Investment Strategy in Supply Chain of Automotive Industry

Tesi di Laurea Magistrale

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Abstract

Automotive industry has been developed for more than one hundred years, and it is one of the most complicated industry areas which covers mechanical, electronic, material, chemistry. Automotive giants used to produce every component of their products, but situation has changed for the last decades. More and more suppliers were introduced to make some components for the automotive giants. So the giants can focus on their core value.

The suppliers also had a big change for the last 30years. As new market such as China, South Korea improves very fast, many suppliers coming from that area had replaced the ones in the “traditional area” such like North America and Europe.

Meanwhile, as EV cars had been developed dramatically in the last 10 years. Automakers from new market are challenging the old traditional giants because they are good at battery making, motor producing. That is also influence the supply chain market in the new market.

From above all, we can see the challenges of the supply chain are emerging. This thesis will focus on research of the investment strategy in supply chain of automotive industry.

Content

Chapter 1. Introduction to Supply Chain in the Automotive Industry

1.1. Introduction to the Supply Chain in Automotive Industry

The automotive industry is a form of an industrial network comprised of a network of firms operating in different contexts to accomplish a central goal. In particular, the automotive industry refers to all the activities and firms participating in the motor vehicle manufacturing process, including various components such as bodies and engines but does not incorporate fuel, tires, and batteries. This industry's primary production leads to the development of passenger automobiles and light trucks, including sports utility vehicles, vans, and pickups. Commercial vehicles including transport and delivery trucks are considered secondary in the automobile industry production. The automotive industry is among the largest globally, and in 2021 in 2021, the global automobile sales reached 66.7 million units, where the passenger cars contributed the most significant sales proportion with 57 million units of the annual sales (Carlier, 2021). Among these car sales, Toyota remains the leading brand as it made 10.5 million unit sales creating an annual revenue of 27 trillion JPY (Carlier, 2021). Essentially, this amount of sales has been brought about by an extensive supply chain within the industry. This supply chain refers to the basic level comprised of four key phases: the parts suppliers, manufacturing, dealership, and customers. According to Delic and Eyers (2020), the supply chain in this industry exists to optimize specialization, ensure opportunity cost and lack of scale, amortize the cost of manufacturing some products such as computer chips used in automobiles, and adhere to the regulation such as in the US which restricts direct car sales by the manufacturer. Therefore, this thesis will analyze the supply chain in the automotive industry in detail to create a clear picture of automobile production and distribution.

1.1.1. Description of the Automotive Industry Supply Chain through the Fundamentals of Supply Chain Management

The four fundamentals are developed to define the significance and value of supply chain management (SCM). These fundamentals designed by the National

Institute for Transport and Logistics (NITL) are essential for this thesis to break down how the organizations in the automobile industry participate in SCM to ensure coordination among each other and some other companies outside the automotive industry. Therefore, this subsection will critically analyze the automobile industry relative to the four SCM fundamentals.

Supply chain management objectives are the first fundamental. According to NITL (2022), SCM seeks to achieve two objectives: to maximize total supply chain cost and investment and to meet and exceed the customer service level in the target market. These objectives place the cost/service approach as the core factor of the SCM, where the customer service demands shape the supply chain. In addition, the companies in the supply chain focus on reducing the NVAs (non-value adding activities) to ensure the demanded quality services are met at optimum costs. This NVAs elimination translates to automotive companies creating strategies to minimize production costs through their supply chain, starting from the raw material supplies. For instance, the Toyota Motor Company has been focusing on cost reduction since 2000, after the launch of the CCC21 initiative aimed to utilize new concepts in vehicle building to maintain supremacy in the industry (Toyota, 2022). This initiative extended throughout the globe and involved cooperation between the suppliers, procurement, manufacturing, and production engineers to revise the company's supply chain policies.

SCM philosophy is the second fundamental which defines the nature of the automobile supply chain. This fundamental outlines that every service or product reaches the final customer via a network of movements between organizations within the chain (NITL, 2022). In other words, the supply chain comprises interlinked organizations where an inefficiency caused by one of the firms fails the entire chain, affecting attaining the true competitive potential. This concept of competition means that there are many supply chains in an industry, and a failure in a chain lowers its competitive power. Similarly, the automobile industry can be primarily defined as comprising four phases: parts suppliers, manufacturing, dealership, and customers, which comprise several organizations that contribute to the production and sale of the

automobiles to the final customers.

Managing the flows is the third fundamental that defines SCM. This principle upholds that information, money, and material flows must be managed holistically and guided by the cost and overall service objectives to ensure maximum efficiency and effectiveness (NITL, 2022). Information flow can be considered the primary element among the aspects involved in the flow within the supply chains because the flow of other factors, including material and money, is initiated through communication between the involved organizations. Consequently, the goal of effective SCM has made ICT (information and communication technology) an essential and rapidly developing factor in supply chains (NITL, 2022). Based on the NITL description of this fundamental, the automotive industry supply chain comprises extensive ICT systems to optimize information flow, ensuring the efficiency of the supply chain. Adel (2020) supports this argument through an investigation of the indirect and direct impact of ICT on HSCP (hybrid lean-agile supply chain performance) in Egypt's automotive supply chain. This Adel's report found out that ICT improves HSCP and supply chain integration, enhancing information sharing within the supply chain.

Supply chain relationships are the fourth fundamental of the supply chain relationships as outlined by NITL. This aspect highlights the necessity of creating and managing productive relationships between external and internal suppliers and customers. In essence, supply chains are built around a win-win relationship forged in partnerships (Seuring et al., 2019). Based on this argument, a supply chain is developed and strengthened through the presence of shared objectives and goals, openness and mutual benefits, and trust. The automotive industry supply chains also reflect this value of supply chain relationships. AlDoori (2019) found out that supply chain collaboration in terms of joint decision making and information sharing improves performance in the automotive industry. The author outlines that joint decision-making improves the automotive supply chain by synchronizing partners on order delivery, inventory replenishment, and order placement.

1.2. Current and Future Development of the Automotive Industry

The automotive industry is rapidly leading to gradual improvement of the vehicles developed by various manufacturers. Verevka et al. (2019) explain that the increased number of automotive companies has increased competition, resulting in increased investment in research and development (R & R&D), leading to the constant improvement of vehicle building technologies. Consequently, new models with upgraded systems and better efficiency have been created as every company works to improve or maintain its market share. The increased environmental consciousness has also brought about the automotive industry's development in the world. Therefore, there is a need to assess the current and future developments in the automotive industry to detail how the industry is improving to meet and exceed customer needs.

1.2.1 Current Automotive Industry State

The current automotive industry can be defined as a transition stage where the traditional cars fuelled with petrol and diesel are gradually being replaced by hybrid vehicles. Agrawal and Rajapatel (2020) explain that this trend is occurring due to increased customer increase in environmental consciousness, constant hiking of petroleum product prices, and the high efficiency of electric cars. This trend is evidenced by the doubling of the global electric car sales in 2021, see figure 1. The figure shows that the industry is shifting toward sustainability by investing more in electric cars since the unit sales increased by 3.3 million units in 2020 (Ritchter, 2022). in fact, car customers are showing decreasing interest in the petroleum fuelled cars. For example, in the UK, the demand for diesel cars decreased by 45.8%, petroleum cars decreased by 15.2%, and plug-in electric cars increased by 89.8% (Armstrong, 2021); see Figure 2. This demand adequately describes the robust growth in Tesla of 157% in 2022 (Carlier, 2021). Being the leading electric vehicle brand, Tesla is continuously increasing electric automotive manufacturing after announcing the development of a light-duty electric track (Carlier, 2022). Accordingly, the current

automotive industry is continuously changing to manufacture more sustainable vehicles to meet the current customer needs.

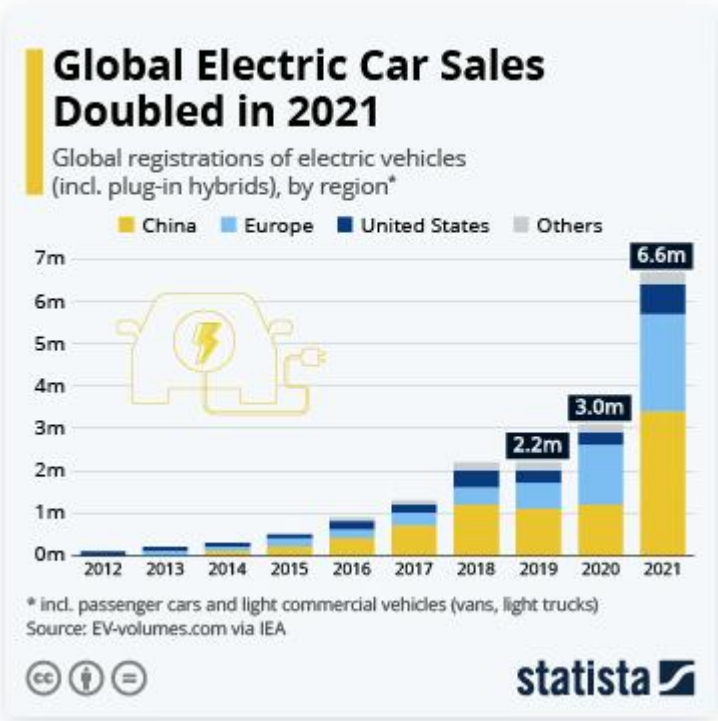


Figure 1. Global Electric Car Sales from 2012 to 2021. Retrieved from Statista by Armstrong, M. (2021https://www.statista.com/chart/23119/uk-new-car-registrations-b

