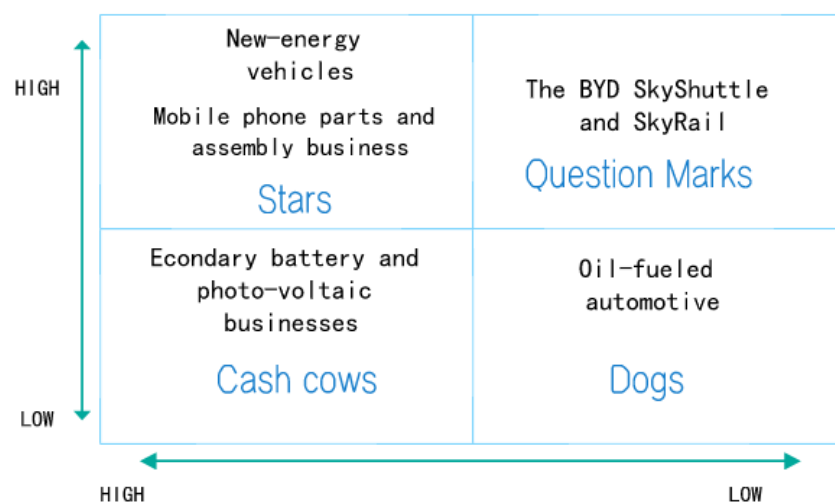


Figure 8: Boston Matrix for BYD

Focus on the automotive part, BYD is the industry leader in the Chinese NEV businesses. The market share of the new energy of automotive business increased from 20% in 2018 to 24% in 2019. In the 2019 BYD has launched many new kinds of new energy automobile of the Dynasty series like new Don

EV which is the fastest NEV in China.

### 3.1.3 Crew and Management



Figure 9: Chuanfu Wang

Chuanfu Wang, 54 years old, is the executive director and founder of the BYD. He has 18.83% shareholding ratio of BYD. Besides his brother also has 14.73% shown in table 1. From his experience, it can be known he is a man with purposeful and independent character who good at

taking advantage of the BYD and dare to challenge. Under the leadership of Wang the BYD creates the kangaroo management theory. BYD has three features like the kangaroo: “long leg”, “pouch” and “self run”. (Chen, 2010)

Name	Number of A-shares	Shareholding ratio
Chuanfu Wang	513,623,850	18.83%
Xiangyang lv	401,910,480	14.73%

Table 1: Number of A-shares and shareholding ratio for Wang

### 3.1.4 Supply chain

Vertically integrated purchasing management strategy was adopted. The self-sufficiency rate of accessories is over 50%. It is different many large enterprises around the world. Relying on the strategy of the Vehicle design, engine, vehicle electronics, BYD is capable to use the resources more efficiently and reduce cost. As the result the product of BYD is more reasonable performance to price ratio. The power of supplier is relatively low. But every coin has two sides. This model also has some disadvantage. Due to the long industrial chain the BYD need more money to support it. Or When the financial situation is not optimistic it will limit the development of the company. Since 2015, the revolution of the supply chain has begun.

Increasing parts manufacturers will collaborate with BYD. (2018) As a result, the power of supplier may gradually increase.

### 3.2 Strength

BYD has a good reputation among consumers, some artistic designs satisfy them such as dragon face.

Also, BYD adopt vertical integration management which has an efficient degree of self-sufficiency and minimize the cost of resources.

As for the leadership, its CEO Chuanfu Wang is a person who dares to challenge and innovate. He also created the kangaroo management theory and implemented 7+4 Full Market EV Strategy. The company prospers under the charge of him and has a great number of crews and industrial estates.

So far, BYD has mastered numerous technologies and invest heavily. As a result, it can receive many orders from manufacturers who pay highly for its products. Gradually, it becomes well-known and accumulates a lot of assets. Especially BYD's battery technology, it can function between -40 to 60°C with approximately 1 hour charging time.(Sun, 2019).

### 3.3 Weakness

The low-mileage and high price of Don incurs discontented feedback from consumers. Secondly, vertical integration management needs high investment. Another shortcoming is that BYD has low international fame and its oversea sale is approximately zero. Finally, CEO Wang is too influential and holds a lot of shares in the company. Once he made an unwise decision, no one can prevent him doing so.

### 3.4 Opportunity

Chinese government implements many favorable policies to upgrade the NEV industry. Nowadays, government speeds up the construction of charging

station to meet the needs of consumers.

Populous domestic market is suitable for BYD Don due to the potential growth in the future. People who receive high education are more likely to purchase Don.

In the future, China may make breakthroughs in NEV thanks to the rising number of talents who receive higher education.

### 3.5 Threats

First, high level of inflation and the increase in prices of daily commodities can pose challenges for Don, because these factors shrink the purchasing power of the public. What's worse, those prices sensitive buyers become reluctant to buy Don as the government has decided to cut down the subsidies for buying NEV.

Also, the cost of labor can decrease the profit of BYD company. Once BYD company lack of money, they are unable to invest the places where desperately need money and innovate to make breakthroughs. Especially some aspects such as high cost and low lifespan of battery need improvement.

Some joint venture enterprises take the share and cause trouble to Don. Finally, current infrastructure is imperfect and can't meet the need of charging.

## IV. Product

### 4.1 Introduction to Don DM

BYD Don is a mid-size SUV, with fuel vehicles (Don), plug-in hybrid (DM) and pure electric vehicles (Don EV600) three models, including fuel cars and plug-in hybrid provide all editions of models, which are based on BYD BNA framework of BLP platform to build, the vehicle on modelling basic same, and have adopted the "Dragon Face" design concept (2018).



*Figure 10: BYD Don DM*

## 4.2 Product's features

BYD Don DM 's 100km acceleration time takes only 4.3 seconds, it has dual-mode drive and have a HEV/ECO/SPORT/EV four driving modes, in addition, it's pure electric range is 81 km, and before and after carrying the AC permanent magnet synchronous motor, the total power of 441 kw. There is also a DiLink smart networking system, which can use most mobile software, and a Dirac Live hi-fi system. (2018) BYD Don, as scarce existing PHEV, is priced around 240000 Yuan, the power of buyer is relatively low.

From consumers' feedback, people are also satisfied with the acceleration of the car. However, buyers reported a relatively high level of driving noise, and the operation was slightly more complicated and difficult to start. (Yi, 2019)

## 4.3 Technology

### 4.3.1 Advantage

BYD has complete and mature battery industry chain, which helps BYD's NEV improve performance and technology.

A Chinese researcher has made a comparison between many NEV company. As showing in table 2, BYD owns all mentioned technology. On the

contrast, no one company has owned all technology. (Xu, 2019). Many automotive companies have been trying to conquer these technologies but fail. Obviously, it has become a barrier to entry.

	Tesla	Nissan	NIO	ROEWE	BYD
Full Car OTA	√	√	√	√	√
Panorama Image			√		√
Human Computer Interaction	√		√	√	√
Head-up Display	√				√
Long-range control	√	√	√	√	√
ADAS	√				√

*Table 2: A comparison with several BEV company*

Table 3 below have listed some salable NEV. As shown, its system integrated max power and torque are the greatest among those vehicles. (2019)

#### 4.3.2 Disadvantage

There are some disadvantages for this product shown in table 3. Its price is much higher than other, even if it is 4 times more expensive than other vehicles. Its battery capacity is the lowest, but almost no difference. Its pure electric driving distance in working condition is the lowest, which is a fatal flaw. BAIC EU5's is 5 times further than its!

	Price (Yuan)	System Integrated Max power ( kW )	System Integrated Max Torque ( N·m )	Working Condition Pure Electric Driving Distance ( Km )	Battery Capacity ( kWh )
BYD Don DM	229900	321	700	81	19.96
Chery E100	49800			250	24
BAIC EU5	129900		300	416	
Chery eQ	65800	41.8	150	151	22.3

*Table 3: Comprehensive comparison of NEVs.*

## 4.4 Market

### 4.4.1 Condition (sale volume)

The sales volume of NEV is increasing year by year. There is indeed a strong market potential in China. Although BEV will account for a larger proportion, PHEV will still become an important factor affecting market sales. More detail can be found in table 5, appendix.