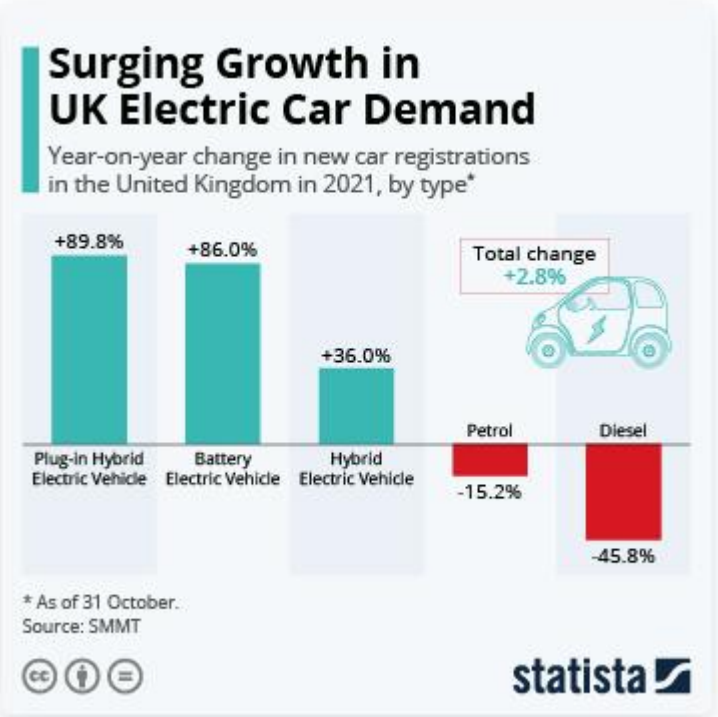


Figure 2. Increasing Growth in UK Electric Car Demand. Retrieved from Statista, by Ritchter, F. (2022), from https://www.statista.com/chart/26845/global-electric-car-sales/

1.2.2. Future Development of the Automotive Industry

The current state and development of electric cars form the basis of the automotive industry developments. Firstly, cars will increasingly become electric with the traditional auto manufacturers such as Volvo, Toyota, General Motors, and Volkswagen will entirely change from the building of petroleum fuelled cars to the electric cars. Since climate change remains a concern, especially among the youth, the firms will focus on developing more cleaner vehicles. Danielis et al. (2018) explain that with continuous technological advancements, electric automobiles will be designed with higher mileage between charges, making them more attractive to customers. This development will result from increased competition as car brands move to electric car manufacturing to meet the sustainability customers' demands.

Chapter2: Current Supply Chain Strategy for Internal Combustion Engine cars

In this chapter, Mercedes-Benz and Fiat will be taken as research objects. Based on the current supply chain strategies of these two brands, the author sorts out the supply chain strategies of internal combustion engine vehicles.

2.1 Current Supply Chain Strategy for Mercedes-Benz

Mercedes-Benz is a German automobile manufacturer headquartered in Stuttgart, Baden-Württemberg, Germany. It is a foreign subsidiary of the German company Daimler AG. The company produces high-end and luxury automobiles, as well as buses, coaches, and trucks. Mercedes-Benz is a well-known and proven carmaker, as well as one of the world's oldest automotive companies, having built the first petrol-powered automobile that is still in production (Mellinghoff et al., 2009). By

recognizing the supply chain problem and its management, Mercedes-Benz will serve as the backdrop for the investigation. Numerous factors influence a company's decision. With a market capitalization of over EUR 129 billion, it is one of the world's most prominent and successful multinational corporations . It is possible that the success of the company serves as irrefutable evidence of the significance of even the most little details. Mercedes-Benz places a high priority on maintaining an effective supply chain because it recognizes that this is one of the most important components in the success of any organization.

Figure 2.1 Supplier distribution of Mercedes GLC

2.1.1 Mercedes-Benz's Supply Chain Strategy in the Past

Many elements of Mercedes cars have to be of excellent quality and conform to the company's brand enhancement over the past two decades. There are several components manufactured by Mercedes for use in its autos(Wong et al., 2020). It's possible to get more information from other sources, however. The parameters of the agreement are laid out in these terms, including the quantity of elements that must be included and the cost. In addition, it is necessary to specify the required levels of quality. Other manufacturers' parts are frequently utilized in Mercedes-Benz final

products, and their costs impacted the cost of the car. There's a chance this explains why Mercedes automobiles used to be so expensive. The Beijing Benz Engine Plant, under the direction of Mercedes-Benz, manufactures critical components for small-displacement Mercedes-Benz engines. Suppliers in Southeast Asia and China now supply Mercedes-Benz. Mercedes, on the other hand, continues to be the company's key manufacturer. It is as a result of this that the corporation has total command over this link in the supply chain(Szegedi et al., 2017). There is a dedicated team of experts that supervise every step in automobile assembly in order to optimize the company's competitive advantages and guarantee that the goods meet the company's criteria. A wide range of benefits might be derived from this technique. As a first step, it helps to keep the company's brand intact and promote its growth by preventing numerous errors in automotive manufacture. The examination of items may also prevent the need for a recall, which would necessitate returning the entire production line to the maker.

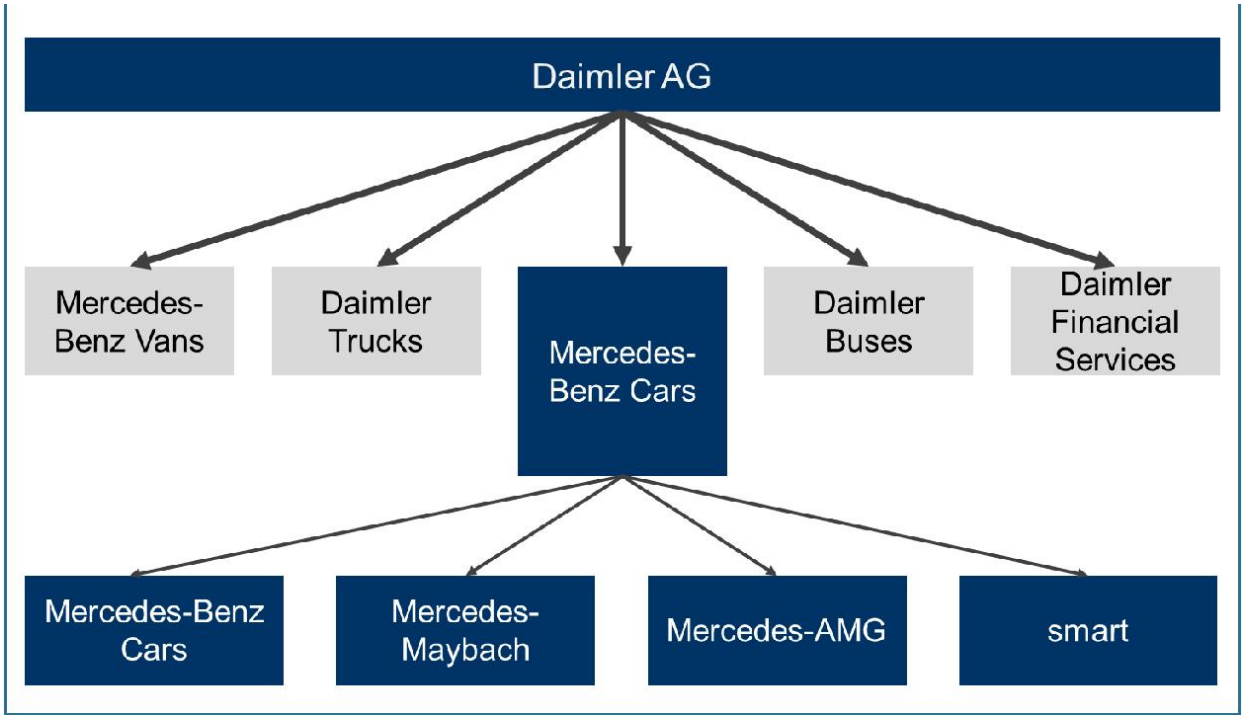


Figure 2.2 The divisions of Daimler AG with a focus on Mercedes-Benz passenger cars

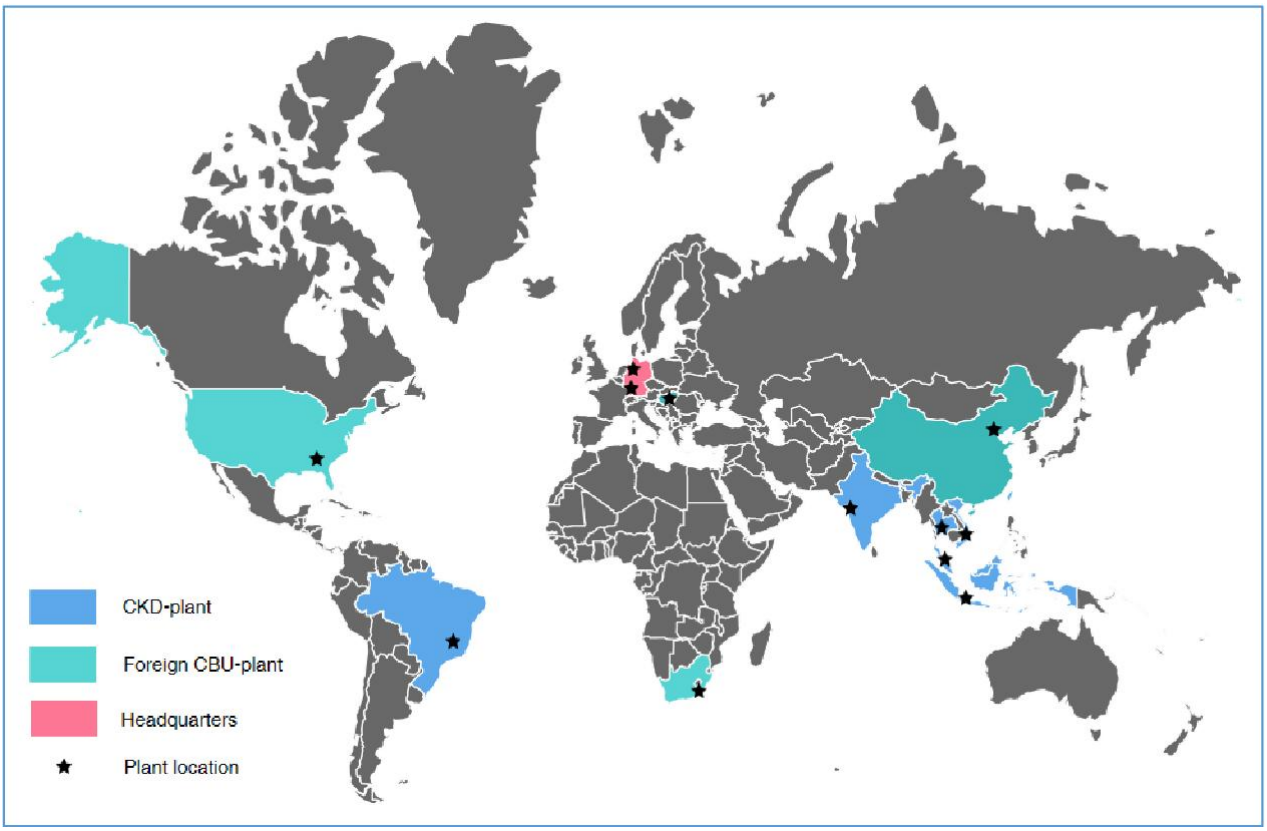


Figure 2.3 Plant locations MBC

2.1.2 Logistics Strategy

Logistics is a critical component of the supply chain. It is estimated that 20% of a car's value is governed by this factor . A more effective distribution plan for autos would be beneficial to Mercedes. There are several methods to go about it. The first involves setting up factories in places where the demand for autos is high. There is a possibility that it might help reduce delivery costs and improve efficiency (Lambert, 2017). Secondly, a company's headquarters are established in locations where the company's goods are likely to get a lot of attention. To minimize expenses and lower prices, Mercedes employs these two tactics, which might enhance interest in the company's products among customers. Finally, a well-functioning supply chain relies on a successful sales process since it has a significant impact on both the general operation of the company and how its goods are perceived by its customers. It's because of this dedication to the process that Mercedes spends a lot of time and effort monitoring it and making ideas that may assist increase sales. The company makes

itself available to its customers by offering all relevant information on a certain car or line. Trial runs have also been established by the business in an effort to build customer confidence and enhance its brand. Finally, Mercedes stands behind the quality of its products and the level of care it provides to its customers by providing a warranty on every one of them. The company's centers in many nations are used to increase sales and improve the company's performance. Wong and colleagues (Wong et al. 2020) In today's environment, a company's supply chain is critical since it provides the basis for future growth and has a substantial influence on the operations of all of the company's divisions. It has a number of critical components that must not be missed. For Mercedes-Benz, which is a world-class corporation, managing its supply chain is critical. When it comes to developing its brand and increasing consumer value, the firm places a high priority on its supply chain management. With Mercedes-Benz, like for many other firms, the Great Depression necessitated cost-consciousness, therefore expressing gratitude was critical. Attempts to reduce logistical costs have led to strained relationships with a number of suppliers. Due to a rebounding economy and increased demand for automobiles, Mercedes-Benz has realized the need of assessing the entire health of its logistics network in addition to expenses.

2.1.3 Block-Chain in Mercedes-Benz Supply Chain Management

Mercedes-Benz dealerships play an increasingly important part in the manufacturing process (Allen, 2018). A normal manufacturer contributes around half of the cost of a product's retail price (Amiot et al., 2006). Furthermore, suppliers said that, in addition to efficiency and technology, the speed and responsiveness of buying firms would be critical in delivering the improvements necessary to continue expanding. Rather than posing a challenge to the business, blockchain acts as an antidote to it (Bansal & Bansal, 2018). The total performance of Mercedes-Benz depends on management's capacity to accommodate the dynamic structure of the organization's commercial relationships (BIS, 2015). As a result of this, supply chain management (SCM) has been coined as a term (Blundell-Wignall, 2014).

2.2 Current Supply Chain Strategy for Fiat

Design, engineering, manufacture, distribution, and sale of cars, parts, and production systems are all part of Fiat Chrysler Automobile's remit as a global automaker. Brands in this category include both automotive and components and manufacturing systems manufacturers (Figure 2.4). In addition, subsidiaries and financial partners provide retail and dealer financing, leasing, and rental services relating to and supporting the Group's automobile business.

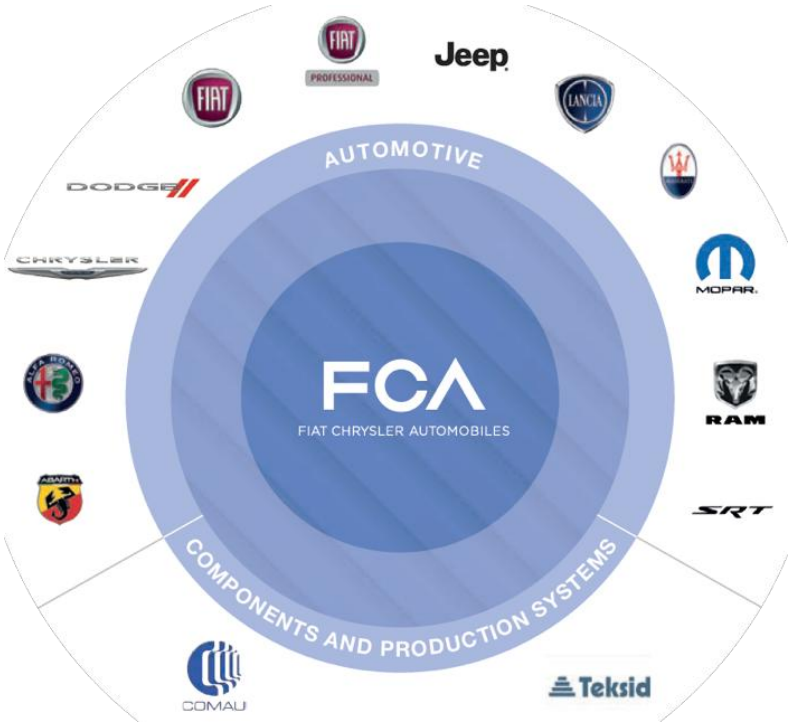


Figure 2.4 FCA's companies (Source: FCA Corporate Presentation, 2018)

It is the goal of Supply Chain Management to ensure that demand (customer orders) and installed capacity (at manufacturing facilities and at suppliers) are maintained at an optimum level to maximize profit. Due to the fact that FCA is a worldwide phenomenon, the SCM function is both regional and global. In this structure, orders are collected, vehicles are distributed and delivered, and capacity and materials planning are taken care of throughout the entire process. Even while each

division has its own micro-goals and activities, the 10 SCM divisions all work together toward a common purpose (Figure 2.5).