It's not hard to see from the chart that BYD's dynasty line of PHEV has been selling well. But sales of Don DM have declined in 2019. The internal reason is that Don is BYD's flagship model in 2018. The external factor is the rise of PHEV of joint-venture brands, as with some brands mentioned, they're more competitive.

When Don DM first appeared on the market in 2017, the sale was weak in 2017 shown in fig 11. Then BYD company promoted it by advertising and its sale culminate in February 2019 at the volume of 6.9 thousand. After BYD subordinating Don to another BEV Song Pro, its sale maintains in the vicinity of the volume of 2 thousand.

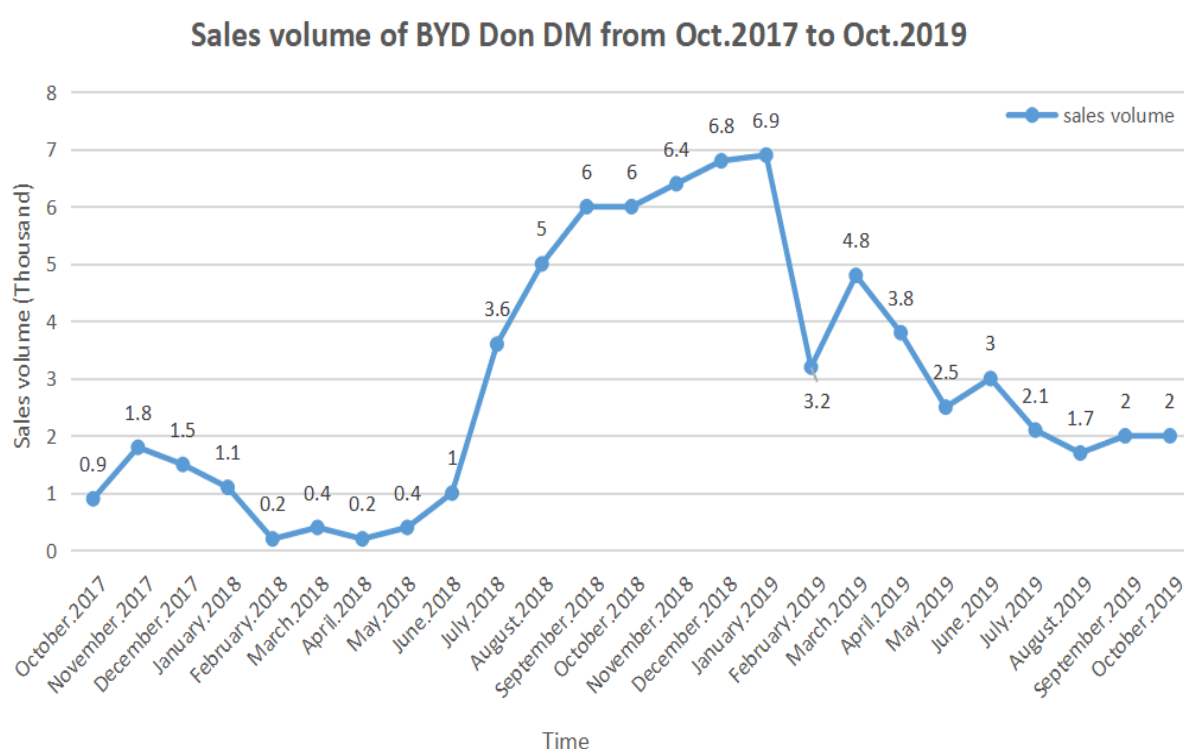


Figure 11: Sale Volume of BYD Don DM recently

#### 4.4.2 Competition level and substitutions

Though Don DM has some product strengths, with the development of NEV, more and more competitors come out, such as BAIC, TESLA, etc. Moreover, the competitive power of Don DM is decreasing, and more substitutions such as its brothers Yuan EV and e5, its competitors: Chery eQ and Emgrand EV should not be overlooked and they are getting increasing attentions.

From the sales volume of NEV shown in fig 12, almost sales volume of virtually all electric cars rose in 2019 compared with 2018. BAGC EU and BYD Yuan EV had the largest proportion of the sales volume of NEV which sharply rose up. Despite dismal sales in 2018, EADO EV has rocketed and become



increasingly competitive. On the other hand, as a new model in 2019, Ora r1 still occupied a relatively large market which was almost the same as Emgrand EV and Roove Ei5. (Zhu, 2019)

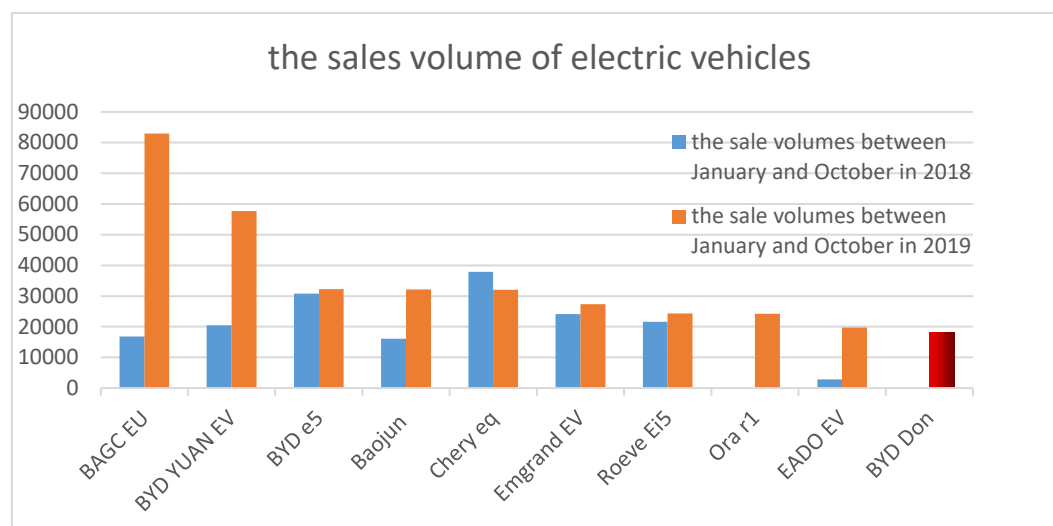


Figure 12: The sale volumes of electric car

As shown in fig 13, BYD Don DM ranks 14th among all midsize SUVs. Most of the vehicles with better sales are gasoline vehicles. Therefore, NEV do not have strong competitiveness in the market of medium-sized SUVs.

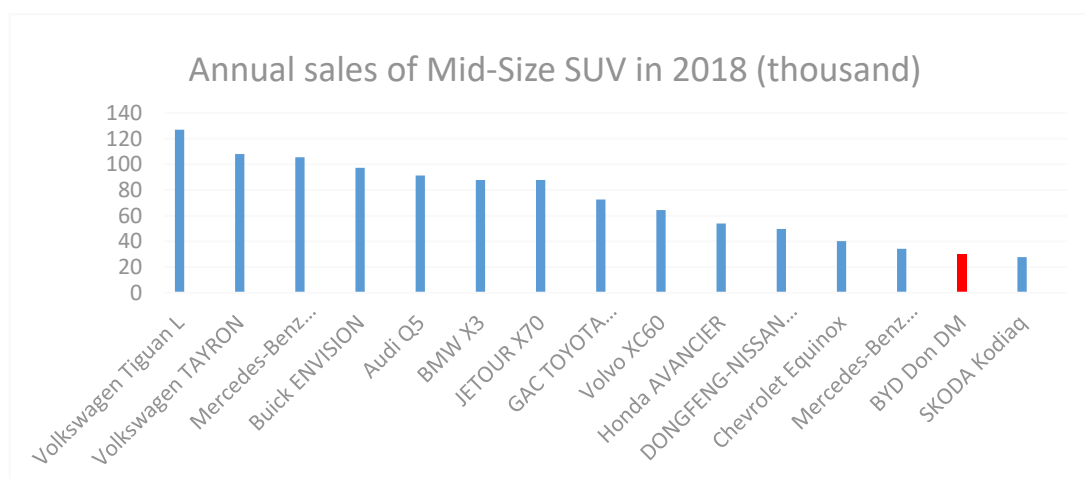


Figure 13: Annual sales of Mid-Size SUV in 2018 (thousand)

In a car market with a price tag of around 240,000, consumers relatively prefer the BYD Don DM (3rd). It can be seen that it not only outperforms other PHEVs at the same price, but also surpasses many gasoline vehicles as fig 14 shown.

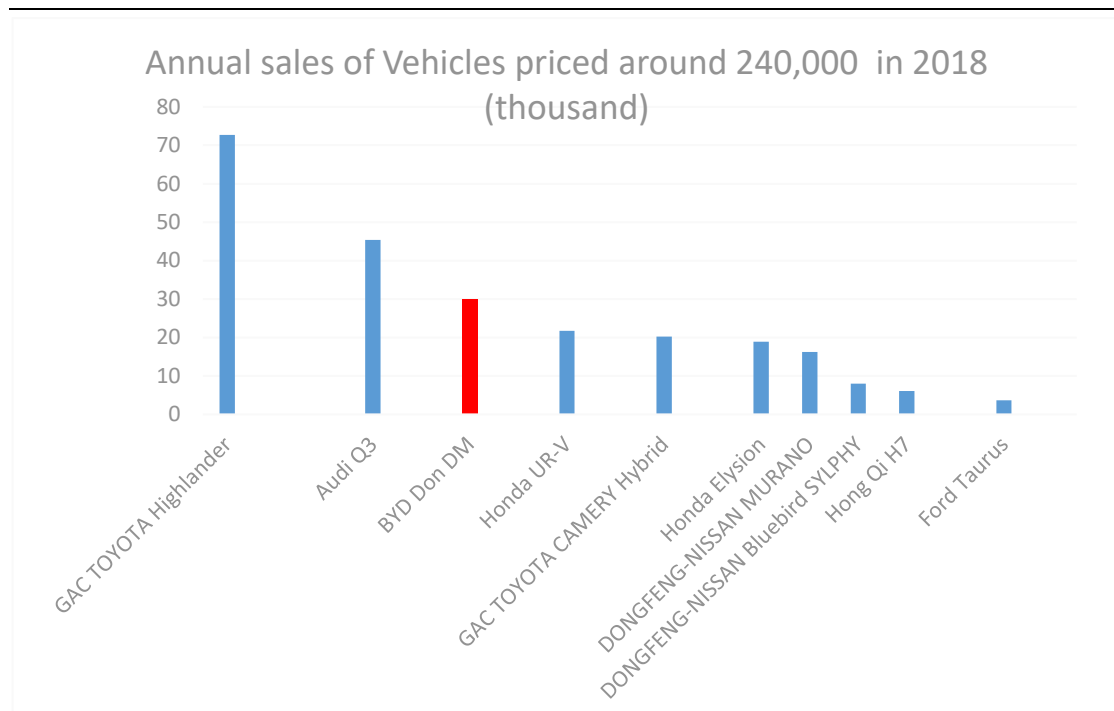


Figure 14: Annual sales of Vehicles priced around 240,000 in 2018 (thousand)

The annual sales of Don DM are about 30 thousand, however, the worst sellers on the list are about 200 thousand. Fuel vehicle is a competitive substitution for BYD Don shown in fig 15.

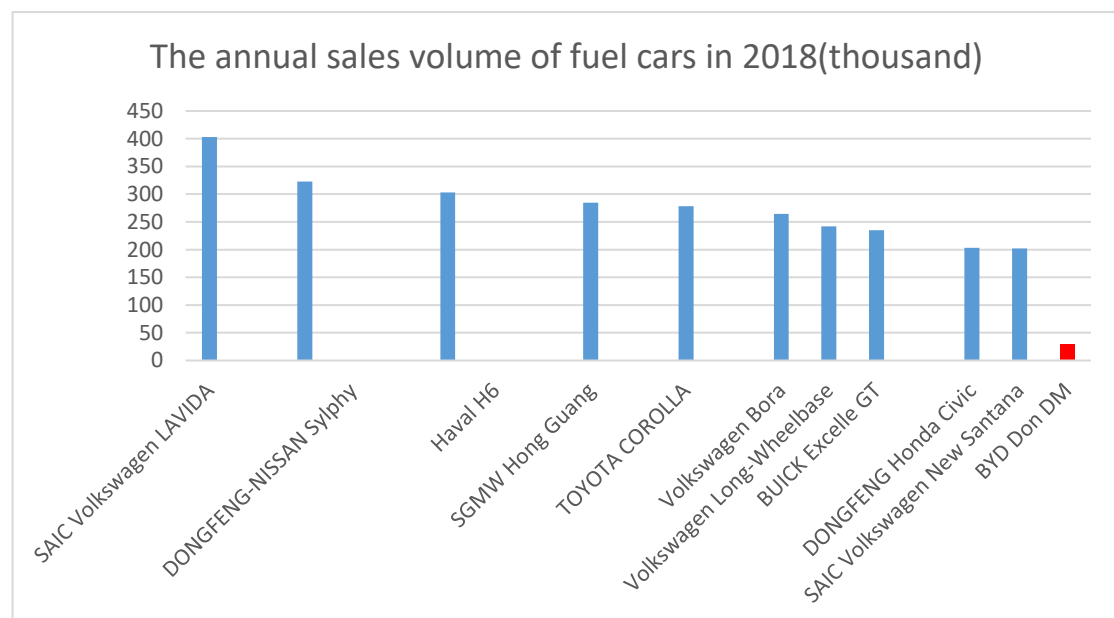


Figure 15: The annual sales volume of gasoline cars in 2018 (thousand)

Among PHEV, the sales volume of Don DM is high due to its technology and brand advantages. (showed in figure 16)

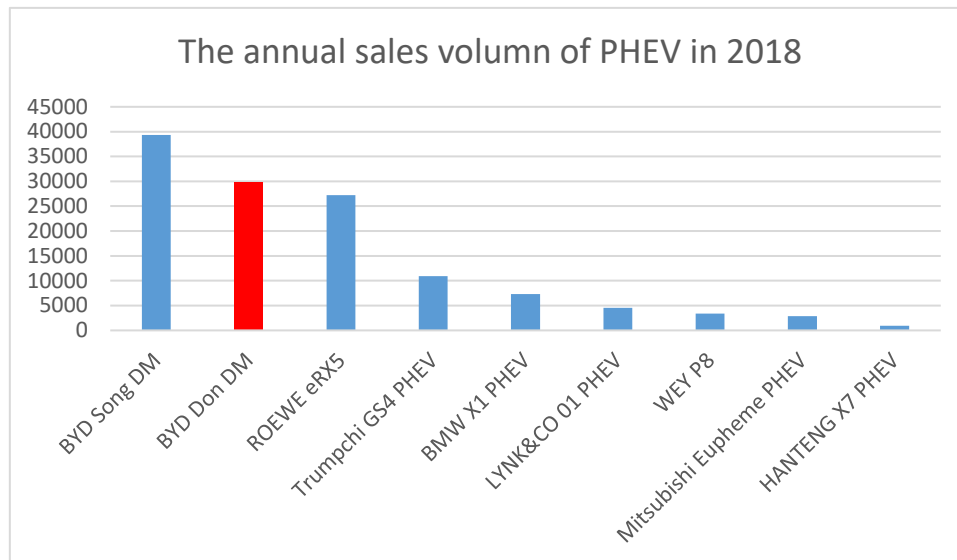


Figure 16: The annual sales volume of PHEV in 2018

## V. Conclusion

In conclusion it can be found that the NEV is becoming the main stream in the future which creates opportunities for the NEV companies. But there are also many threatens to them such as the reduction of the subsidies and so on.

The BYD, a company with numerous technologies is competitive in China market now. However, the excessive concentration of power and the overextended industrial may pose many potential threats. As a main product of BYD, the Don DM is product with high satisfaction. The PHEV not only conform to the new energy policy and fuel-efficient but also avoid the inconvenience of electric cars. But to become more successful and competitive in the domestic market, it still needs to make up for the deficiency in certain fields, for example, the cost of battery. BYD and Don have a long way to go.