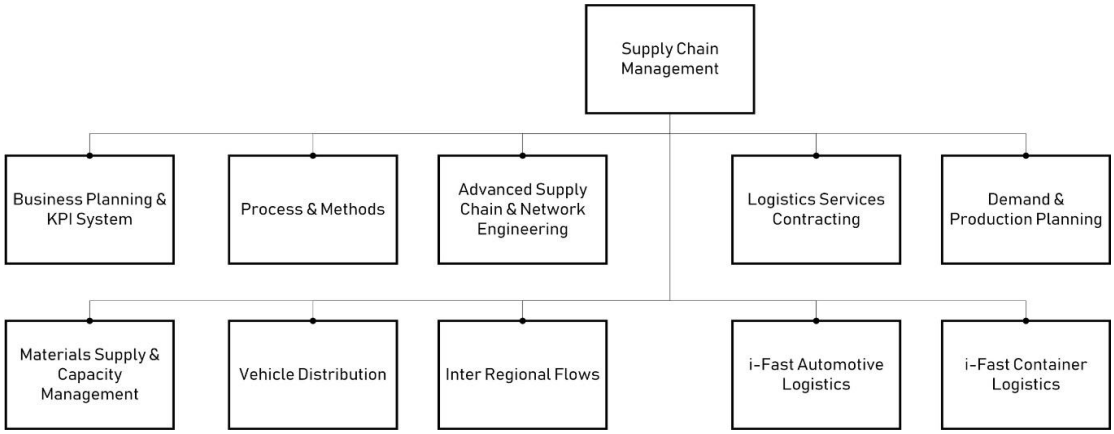


Figure 2.5 Supply Chain Management divisions (Source: FCA Supply Chain Academy, 2018)

2.2.1 Sales Channels and Final Customers

FCA is a worldwide company with a wide range of brands, which means it has a wide range of clients and sales channels, all of which have distinct demands and expectations.

Consumers can buy FCA products through a variety of channels, including:

- • Dealers: a network of independent entrepreneurs who serve as a conduit between FCA and their end users.
- Rent A Car (RAC): rental firms;
- Converters: specialists who work on Fiat Professional vehicles, converting them into campers;
- Direct sales: a network of owned dealers who are in direct touch with clients are all examples of what dealers do. Mirafiori Motor Village is the most well-known.

The most important segment for FCA sales is the first one.This will be taken into account for further investigation in the future.

Private and employee consumers, as well as government agencies that may request cars through public bidding or commercial businesses that acquire fleets, are the final customers.

Apart from that, there are new and used cars. Vehicles in the first category are new and are sold directly to consumers, while those in the second category are used vehicles that have been returned from a previous formula of renting to governments, businesses, and private individuals or from a formula of exchange, in which a customer returns his old vehicle in exchange for a new one.

COUNTRY	PLANT	VEHICLES
Italy	Modena	Alfa Romeo 4C
	Cassino	Alfa Romeo Giulietta, Giulia, Stelvio
	Sevel Val di Sangro	Fiat Ducato
	Pomigliano d'Arco	Fiat Panda
	Melfi	Fiat 500X, Jeep Renegade
Serbia	Kragujevac	Fiat 500L
Turkey	Tofas	Fiat Tipo, Doblò, Fiorino
Poland	Tychy	Fiat 500, Lancia Ypsilon
Mexico	Toluca	Jeep Compass
USA	Toledo	Jeep Wrangler
	Jefferson	Jeep Grand Cherokee
	Belvidere	Jeep Cherokee

Table 2.1 FCA's plants and vehicle produced for EMEA market (Source: FCA)

2.2.2 Order-To-Delivery Process

The car industry use the OTD (Order-to-Delivery) method (Figure 2.6). When a customer puts an order with a dealer, the procedure starts and ends with the delivery of the vehicle. To be clear, not every car is sold in this manner since the dealer obtains a large number of automobiles from the manufacturer without a final customer in order to keep stock on hand at the dealership site. In the North American market, it is uncommon for a buyer to order a car and then wait for the manufacturing process to be completed; instead, buyers often purchase a vehicle after examining what is on the dealer's premises (Stablein et al., 2011). Customers in Europe, on the other hand, are more willing to wait for the car to be manufactured because they want to personalize

it. While half of European car customers buy from dealerships (Volling et al., 2013).

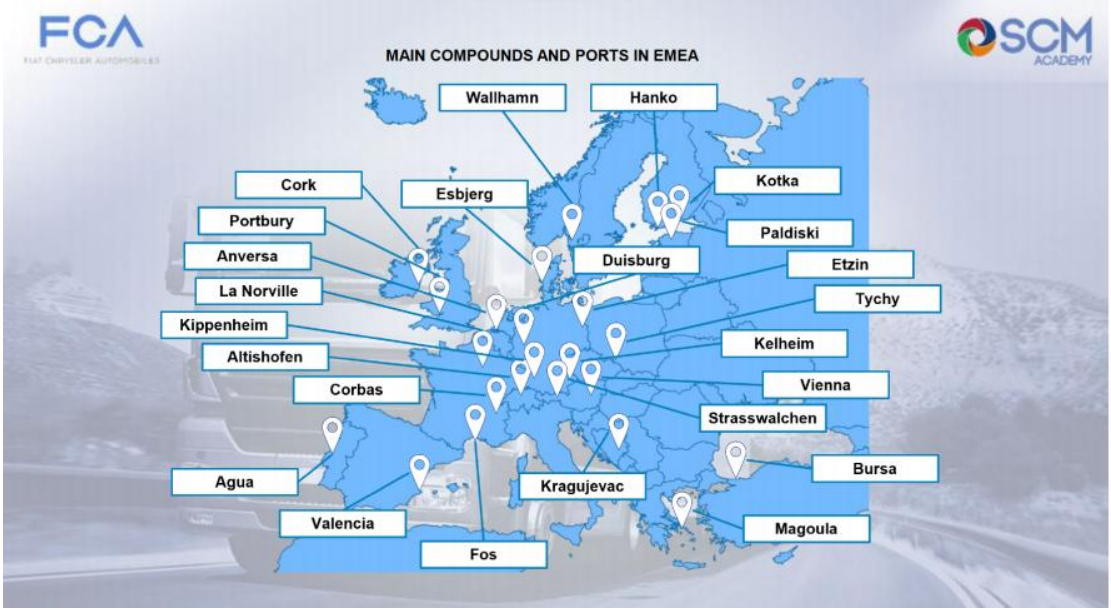


Figure 2.6 FCA's European compounds (Source: FCA SCM Academy)

The OTD process for the vast majority of automotive firms consists of a generic structure that includes order entry, order bank, order scheduling, order sequencing, production, distribution to market compound, and transportation from market compound to dealer (Aoki et al., 2014; Staeblein and Aoki, 2015). Order entry, order bank, order scheduling, order sequencing, manufacture, distribution to market compound, and transportation from market compound to dealer make up the general framework of the OTD process for the majority of automotive companies (Zhang et al., 2007).

When a client places an order with a specified configuration, FCA refers to it as a "FCA Final Customer Order" (OCF in business lingo). After a customer visits the dealership, the dealer takes note of any additional features they want on the vehicle (heated seats, glass roof, bigger wheel rim, etc.), and then the order is loaded into FCA's system LINK, which returns a first approximation of the estimated time of arrival (ETA) (focus in next chapter). A pair of OCFs warn FCA that this specific car has already been sold to a final buyer and hence has to be given priority attention in the queue. The order is then planned by the information system inside Operational

Planning (PO in the company's vernacular) and a confirmation date is supplied to the dealer, taking into account any production restrictions. On the Friday preceding the week when the car will be manufactured, the confirmation date is set. Automakers enable their customers to modify the vehicle's configuration, unless production limitations prevent them from doing so.

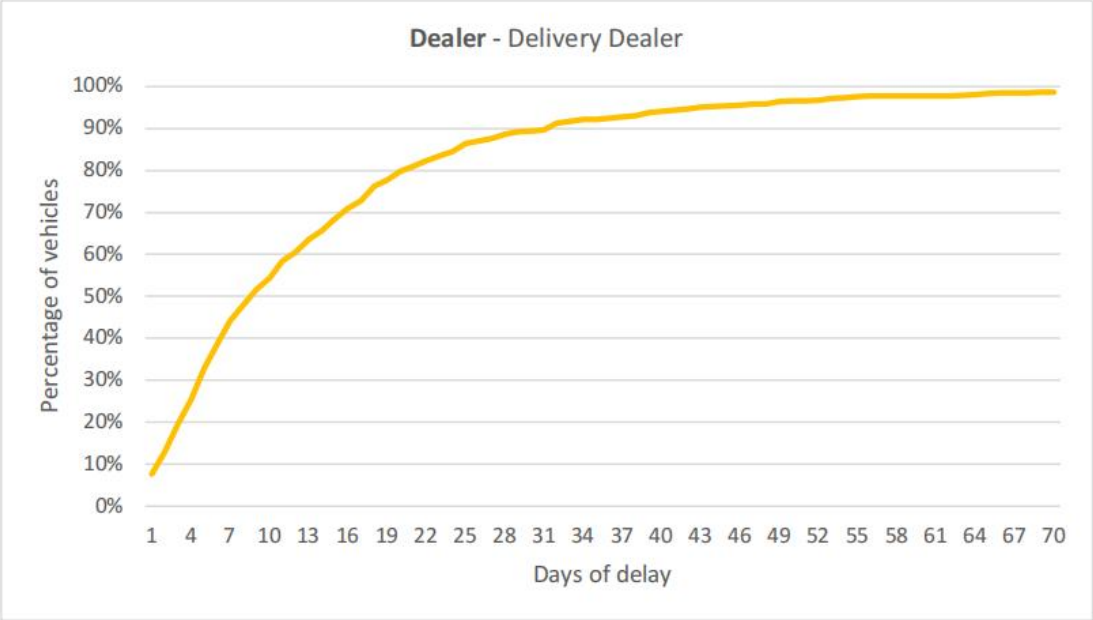


Figure 2.7 Dealer Category: Delivery Dealer - Cumulative percentage of vehicles per days of delay (Source: FCA)

Since most carmakers enable dealers to satisfy client requests by using an unsold vehicle or a replenishment order in the pipeline received from another dealer, this practice is commonplace (Williams and Bozon, 2006). FCA then builds the automobiles at one of its own factories and distributes them to dealers and customers when all of the order operations are completed (this process will be discussed in later paragraphs). Upon the dealer's declaration that the last client has been delivered, the procedure comes to a close (CCF).