## VI. Appendix

On March 26, 2019, the Ministry of Finance (2019) issued a notice on further improving the fiscal subsidy policy for the promotion and application of NEV. The new subsidy policy for NEV is detailed in the notice. For plug-in hybrid models, the subsidy is 10,000 yuan per vehicle. However, according to the new policy issued by Chengdu municipal people's government (2019), on the basis of the central financial subsidy, a municipal supporting subsidy of 50% of the central financial subsidy for each vehicle is given. In addition, subsidies for buyers of NEV will be eliminated in the near future.

Table 4 is the sale volume of NEV from 2016 to 2019 Q1.

Date	Cumulative sales value (10,000 units)	Year-on-year sales increase or decrease (%)	Inventory increase or decrease at the beginning of the year (%)
2019 Q1	23.81	1.7	42.9
2018 Q4	131.73	1.7	11
2018 Q2	46.79	3.5	13.9
2018 Q1	16.46	-8.4	54.7
2017 Q4	80.38	-1.6	46.3
2017 Q3	37.86	-10.8	101
2017 Q2	18.28	-9.3	73.3
2017 Q1	6.04	-16	12.9
2016 Q4	48.19	0.6	12.5
2016 Q3	43.07	-0.4	33.5
2016 Q2	27.75	5.8	10.4

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2016 Q1	8.78	10.6	-8.3
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*Table 4: Sale data of NEV*

Table 5 is the sale volumes of BYD Don DM in different conditions.

	2019-7	019-8	019-9	2019-9 compare on year-on-year	2019-9link relative ratio	1-9 accumulative total	The cumulative year-on- year
BYD Don DM sales	2100	658	012	-66.57%	21.35%	29.9 thousand	91.73 %
Among them, PHEV sales	2100	658	012	-66.57%	21.35%	29.9 thousand	91.73 %
Share of BYD	6.90%	.68 %	.02 %	---	---	9.72%	---
In 170,000- 280,000 yuan model share	0.70%	.51 %	.59 %	---	---	1.10%	---
Share in the SUV segment	0.34%	.24 %	.26 %	---	---	0.50%	---

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Ranked in 170,000- 280,000 yuan models	38	7	2	---	---	23	---
Ranked among SUV segment	86	04	9	---	---	61	---

Table 5: Sale data of BYD Don DM

Following figures lists some feedback from consumers (in Chinese).



Figure 17: Consumer's Feedback



Figure 18: Consumer's Feedback

## XJME 2640 Economics and Management



综合评价 **5.00**

外观

★★★★★

5

内饰

★★★★★

5

空间

★★★★★

5

舒适

★★★★★

5

油耗

★★★★★

5

动力

★★★★★

5

操控

★★★★★

5

性价比

★★★★★

5





发表于 2019-03-27

精华

购车信息

爱车车型	2019款唐DM 2.0T 四驱智联创领型 5座 国V
购入时间	2019-01-01
购车地点	[广东省]
裸车价格	26万 (厂商指导价 27.49万)
当前油耗	11L/100km

实拍图片



爱车简评

首先给人的感觉是非常舒适的，高速行驶也足够扎实。对于我来说，纯电模式表现已非常够用，基本每天我家五个人坐，空间完全达到我的要求，七座只是零时急用。夜间LED灯很好看，有人说很炫还有一点骚气。

爱车评价

**【最满意】**到现在已有两个月，行驶已有2000多公里，首先我觉得动力非常充足，混动模式时，更加动力充沛，提速超车一气呵成。转向精准，100公里每小时高速公路过弯很平稳，内饰很精致，自动启停很实用，没有顿挫感，也不用担心发动机频繁启动。比亚迪唐拥有精秀的外观和良好的做工，可以说在同级别当中处于绝对领先的地位。在日常驾驶中，首先给人的感觉是非常舒适的，高速行驶也足够扎实。对于我来说，纯电模式表现已非常够用，基本每天我家五个人坐，空间完全达到我的要求，七座只是零时急用。夜间LED灯很好看，有人说很炫还有一点骚气。

**【不满意】**没有提供备胎，长途驾驶还是有点担心。重新买了一套原厂22寸轮毂和马牌轮胎，有备无患。

**【外观】**外形只能用惊艳来形容，这个价位来说在国产车中属于佼佼者。新车前脸采用比亚迪最新dragon face家庭式造型，前格栅

Figure 19: Consumer's Feedback



综合评价 **5.00**

外观

★★★★★

5

内饰

★★★★★

5

空间

★★★★★

5

舒适

★★★★★

5

油耗

★★★★★

5

动力

★★★★★

5

操控

★★★★★

5

性价比

★★★★★

5

发表于 2019-02-28

精华

购车信息

爱车车型	2019款唐DM 2.0T 四驱智联创领型 5座 国V
购入时间	2019-01-01
购车地点	[广东省]
裸车价格	26万 (厂商指导价 25.49万)
当前油耗	3L/100km

实拍图片



爱车简评

在日常驾驶中，首先给人的感觉是非常舒适的，高速行驶也足够扎实。对于我来说，纯电模式表现已非常够用，基本每天我家五个人坐，空间完全达到我的要求，七座只是零时急用。夜间LED灯很好看，有人说很炫还有一点骚气。

爱车评价

**【最满意】**我觉得动力非常充足，混动模式时，更加动力充沛，提速超车一气呵成。转向精准，100公里每小时高速公路过弯很平稳，内饰很精致，自动启停很实用，没有顿挫感，也不用担心发动机频繁启动。比亚迪唐拥有精秀的外观和良好的做工，可以说在同级别当中处于绝对领先的地位。在日常驾驶中，首先给人的感觉是非常舒适的，高速行驶也足够扎实。对于我来说，纯电模式表现已非常够用，基本每天我家五个人坐，空间完全达到我的要求，七座只是零时急用。夜间LED灯很好看，有人说很炫还有一点骚气。

**【不满意】**没有提供备胎，长途驾驶还是有点担心。重新买了一套原厂22寸轮毂和马牌轮胎，有备无患。

**【外观】**外形只能用惊艳来形容，这个价位来说在国产车中属于佼佼者。新车前脸采用比亚迪最新dragon face家庭式造型，前格栅

Figure 20: Consumer's Feedback

VI. Reference

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**XJME2640**

**Economics and Management**

**Team Peer Assessment for Assignment**

**Group ID:**

**Mark**

For Module Leader  
use only

Student Name	Student Number (SID)	Signature
Yuhui Bi	201199486	Yuhui Bi
Shengting Xie	201199318	Shengting Xie
Feng Yu	201199250	Feng Yu
Yuanyuan Liu	201199500	Yuanyuan Liu
Yao Tan	201199283	Yao Tan

*Each design team should submit*

- *One copy of this page*
- *One copy of Peer Assessment form: Summary*
- *A copy of Peer Assessment form for each group member.*

*All the above must be bound or stapled together.*

## Peer Assessment Form: Summary

Carry forward totals for each assessing student's sheet onto this form, including each student's self assessment

	Assessed Student Names	1 Yuhui Bi	2 Shengting Xie	3 Feng Yu	4 Yuan yuan Liu	5 Yao Tan
Assessing Student						
1 Yuhui Bi		24	22	22	19	18
2 Shengting Xie		24	23	23	22	22
3 Feng Yu		24	24	24	22	21
4 Yuanyuan Liu		24	24	24	24	24
5 Yao Tan		24	24	24	24	24
Total for each student ( $S_1, S_2, \dots, S_9$ )		120	117	117	111	109

Group Average, GrpAv	$\frac{\sum S_i}{n}$	114.8
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Peer Group Factor	$S_i/\text{GrpAv}$	1.05	1.02	1.02	0.97	0.95
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## Peer Assessment Form

After your group has completed the case study assignments each member of the group should complete one of the following forms. Then, as a group, collate the marks on the summary form on the Peer Assessment Form: Summary.

To complete the form attempt to assess, under the headings given, the level of contribution of each of the group members, **including yourself**, towards the completion of the assignments.

Score using a points scale of 0 to 6:-

**6** being for **outstanding** contribution

**1** being for **minimal** contribution

**0** being for **NO** contribution - this should be used only in exceptional circumstances

Assessing Student	Signature	Group ID
<b>Yuhui Bi</b>	<b>Yuhui Bi</b>	<b>201199486</b>

Assessed Student Names	1 Yuhui Bi	2 Shengting Xie	3 Feng Yu	4 Yuan Liu	5 Yao Tan
Contribution to group					
Was he/she regularly at the group meetings and available for discussion, planning and actions?	6	6	5	4.5	5
Did he/she contribute to the needs of the group? e.g. produce ideas, listen to others, provide leadership or direction, help the group function well as a team.	6	5	6	5	4.5
Did he/she do what was agreed to be done at the meetings?	6	6	5	5	4
Did he/she take a fair share of the work?	6	5	6	4.5	4.5
<b>Total for each student</b> (max 24)	<b>24</b>	<b>22</b>	<b>22</b>	<b>19</b>	<b>18</b>
(Please carry forward to summary sheet)					

## Peer Assessment Form

After your group has completed the case study assignments each member of the group should complete one of the following forms. Then, as a group, collate the marks on the summary form on the Peer Assessment Form: Summary.

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Assessing Student	Signature	Group ID
Shengting Xie	Shengting Xie	

Assessed Student Names	1 Yuhui Bi	2 Shengting Xie	3 Feng Yu	4 Yuan Liu	5 Yao Tan
Contribution to group					
Was he/she regularly at the group meetings and available for discussion, planning and actions?	6	6	5	5	5
Did he/she contribute to the needs of the group? e.g. produce ideas, listen to others, provide leadership or direction, help the group function well as a team.	6	6	6	6	6
Did he/she do what was agreed to be done at the meetings?	6	6	6	6	5
Did he/she take a fair share of the work?	6	5	6	5	6
<b>Total for each student</b> (max 24)	<b>24</b>	<b>23</b>	<b>23</b>	<b>22</b>	<b>22</b>
(Please carry forward to summary sheet)					



## Peer Assessment Form

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Assessing Student	Signature	Group ID
Feng Yu	Feng Yu	

Assessed Student Names	1 Yuhu i Bi	2 She ngti ng Xie	3 Fen g Yu	4 Yua nyu an Liu	5 Yao Tan
Contribution to group					
Was he/she regularly at the group meetings and available for discussion, planning and actions?	6	6	6	4	5
Did he/she contribute to the needs of the group? e.g. produce ideas, listen to others, provide leadership or direction, help the group function well as a team.	6	6	6	6	5
Did he/she do what was agreed to be done at the meetings?	6	6	6	6	5
Did he/she take a fair share of the work?	6	6	6	6	6
<b>Total for each student</b> (max 24)	24	24	24	22	21
(Please carry forward to summary sheet)					

## Peer Assessment Form

After your group has completed the case study assignments each member of the group should complete one of the following forms. Then, as a group, collate the marks on the summary form on the Peer Assessment Form: Summary.

To complete the form attempt to assess, under the headings given, the level of contribution of each of the group members, **including yourself**, towards the completion of the assignments.

Score using a points scale of 0 to 6:-

**6** being for **outstanding** contribution

**1** being for **minimal** contribution

**0** being for **NO** contribution - this should be used only in exceptional circumstances

Assessing Student	Signature	Group ID
Yuanyuan Liu	Yuanyuan Liu	

Assessed Student Names	1 Yuhu i Bi	2 She ngti ng Xie	3 Fen g Yu	4 Yua nyu an Liu	5 Yao Tan
Contribution to group					
Was he/she regularly at the group meetings and available for discussion, planning and actions?	6	6	6	6	6
Did he/she contribute to the needs of the group? e.g. produce ideas, listen to others, provide leadership or direction, help the group function well as a team.	6	6	6	6	6
Did he/she do what was agreed to be done at the meetings?	6	6	6	6	6
Did he/she take a fair share of the work?	6	6	6	6	6
<b>Total for each student</b> (max 24)	24	24	24	24	24
(Please carry forward to summary sheet)					

## Peer Assessment Form

After your group has completed the case study assignments each member of the group should complete one of the following forms. Then, as a group, collate the marks on the summary form on the Peer Assessment Form: Summary.

To complete the form attempt to assess, under the headings given, the level of contribution of each of the group members, **including yourself**, towards the completion of the assignments.

Score using a points scale of 0 to 6:-

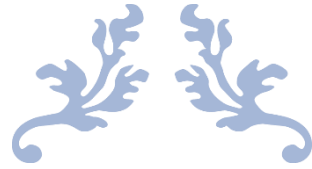
**6** being for **outstanding** contribution

**1** being for **minimal** contribution

**0** being for **NO** contribution - this should be used only in exceptional circumstances

Assessing Student	Signature	Group ID
<b>Yao Tan</b>	<b>Yao Tan</b>	

Assessed Student Names	1 Yuhu i Bi	2 She ngti ng Xie	3 Fen g Yu	4 Yua nyu an Liu	5 Yao Tan
Contribution to group					
Was he/she regularly at the group meetings and available for discussion, planning and actions?	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>
Did he/she contribute to the needs of the group? e.g. produce ideas, listen to others, provide leadership or direction, help the group function well as a team.	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>
Did he/she do what was agreed to be done at the meetings?	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>
Did he/she take a fair share of the work?	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>
<b>Total for each student</b> (max 24)	<b>24</b>	<b>24</b>	<b>24</b>	<b>24</b>	<b>24</b>
(Please carry forward to summary sheet)					



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# ECONOMICS GROUP PROJECT 2020

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Group member	Student ID
Yuhui Bi	201199486
Shengting Xie	201199318
Feng Yu	201199250
Yuanyuan Liu	201199500
Yao Tan	201199283

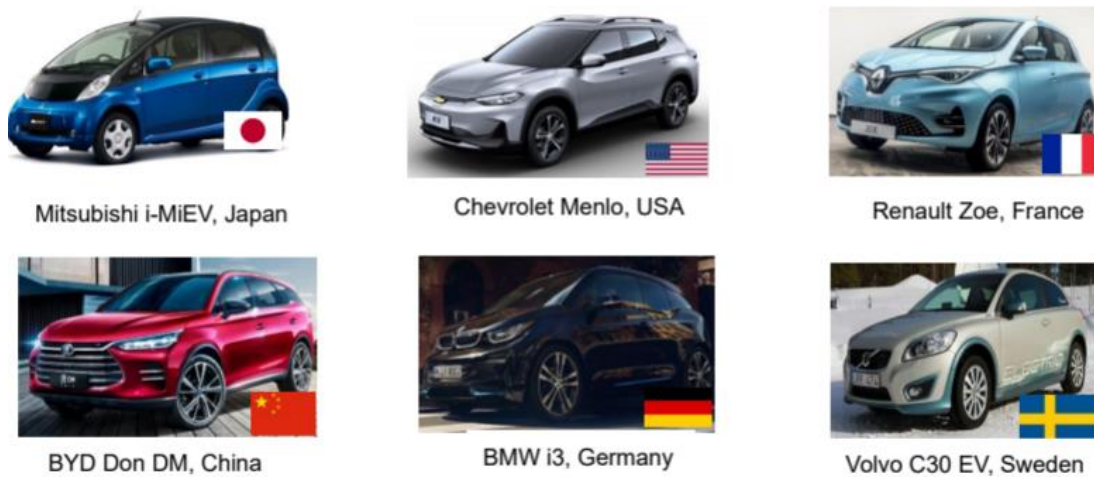
2020-4-29

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## I. Introduction

Nowadays the electric car is a popular trend in the world. The market and manufacture of the electric vehicle are getting a lot of attention. Many well-known vehicle's companies (2020) have devoted themselves to invest BEV (battery electric vehicle), such as Figure 1. Cooperation such as Mitsubishi, and Volvo have their star products in BEV's field.



**Figure 1:** well-known vehicle cooperation with their star product

The Tesla Model S (In the following text, the Tesla Model S is called TMS.) is a High-performance electric car from the Tesla, inc which is an American electric vehicle and clean energy company. As a typical electric vehicle, The TMS is selected for study to better understand the market of electric vehicle. The theories like the market elasticity, nature of competition, minimum efficient scale (MES), net present value (NPV), internal rate of return (IRR) and so on will be applied. Then an evaluation of the manufacture and marketing of the TMS will be given.