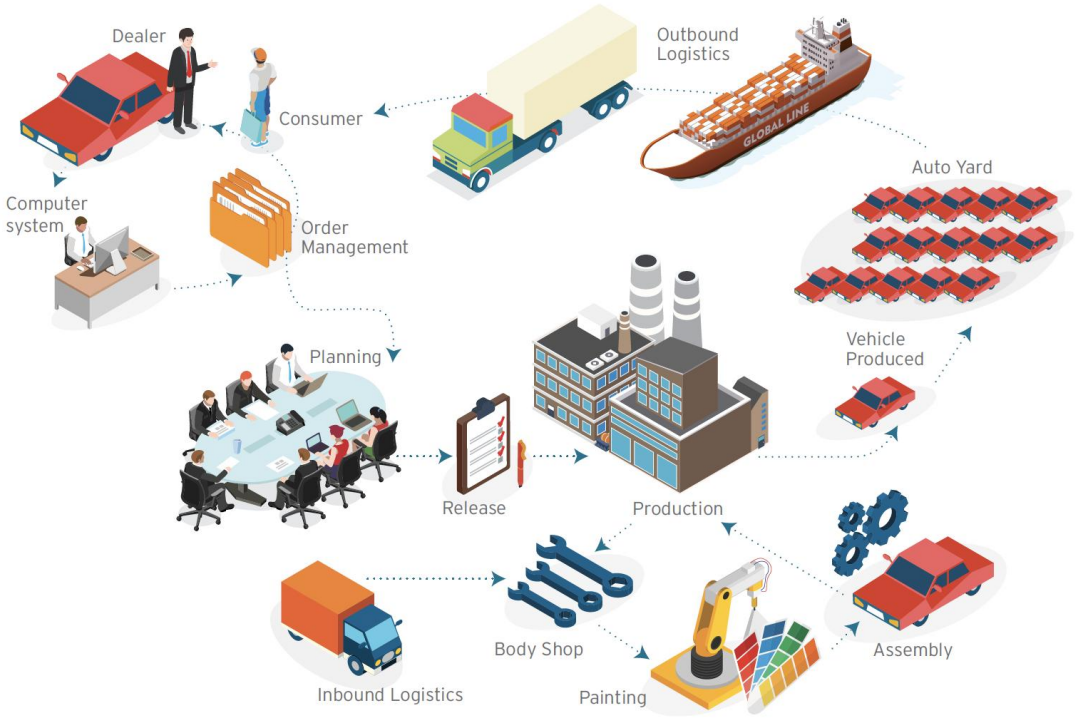


Figure 2.8 The Order To Delivery process (Source: Cognizant 20-20 Insights)

Chapter3: Current Supply Chain for EV vehicles

As the global automobile industry electrifies, automakers are quietly shifting away from part production in favor of relying on third-party suppliers. Automakers are trying to acquire more control over the supply chain for electric vehicles by forging new agreements with raw material suppliers and investing in facilities to produce chemicals used in batteries. The supply chains of Tesla, BYD, and Mercedes-Benz electric cars are the focus of this chapter's research.

3.1 Current Supply Chain Strategy for BYD

BYD is a high-tech firm dedicated to the advancement of human welfare via the use of cutting-edge technology. Since its founding in February 1995, BYD's workforce has expanded from only 20 people to more than 220,000. BYD's rapid expansion over the last two decades has resulted in the creation of more than 30 industrial parks on six continents, where the company has played a vital role in the fields of electronics, vehicles, renewable energy, and rail transportation. BYD is

committed to offering zero-emission energy solutions from generation and storage to application. BYD's motto is "Technological innovation for a better living," and the company is constantly looking for new ways to improve the quality of people's lives (Wang & Luo ,2010).

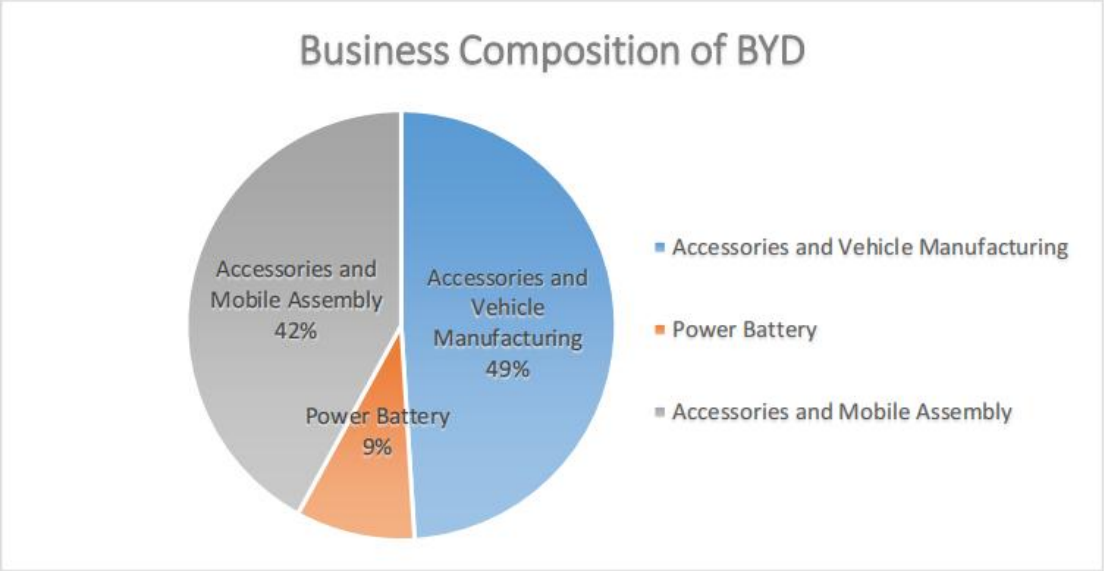


Figure 3.1 Business Composition of BYD

Due to the rapid growth of new-energy vehicle penetration, BYD's operational income and market value have expanded significantly over the last several years as a result of its leading edge in new-energy vehicle technology.

3.1.1 Procurement Management under the Supply Chain

When it comes to procurement management, BYD Automobile does not measure up to the world's most well-known enterprises. It is, in fact, a vertically integrated procurement management method. The rationale for vertical integration is based on the rationales of resource efficiency and resource maximization. More than half of BYD's automobile components are manufactured in-house. Rather than a fixed value, the degree of vertical integration of BYD is a multivariate function. A company's vertical integration is directly influenced by changes in technology, capital and labor as well as the cost of raw materials. With BYD's vertical integration strategy, the firm

is able to better use resources, save money, and provide its products a cost-effective advantage, all of which contribute to its competitiveness. In recent years, BYD's resource allocation and cost management have improved because to the company's extensive use of vertical integration, which encompasses everything from vehicle design to molds and engines to chassis and all kinds of interior components. Electronics, rechargeable batteries, and solar cells are all being developed by BYD (Simon, 2013). As a result, BYD claimed that it will continue to explore vertical integration in the future because no one can achieve a faultless driving record. To avoid a negative impact, BYD has a long industrial chain that takes a lot of money to maintain; otherwise, it would be detrimental to the company.

	2017		2016		2015	
	revenue (billion)	number (thousand)	revenue (billion)	number (thousand)	revenue (billion)	number (thousand)
ICEV	17.5	296	22.4	326	19.3	322
EV	39.1	114	34.6	96	21.3	58

Table 3.1 BYD’s sale data of ICEV and EV

BYD's success in the new-energy vehicle market is directly tied to the organization of the whole industrial chain from the top to the bottom. As a manufacturer of midstream components, the company can develop and manufacture batteries, motors, electronic controls, and other new energy vehicle core components independently. The company also has control over battery raw materials and has lithium resources in both the Qinghai Salt Lake and the Xizang Salt Lake. The firm has finished the vehicle production and research and development system in the downstream vehicle industry, and the sales volume of new energy cars ranks first among China's domestically owned brands (Steinfeld &Beltoft, 2014). As of April, the COVID-19 pandemic and related shortages of semiconductors has affected the supply chains of all except BYD's electric cars. BYD, on the other hand, has been protected by its very vertical supply chain, which allows it to manufacture its own crucial components.