## II. Part One---Market and Competition

### 1. Description of product details, features and underlying economic market

TMS is a full-size, high-performance, pure electric vehicle (PEV) made by Tesla. it has advanced electric system, dual motor all-wheel drive, adaptive air suspension, ultra-long endurance and excellent acceleration performance. Besides, it has HEPA (high-efficiency air filtration system) which effectively prevents viruses, bacteria and odors from entering the car, and tinted glass roof, which effectively blocks ultraviolet and infrared rays. The TMS also equips Autopilot, which enables the vehicle to steer, accelerate and brake in the lane when activated, and to park and exit parking spaces when upgraded. (2020)



**Figure 2:** Tesla Model S (2020)

PEV sales have declined due to the decrease or even cancel of state subsidies, but PEV is an inevitable trend from a worldwide perspective. With the technology advancing year by year and the income level of the younger generation increasing, the market for PEV is promising.

## 2. Nature of Product Differentiation

Table 2.1 (in Appendix section) lists the parameters of TMS compared with its competitor. TMS has advantages in maximum power, endurance and acceleration time. overall performance is better than other PEVs (2014). However, compared with the fuel cars, the endurance and extreme speed are the weakness of TMS.

## 3. Market competition type analysis of TMS

There are not many competitors in the PEV market, such as Tesla, BYD and BMW. Although the details of each company's products are different, the core of them is driven by pure electricity. Moreover, there are many barriers to entry in this industry, such as capital barriers, product differentials, technical barriers and administrative barriers. Carmakers rely heavily on upstream raw materials, so suppliers have strong bargaining power. To sum up, the PEV market is oligopolistic competition. In China, the main barrier is administrative barriers, which restrict existing companies from exceeding their target product areas. In addition, some local governments will reject foreign products through administrative means. Tesla is short of liquidity, and despite good car sales, the company is not making much profit because of its high debt. For TMS, these are big barriers to future market expansion. (2017)



**Figure 3:**  
Technical barrier

## 4. Competitive strengths

Tesla has 4 main advantages in the PEV market competition:

1. First-mover advantage. It started to develop PEV in 2003 and has accumulated for 17 years with mature and developed technology.

2. Scale advantage: Tesla is currently the world's largest



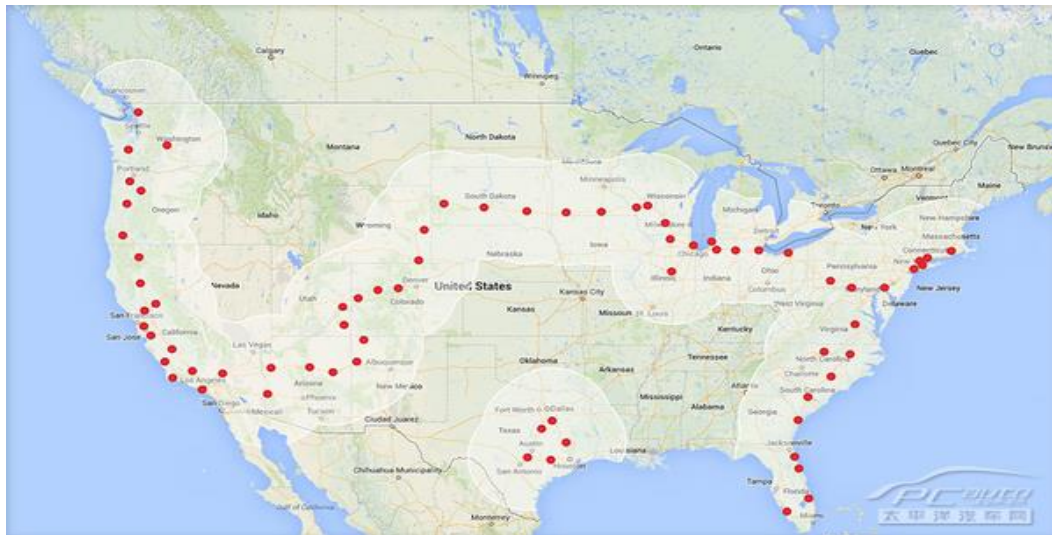
**Figure 4:** Tesla Inc in Shanghai (Baidu Image, 2019)



electric vehicle company by sales volume, in 2018, it delivered 245,000 PEVs with a market share of 12.3%, ranking the first in the world.

3. Brand advantage: tesla has become a leader in the PEV industry with more than a decade of operation and technical research, and its CEO's legendary life and personal charm add a lot of brilliance to the brand. Tesla break through the traditional car sales model, to create a direct model.

4. Technical advantages: Based on the closed loop of the original electric platform, low cost and high performance. Years of research in this field has given it a leading edge in intelligent driving, electric motor control, OTA upgrade, etc.



**Figure 5:** A map of Tesla's network of supercharging stations in the US (2013)

### III. Part Two----Demand/ Elasticity Section

1. Demand responsiveness to changes in price of possible substitutes or complements, preferences, future expectations

The price of a product has negative proportional to quantity demand.

For TMS, the auto insurance, automotive interior and automobile data recorder belong to possible complements. Other types of BEV, such as Mitsubishi i-MiEV and Nissan Leaf, even PHEV and conventional petrol vehicle, belong to TMS's possible substitutes.



**Figure 6:** car insurance  
(Baidu Image,2019)

When the price of complements and substitutes rising, the demand for the TMS is to decrease and increase respectively.

For future expectation of prices and income, If the price of a TMS is expected to rise in the future, current demand will increase. However, the price of TMS won't fluctuate too much in stable market. When income is expected to rise in the future, the demand may increase currently.

For preference, people have different preference absolutely, which results in people have different demands with same income. It won't affect the demand quantity generally.

#### 2. Some Simulated values of elasticity (different demand elasticity)

The reference price of TMS is in the range of 648 to 852.5 thousand with varying time and type of vehicles. (2020).

Table 3.1 lists the automotive TR and production of model s/x in 2019.(2020, p.4,6)

**Table 3.1:** TR and model s/x production in 2019

	Q1	Q2	Q3	Q4
TR (in million USD)	3724	5376	5353	6368
Model s/x production	14163	14517	16318	17933

Due to shortage of exact production and sale price for TMS, assuming half of total production belongs to TMS approximately and referring to reference price of TMS, table 3.2 lists its simulated estimate value of price and quantity.

**Table 3.2:** simulated estimate value of price and production of TMS in 2019

	Q1	Q2	Q3	Q4
Price (in thousand CNY)	850	800	750	650
Quantity	7000	7500	8000	9000

Its price quantity curve could be plotted as Figure 7:

**Figure 7:** simulated estimate of price quantity curve

Calculation for elasticity demand is equation 3.1 below:

$$E_d = -\frac{\Delta Q_d / Q_{ave}}{\Delta P / P_{ave}} \quad (3.1)$$

From Q1 to Q2, its  $\Delta Q_d = 500, Q_{ave} = 7250, \Delta P = -50, P_{ave} = 825$

$$E_{d1} = -\frac{\frac{\Delta Q_d}{Q_{ave}}}{\frac{\Delta P}{P_{ave}}} = \frac{\frac{500}{7250}}{\frac{-50}{825}} = 1.138, E_{d2} = 1, E_{d3} = 0.824$$

From calculation above, a conclusion can be drawn:

From Q1 to Q2, demand elasticity is elastic demand.

From Q2 to Q3, demand elasticity is unit elastic demand.

From Q3 to Q4, demand elasticity is inelastic demand.

### 3. Elasticity to change if there is a change in price of substitutes (competing brand), income

More the number of substitutes for a good or service, the more elastic is the demand for it.



For TMS, there are plenty of product belonging to its substitutes, such as Mitsubishi i-MiEV and Nissan Leaf, even PHEV and conventional petrol vehicle. If its substitutes' price is to change, demand of TMS will get more elastic.

**Figure 8:** Nissan Leaf (2020)

The greater the proportion of income consumers spent on a good, the larger is its elasticity of demand.

For the public, no one won't spend the great proportion of income on purchasing BEV, which results that its demand elasticity is large. If income is to change, demand of TMS will get more elastic.

### 4. Responsiveness of revenue earnings to elasticity

If demand is *elastic*, total revenue increases.

If demand is *inelastic*, total revenues decreases.

If demand is *unitary elastic*, total revenue remains unchanged.

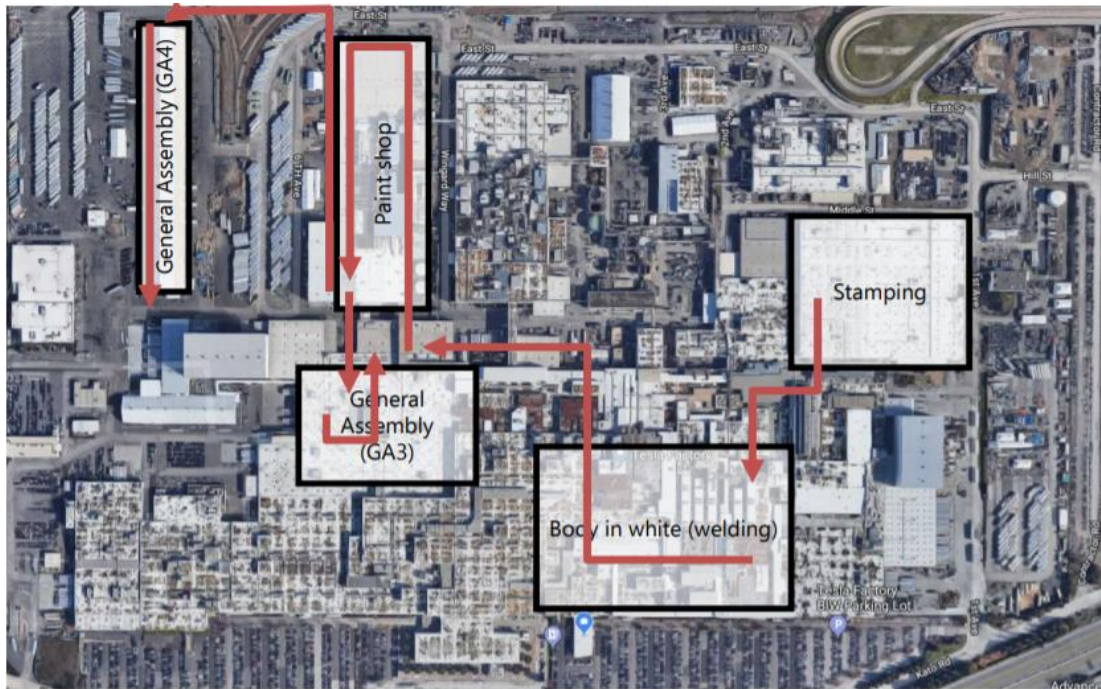
From Q1 to Q2, TR increased due to elastic demand.

From Q2 to Q3, TR doesn't change due to unit elastic demand.

From Q3 to Q4, TR decreased due to inelastic demand.

#### IV. Part Three---Manufacturing

##### 1. Resources / production process



**Figure 9:** Fremont, CA (Tesla, Inc., 2019)

Some major components are purchased from suppliers and manufactured in Tesla's factories. In Gigafactory Nevada, Tesla works cooperate with suppliers to integrate battery, module and battery pack production. Then the battery will be delivered to other factories.

Tesla's factory in Shanghai produces very little, most of the TMS is produced at facilities in the California Bay Area, where has a high level of vertical integration in manufacturing processes. Several manufacturing operations are done in there, including machining, casting, body assembly, paint operations, seat assembly, final vehicle assembly and end-of-line testing for our vehicles, as well as production of battery packs and drive units for Model S/ X. (Tesla, Inc., 2019).

## 2. Some ideas of average per unit cost

Tesla provides the number of total deliveries of Model S/X. As their purchase prices are all approximately \$ 100,000. It can be assumed that the cost is the same.



**Figure 10:** Profit

According to the financial summary, automotive gross profit is 1,434 million dollars in 2019 Q4. And during that time, the Model S/X deliveries is 19,475 while Model 3 deliveries is 92,620 (Tesla, Inc., 2019). The purchase price of model 3 range from \$ 39990 to \$ 56990 while the purchase price of Model S/X range from \$ 79990 to \$ 104990. The major automotive gross profit comes from the sale of Model 3 and Model S/X. In calculation, it is assumed that mean unit price of Model S/X is \$ 90000 and the mean unit price of Model 3 is \$ 50000.

$$\begin{aligned} \text{Automotive gross profit} = & \text{Unit price of Model S/X} \times \text{deliveries} \times \text{gross margin} \\ & \text{of Model S/X} + \text{Unit price of Model 3} \times \text{deliveries} \times \text{gross margin of Model 3} \end{aligned} \quad (4.1)$$



### Tesla Third Quarter 2018 Update

- GAAP net income of \$312M, non-GAAP net income of \$516M
- Operating income of \$417M and operating margin of 6.1%
- Free cash flow of \$881M supported by operating cash flow of \$1.4B
- \$3.0B of cash and cash equivalents at Q3-end, increased by \$731M in Q3
- Model 3 GAAP and non-GAAP gross margin > 20% in Q3
- Reaffirm expectation of continued GAAP net income and free cash flow in Q4

Figure 11 describes the data of Tesla Third Quarter 2018.

As can be seen from **Figure 11** (Tesla, Inc., 2018)

From early update, the gross margin of Model 3 is approximately 20%.

Thus, the gross margin of Model S is about 29.0%

average per unit cost of models is  $90000 \times (1 - 0.29) = \$ 63900$



***Capital / investment***

As can be seen from Figure 12 in appendix (Tesla, Inc., 2019).

The capital costs of plants and equipment is 14130 million dollars.

**Labor and material cost**

As can be seen from table 4.1 in appendix. The labor cost is 57% while the material cost is 10%. According to our estimation, the total cost is about \$ 64900. As a result the labor cost equals to  $64900 \times 10\% = \$ 6490$  and the material cost equals to  $64900 \times 57\% = \$ 36993$

**3. Importance of economies of scale / minimum efficient scale**

*Tesla is free-standing producer and manufacture vehicle* primarily at Fremont Factory. They construct the Gigafactory Shanghai in 2019. They also selected a site near Berlin to build a factory for the European market, which refer to as Gigafactory Berlin (Tesla, Inc., 2019). Tesla decides to enlarge their production by building more factories, not only to achieve higher revenue, but also to make the production attain economies of scale. When the production increase, the cost would decrease at first, this process is defined as increasing returns to scale. And then the cost will rise at massive production, this process is called diminishing returns to scale.

MES means the smallest quantity of output at which the long-run average cost reaches its lowest level. (Chakrabarti, 2020). When the cost is minimum, Tesla can increase automotive gross margin. By making use of extra money, the company can invest more on design models, making it more competitive in the market. Also, company can give hortative money to hard-working employee, which can retain persons with abilities and is beneficial to the future of the company.

Minimum efficient scale for integrated car production is about 4,000,000 cars per year (Rhys, 2005). In 2019, Tesla manufacture 367656 vehicle, of which production of



Model S/X is 66771. If the proportion remains the same when Tesla is able to produce three million vehicles per year, the number of Model S/X will be 726450. Assume the sale of TMS is half of total sale of Model S/X, the number would be 363225.

#### 4. Outsourcing

Many components are purchased from a single supplier. For certain key components, Tesla have different suppliers to reduce risks of disruption of the supply. Also, Tesla try to find more qualified suppliers for key components. However, in the past, their battery supply highly relies on the Panasonic. If Panasonic decide to raise the price of battery, Tesla must accept it.



**Figure 13:** Collaboration between Tesla and Panasonic (Baidu Image,2019)

## V. Part Four--- Market sales, profit and financial performance

### 1. sales volume

The table 5.1 lists the sales volume for TMS in 2018 and 2019. (2020,p.6,4)

**Table 5.1:** the sales volume for TMS in 2018 and 2019

	Q1	Q2	Q3	Q4
Model S/X deliveries in 2018	21800	22300	27710	27607
Model S/X deliveries in 2019	12091	17722	17483	19475
Model S/X deliveries in 2020	12200			

The sales volume of TMS and TMX grew gradually in 2018 and slowly picked up in 2019, albeit in a weak way.

The installed annual capacity of model S/X is 90000. Thanks to the strong sales volume of the model 3 and the early arrival of the model Y, as well as the anticipation of the new model S, even if model S sales are flat in 2019, the sales volume should only increase in 2020. However, due to the outbreak of COVID-19, there may be a slight decline in sales volume of TMS, but it would not have a big influence on the trend.