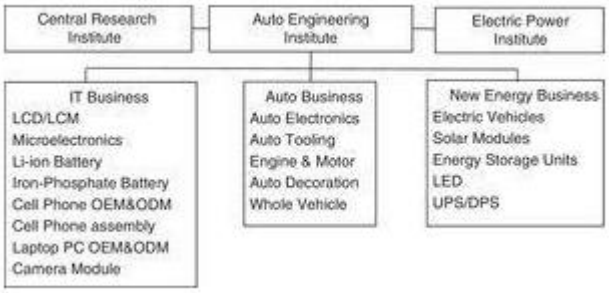


Figure 3.2 BYD's Diversification

Our worldwide database of lithium-ion batteries shows a noticeable shift in LFP's share of manufacturing capacity in recent years (see figure 3.3). The percentage of LFP manufacturing capacity to the whole market has decreased from 38.6 percent in 2015 to 27.9 percent in 2019, as electric car manufacturers have been persistent in their search of increased energy density. The percentage is expected to climb over 30% by 2023 as a result of technological advancements and cost savings (Whelan & Fung, 2016).

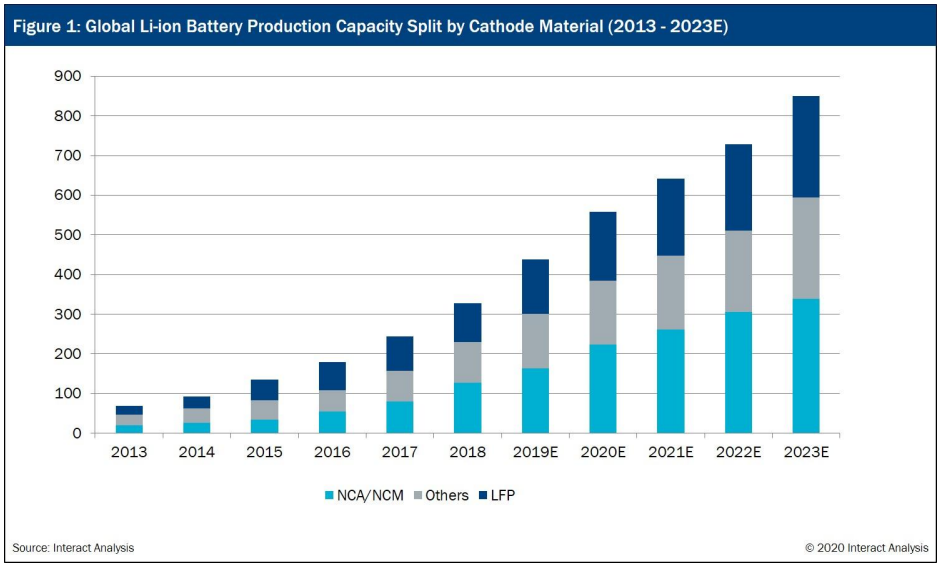


Figure 3.3 This capacity comprises lithium-ion batteries used in electric cars, consumer gadgets, and stationary energy storage devices.

3.1.2 Motivation Analysis of BYD's Vertical Integration

Reduce the Cost

The automobile business, which includes both conventional and alternative fuel vehicles, the components and assembly business, and the rechargeable battery business are BYD's core businesses. As can be observed in BYD's annual report, the company's operational income has increased year after year over the last five years, as has its gross margin. Its cost has been efficiently controlled through vertical supply chain integration (Whetten, 1989).

A drop in car sales expenditures at BYD shows that vertical integration may cut costs and boost profit margins for the firm. In the automotive industry, there's a well-established mindset. Because each vehicle needs so many pieces, the industry has long used a strategy in which larger engine facilities create the primary components while suppliers and dispersed procurement construct the rest. Late-starting automakers can face inadequate negotiation leverage and the difficulty to secure the most advanced technologies due to low production and sales volumes and limited brand influence. BYD set out to turn the car industry on its head when it came to that model. There are two businesses run by BYD: one that makes IT components and another that makes cars. The company's main products are rechargeable batteries, plastic components, LIQUID crystal display panels, and vehicles. BYD auto relies on the company's strong technical and financial strength and takes full advantage of the advantages of multiple industries to develop the path of independent research and development, production, and independent brand. At the same time, manufacturing costs are greatly reduced and quality is rapidly improved through scientific and technological innovation (Lewis, 2007).

Increase Profits

Transaction costs in the market have risen, resulting in an increase in manufacturing expenses for BYD. BYD used this strategy to increase its profit margins by implementing vertical integration. In order to consolidate its many companies, BYD has adopted a vertical integration strategy. Furthermore, new energy vehicles might benefit from new energy batteries from subsidiaries, as well as the use of IT in the manufacturing of new energy vehicles. Take into account each company's

current financial status when selecting a subsidiary to invest in. BYD's vertical integration will help the company save money, reduce costs, and enhance profits. New energy research & development and vertical supply chain integration allowed BYD to make a breakthrough, enabling the gross profit rate to gradually rise, overtaking saic and other established automotive manufacturers(Quan & Sanderson, 2018).

Improve Core Business Competitiveness

Investment opportunities for BYD subsidiaries are evaluated in light of positive industry development and high automobile sales income, and the funds raised are primarily used for three projects: lithium-ion battery production, Shenzhen automobile R&D and production base project, auto company to expand varieties and auto parts project.. By integrating its secondary rechargeable lithium ion battery business with its new energy automotive business, BYD hopes to create a unique competitive advantage and remain at the forefront of the new energy vehicle industry through its vertical integration strategy, which keeps the capital chain fluid and research and development capabilities (Quan, 2008).

To become a prominent new energy vehicle manufacturer, BYD's supply chain management has been critical to its development as a battery manufacturer. Optimizing supply chain operations, integrating organizational structure into the supply chain and other strategies to improve supply chain efficiency. Because of its vertically integrated supply chain model, BYD's fixed asset investment increased, but the supply chain's timely communication and cooperation saved a great deal of transaction costs in the supply chain, reducing overall cost of parts and components to an absolute minimum while also increasing decision-making efficiency. It takes longer and costs more to transmit design changes to a supplier if manufacturing is outsourced, resulting in a longer production cycle and a higher cost of communication(Sodhi & Tang, 2021).

This unique methodology and source of development is BYD's vertical supply chain integration, which significantly reduces manufacturing costs and establishes a strong foundation for BYD's future research and development of new energy vehicles.

Figure 3.4 BYD Products and Services

Segment Information

The chart below sets out comparisons of the Group's revenue by product category for the six months ended 30 June 2020 and 2019:

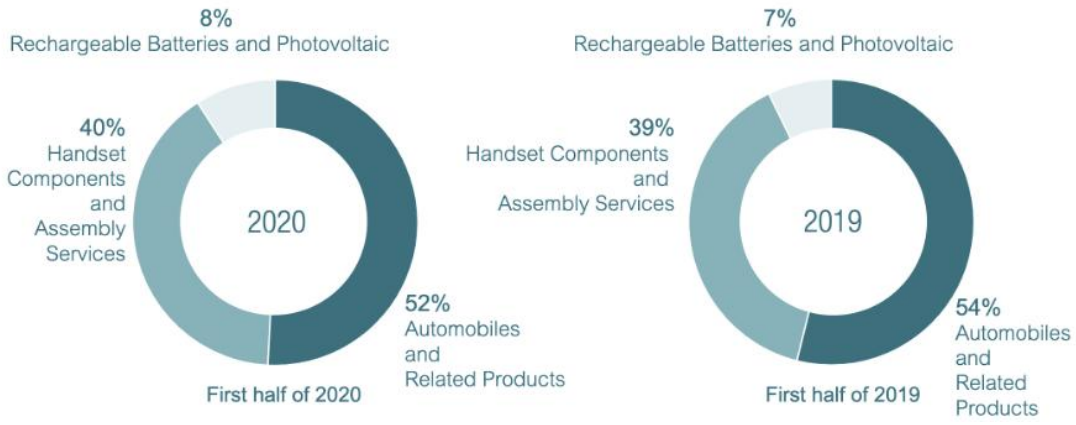


Figure 3.5 Revenue breakdown of BYD from the semiannual report of the first half of 2020

3.2 Current Supply Chain Strategy for Mercedes-Benz

Historically, Mercedes-Benz, the world's oldest conventional automaker, has dominated the manufacturing and sale of gasoline-powered vehicles. Despite this, it is still lagging behind when it comes to electric cars. Currently, the vehicle sector is experiencing chip supply failure as a result of the pandemic, and there is no indication of a cure in sight. Mercedes is able to retain profit growth in a sales decrease, according to the results of the investigation, in large part because of the improvement in sales of new energy cars (Ivanov et al, 2019). Mercedes-Benz new energy models EQA, EQS, and EQC sold 74,000 units, up 19 percent year over year, accounting for 16 percent of the total volume sold in the expanding new energy vehicle market. At the same time, Mercedes-sales Benz's of electric cars will continue to rise in line with the worldwide growth trend. Despite the lack of semiconductor chips, Mercedes plans to cease production at two Brazilian facilities and lay off more than 5,000 workers in April, according to company records. Due to the conflict between Russia and Ukraine, Mercedes had to change several shifts at its Sinderfingen facility at the end of March. Some Mercedes models have been put on hold due of a shortage of basic components. As a result, the manufacturing of electric automobiles has been severely curtailed by the high demand for semiconductors. On one hand, the growing market for electric cars; on the other hand, a lack of manufacturing capacity. Due to a constrained supply chain, Mercedes-Benz manufacturers are unable to keep up with the rising demand for electric cars. Mercedes' electric vehicles have almost all been sold out throughout the globe thus far (Lambert, 2017).

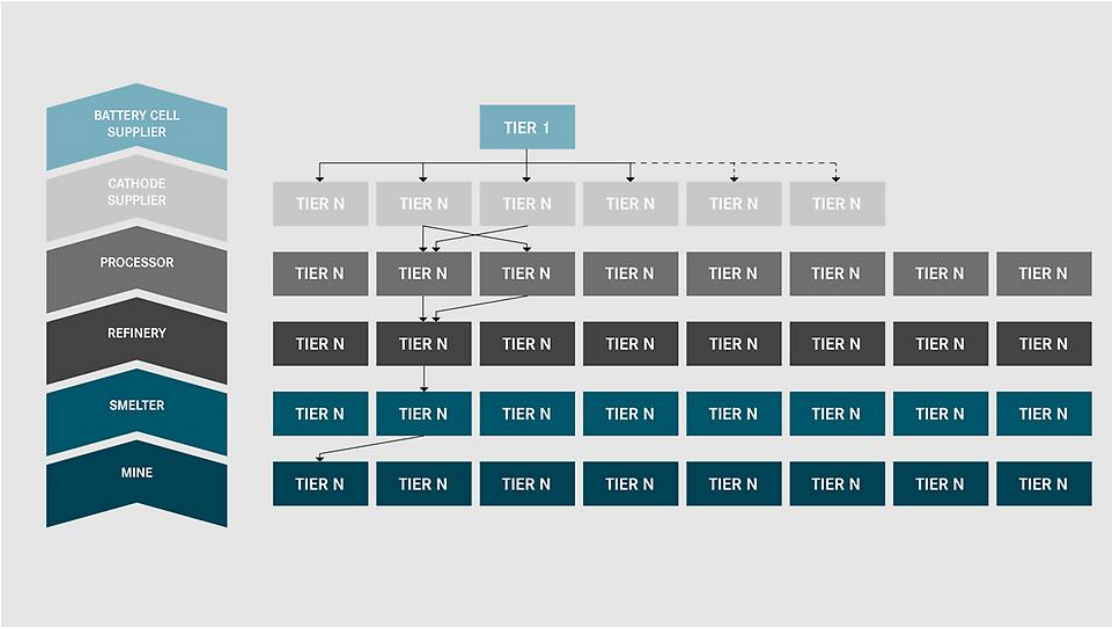


Figure 3.6 The complexity of the raw material supply chain on the example of battery cells.

3.2.1 Supplier Network

In response to the current challenges in electric vehicle development, Mercedes-Benz announced that it is expanding its "case" (Connectivity, autonomy, sharing and service, and electricity) strategy to make its supplier network more multinational and flexible, with a stronger emphasis on localization. In addition to expanding its 2,000-strong global supplier network, the German OEM is pursuing a policy of acquiring components wherever its cars are made to decrease its susceptibility to political events such as trade wars. Mercedes-Benz has used around 300 local suppliers in China so far, and its Tuscaloosa, Ala., manufacturing uses a greater degree of local sourcing than is currently required in the US, with the number of locally created components projected to increase "significantly" over the next five years. The growing flexibility of the supplier network is required not just by the transition to electric vehicles, but also by volatile markets, Mercedes-large Benz's product range, and constantly changing new features (Li & Sethi, 2020) . The supply chain must also be compatible with the company's manufacturing plan, since it must be capable of switching between conventional and electric automobiles. It can swiftly

adapt to changes in client demands and drive technology by combining orders for components for both conventional and electric cars with the same supplier, such as seats or front units.

Mercedes plans to purchase more than 20 billion euros of battery cells by 2030 and is already ready to mass-produce hybrid and electric cars.Mercedes already has a battery supply contract with Ningde Times, and BMW plans to purchase 4 billion euros worth of batteries from Ningde Times over the next few years.After capital injection, upstream enterprises will have a more differentiated structure and gradually form oligarchic advantages in the continuous competition.In the increasingly fierce competition, it is helpful to cultivate leading suppliers with a certain market scale.For Mercedes-Benz, to develop electric vehicles, it is necessary to lay out the whole industrial chain, realize the coordinated development of upstream and downstream, and improve the technology empowerment of the whole supply chain, so as to optimize the product attributes and improve the product value.

Due to the unreasonable allocation of resources and the rapid expansion of the market, the market pricing of electric vehicles was once chaotic.Due to the scarcity of electric vehicle battery raw materials, leading to the early development of the industry in short supply, raw material prices continue to rise, which is not only market demand, but also speculative demand.However, under the pressure of industrial competition and market, the price of raw materials of batteries is gradually stabilizing after falling.The lowest cost in the battery industry is the Ningde era, the highest cost enterprises have been eliminated, in the market competition with squeezed gross margin, cost is king.The same is true for vehicle production (Masoumi &Abdul-Rashid, 2019). It is believed that after technological iterations, several reshuffles and elimination, enterprises with leading technology and cost advantages can win the favor of the market.To facilitate the integration of upstream and downstream industries and collaborative innovation, only by common development and overcoming technological and market difficulties can we highlight the uniqueness of products and have market leading advantages.In order to improve the advantages of internal organizational capacity, Mercedes Benz needs to continuously carry out

vertical integration of its supply chain to further strengthen its leading edge in product technology and form competition barriers.

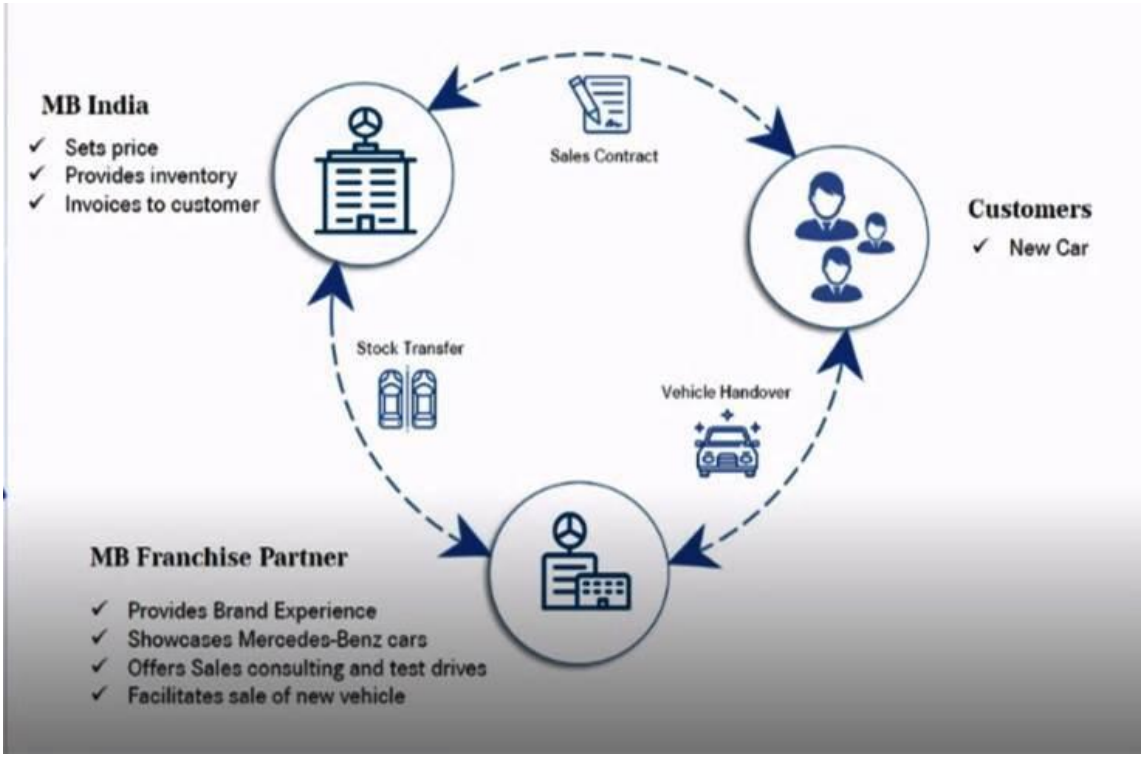


Figure 3.7 Mercedes-Benz ‘s Retail of the Future' (RoTF)

3.2.2 Sustainable Supply Chain

For the company's new vehicle fleet, Mercedes-Ambition2039 Benz says it can achieve CO2 neutrality within three product cycles, if not less. As a consequence, Mercedes intends to sell half of its vehicles as plug-in hybrids or electric vehicles by 2030. The EQC is Mercedes-first Benz's EQ-branded electric vehicle. Having no exhaust pipes means that EQC is taking a huge step towards cleaner transportation. Every car on the road needs to go through the process of being made, transported, and then recycled. If manufacturers want to be long-term, they must begin with the battery-electric vehicle supply chain. The bulk of the CO2 emissions from electric automobiles come from the supply chain, therefore attempts to increase mobility sustainability have mostly concentrated on reducing emissions in this area. Because direct suppliers get their raw materials all around the world, Mercedes is able to ensure that the batteries it purchases are made using the most up-to-date technology.