### 2. Selling price and revenues

Assuming half of total deliveries belongs to TMS approximately and referring to reference price of TMS table 5.2 list the simulated estimate value of price and quantity.

**Table 5.2: Price-deliveries table in 2019**

2019	Q1	Q2	Q3	Q4
Price (in thousand CNY)	850	800	750	650
deliveries	6045	8861	8741	9737

Total revenue = the sale of good or service equals the price of the good multiplied by the quantity sold.

$$TR = P \times Q$$

For Q1,  $TR = 850 \times 6045 = 5138250$ ;

For Q2,  $TR = 800 \times 8861 = 7088800$ ;

For Q3,  $TR = 750 \times 8741 = 6556125$ ;

For Q4,  $TR = 650 \times 9737 = 6329375$ ;

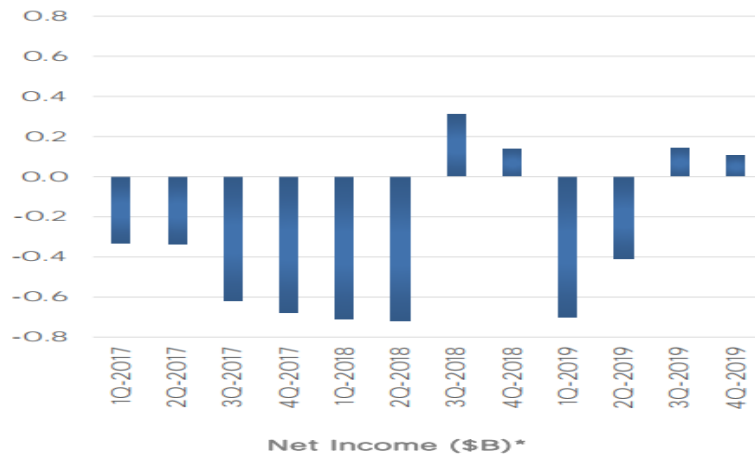
### 3. Profitability

Economic profit is equal to total revenue minus total cost which is the opportunity cost of production.

Table 5.3 list the total revenue, net profit ratio and gross profit rate in 2019. (2019, p.4,9)

**Table 5.3: Summarization data in 2019**

( Dollars in millions )	Q1	Q2	Q3	Q4
Total revenue	4541	6350	6303	7384
Total gross profit	566	921	1191	1391
Total GAAP gross margin	20.0%	12.5%	14.5%	18.9%
Net interest rate	-15.5%	-6.4%	2.3%	1.4%



**Figure 14:** Net income (2019,p.4,16)

From table 5.3 and Figure 14, it is obviously that the company's revenue grew steadily in 2019 and its operating loss dropped sharply. The gross profit margin in 2019 is 16.6%, which is 2.2 percentage points lower than that in 2018 when compared with 18.8%. The main reason is that the sales ratio of Model 3 with low gross profit margin increases, resulting in a slight decrease in the gross profit margin of the auto business, and the revenue ratio of service business with lower gross profit margin increases. The net interest rate of -3.5% in 2019 is 1 percentage point higher than the net interest rate of -4.5% in 2018. The potential annual profits that might be generated over a plausible product lifetime (assume it is 10 years) could be calculated by figure 14 and it is about 10 billion dollars.

#### 4. Return on investment

The return on investment equals to aggregate investment divided by annual return.

The net cash used in investing activities in 2019 year ending is 1436 in million of USD.

The net profit in 2019 is 775 in million of USD.\

$$ROI = \frac{775}{1436} \times 100\% = 53.97\%$$

Why the loss? Although tesla's gross margin is positive, it



**Figure 15:** Return on investment  
(Baidu image, 2019)

starts to lose money after including overhead, research and development, depreciation and amortization. Over the years, tesla's total depreciation and amortization totaled 5.7 billion. If added back to the net profit, the loss would be greatly reduced. High depreciation and amortization costs are also a feature of the manufacturing sector because of the large number of fixed assets.

### 5. Net present value(NPV)

$$\sum_{t=1}^T \frac{R_t}{(1+IRR)^t} = C_0 \quad (5.1)$$

*Initial Costs:  $C_0$ (Equipment, product launch costs etc.)*

*Net Revenues:  $R_t$ (Annual income, net of material costs, labour costs, tax etc.)*

*Project lifetime:  $T$*

*$r$  = discount rate or 'cost of capital'*

Assume that the interest rate is -3.5%.

Taking the data from 2018 and 2019 from table 5.4 below.(2019,p.21,6)

**Table 5.4:** Summarization data

(Dollars in millions)	2018	2019
investment	2337	1436
cost	17419	20509
Total revenue	21461	24578

In 2018,  $PV = \frac{21461-17419-2337}{(1-3.5\%)^1} = 1770$ .

In 2019,  $PV = \frac{24578-20509-1436}{(1-3.5\%)^2} = 2827$ .

Assume the present value before 2018 is the same as 2018, so from 2004 to 2019,

$NPV = 14 \times 1770 + 2827 - 34309 = -6702$ .

Internal rate of return (IRR) is the rate of discount that equates the present value of a project's income stream to its initial cost.

Substitute the values into the equation to find IRR.

$IRR = -0.2172$

The NPV and IRR are all negative. This is because the

investment is high, and the temporary benefits are low. Because manufacturing has a large number of fixed assets, there are high depreciation and amortization costs.



**Figure 16:** NPV (Baidu image, 2019)



**Figure 17:** IRR (Baidu image, 2019)

## VI. Conclusion

Finally, it can be known that the market of BEV where are many barriers to entry in electric vehicle industry and few firms is of oligopolistic competition. The TMS face many competitors from other large firms. As a high price product, the price of the TMS has negative proportional to quantity demand. And the elasticity change with the season. At the begin it is the elastic demand but at Q4 it changes to inelastic. Besides the more substitutes the more elastic is the demand for it. In order manufacture per TMS the Tesla should take \$63900 in 2019 including, \$6490 for the labor and \$36993 for the material. According the capital and average per cost the Tesla manufactures 363225 in 2019 can reach the minimum efficient scale. Lastly, the TMS got a good sale in recent years. The revenues in 2019 reached 25,112,550. Nevertheless, because of overhead, research and development, depreciation and amortization the net interest rate in 2019 is -3.5% which higher than 2018. Beyond that that return on investment equals 53.97% and NPV is -6702.

## VII. Appendix

**Table 2.1:** Performance comparison table for TMS versus major competitors

Dynamic performance comparison between Tesla Model S and competing products					
Parameters/model	Model S		Jaguar I-PACE 2018 EV400 HSE	Audi e-tron 2019 55quattro exclusive	BMW 535Li executive fashion design suit
	85	P85			

Power	Electromotor	Electromotor	Electromotor	Electromotor	3.0T turbocharged gasoline engine
Maximum power (kW)	270	310	294	300	225
Peak torque (Nm)	440	600	696	664	400
MIIT pure electric range (km)	502	502	456	470	—
100km acceleration (S)	5.6	4.4	4.8	5.7	6.2
Extreme speed (km/h)	200	210	200	200	250
Price (10 thousand dollars)	10.485	12.1785	10.00	11.44	11.3942

	December 31, 2019	December 31, 2018
Machinery, equipment, vehicles and office furniture	\$ 7,167	\$ 6,329
Tooling	1,493	1,398
Leasehold improvements	1,087	961
Land and buildings	3,024	4,047
Computer equipment, hardware and software	595	487
Construction in progress	764	807
	14,130	14,029
Less: Accumulated depreciation	(3,734)	(2,699)
<b>Total</b>	<b>\$ 10,396</b>	<b>\$ 11,330</b>

**Fig 12 is the Tesla property, plant and equipment, net**

**Table 4.1: Cost break-down of typical volume made car**

<i>Variable costs</i>	
Direct production materials (i.e. components and materials)	57
Warranty costs (i.e. the repair costs of a car during its 'guarantee' period and borne by the manufacturer)	2
Variable overhead (e.g. maintenance, marketing, etc)	7
<i>Fixed costs</i>	
Direct and indirect labour	10
Fixed overhead (including capital equipment, research and development, etc)	24
	100 <sup>2</sup>



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**Thanks for reading**