Considering the impact on the supply chain is an important consideration for Mercedes-Benz while working to reduce co2 emissions throughout the battery production process. This is a difficult endeavor for both manufacturers and suppliers. Many factors must be considered in order to establish a long-term supply chain in any nation. Two examples of these factors are cultural and economic.

Manufacturers may have a significant impact on human rights, climate change mitigation, and resource conservation. Human rights protection at every level of the supply chain is the focus of the first area of action. Human rights are protected much beyond the scope of Mercedes-relationships Benz's with direct suppliers. The Integrity and Legal Affairs section of Mercedes-Benz also works with independent partners and Mercedes-Benz compliance and human rights specialists to guarantee compliance with Mercedes-Benz ethical standards. In addition to reducing CO2 emissions, alternative driving systems are significantly influenced by supply chains upstream (Kersten & Ringle, 2017). The supply chain has a significant role in the overall CO2 balance throughout the life cycle of these systems. With the help of current suppliers, the Mercedes team is working on a plan to achieve CO2 neutrality. When it comes to corporate social responsibility, Daimler has led by example. Because to Germany's Renewable Energy Act, which is set to expire after 2020, Mercedes-Benz became the first big industrial client to get energy from German wind generating installations in 2018. (EEG). It is because to these contracts that six citizen-owned wind farms will be able to keep going. In addition, future supply contracts will be influenced by how carbon dioxide emissions are handled. In order to save resources, we must increase the percentage of recycled materials in our supply chain and find new methods to construct closed-loop systems. Electric drive systems will be 40% less dependent on basic raw materials by 2030, according to Daimler AG. A specific goal is to decrease the consumption of main raw materials by making relevant technological advances. As long as it is technically and commercially practicable, this will be accomplished primarily through the utilization of secondary materials. Separating scrap metal into its numerous categories is a simple but effective example. Steel, for example, may be recycled quite well in certain situations. Waste

and other manufacturing resources, such as water, are also top priorities for Daimler. There will be industry-specific technical advancements and enhancements, such as greater energy efficiency, implemented as well. As a last stage, corporations may offset their supply chain CO2 emissions. Supply chains will become more sustainable as a result of growth in the digital sphere, which is clearly evident. Blockchain technology, for example, has the potential to change the procurement process. This has the potential to have an impact on almost every link in the supply chain.

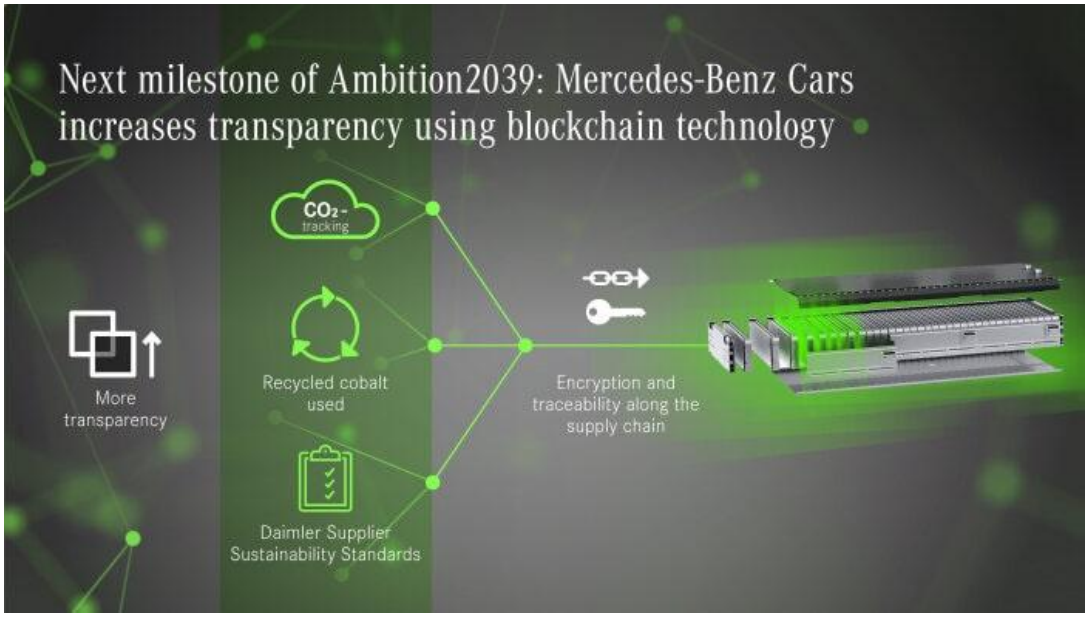


Figure 3.8 Mercedes-Benz Cars drives "Ambition2039" in the supply chain: blockchain pilot project provides transparency on CO2 emissions

3.3 Current Supply Chain Strategy for Tesla

Electric vehicles are the focus of Tesla Motors' business, which was established in 2003 and has since grown into a multi-billion dollar enterprise. Aside from creating full-vehicle manufacturing capabilities in the future, Tesla plans to offer electric vehicle assembly component services such as the research and development of lithium-ion battery packs as well as the manufacture of gearboxes, motors, and other components(DeBord, 2018).

Tesla's current business plan is based on the selling of cars and the development of new models. Revenue is generated via the sale of electric vehicles, supervisory

credit, and powertrain parts and components, respectively. Initially targeting the high-end market, Tesla intends to progressively transition to the low-end market. Vertical and internal integration are two of Tesla's supply chain strategies. Directly managed shops will serve as the link in Tesla's ecological chain, which will include all aspects of product development and manufacture from the ground up, from battery production to car assembly to direct sales and after-sales services. There are plans to bring in suppliers as strategic partners in Gigafactory1, which is scheduled to begin building in 2014, so that they may help reduce manufacturing costs and reduce the amount of time needed for production. A combination of geothermal and wind power, as well as solar panels on the plant's roof and nearby hilltops, will cut energy use when the sun isn't shining(McFarland & Valdes-Dapena, 2020).

3.3.1 Basic Structure of Tesla Supply Chain

Major Supplier

Most of Tesla's significant technology vendors are in Japan, the United States, and the European Union. The company has 38 direct suppliers in these countries. Batteries are supplied by Panasonic, Argent is the only battery cooling part provider, the motor is made in partnership with Taiwan Futian, the electric control part is designed and manufactured by Tesla, while the reducer part is supplied by Taiwan Heda (Naughton, 2020). Tesla's purchase of components is not a normal supply chain model, but an open technique available to the rest of the world. It collaborates with technically advanced suppliers all around the globe to integrate their technology with its own battery management and charging solutions. It works with them. At the same time, Tesla relies heavily on third-party manufacturers. Other than important first-class elements manufactured in-house, vendors from across the globe provide the car's lithium-ion battery, tires, gearbox, and other components, many of which are one-of-a-kind.

Manufacturers

Tesla electric cars are entirely assembled and processed at the company's own facility, ensuring the best possible level of quality assurance for the final manufacture of electric automobiles.

Seller

In contrast to the typical automobile sales approach that relies on dealerships, Tesla sells its goods directly to consumers. Tesla has a service model that allows items to be tailored to meet the specific demands of each individual client. As an example, consumers may choose the color of their car's exterior paint, as well as the skylight, interior design, and other features. Tesla's offline experience shop allows prospective customers to test-drive the electric vehicle of their choice, and then schedule a test-drive appointment. Finally, customers may place an online order and make a deposit, and Tesla will begin manufacturing as soon as the payment is received.

3.3.2 Tesla Supply Chain Panorama

For the first time since the outbreak of the virus, Tesla's quarterly car production fell in the first quarter of 2022. Although chip supply was limited, the electric car manufacturer was able to triple its production in the first two years of the pandemic despite unprecedented congestion at marine ports (Reed, 2020).

However, Tesla's rapid production growth has been hindered by supply chain concerns. Tesla reported a record $3.6 billion in operational profitability, with a 19.2 percent operating margin, despite supply chain difficulties. As a result of sales of the Model Y in the first quarter, the company was able to raise earnings despite a decrease in vehicle manufacturing, according to

Kirkhorn.

Figure 3.9 Tesla quarterly operating profits

The spike in sales of electric vehicles has benefited Tesla. The worldwide market share of electric vehicles (EVs) has more than tripled from 4.11 percent in 2020 to 8.57 percent in 2021, according to the International Energy Agency. These factors have helped to push Tesla's stock price to a record-breaking $1 trillion (Yuying & Quingrun, 2018).

Tesla's supply chain is primarily an Internet marketing business model and business outsourcing, as may be deduced from numerous scenarios and features of the company's supply, buy, and sales interactions.

Business Model - Internet Marketing

There are several ways in which Tesla differs from typical automobiles, including its forward-looking Internet marketing and its reform and innovation in electric energy consumption. For years, Tesla's main method of selling vehicles has been over the Internet, and people have often referred to the company as having Silicon Valley DNA. O2O is Tesla's strong approach to marketing. Online direct sales reduce store expenses while also improving the customer's experience, while the

physical location of the business encourages prospective customers to make a purchase. Tesla, on the other hand, was able to make direct sales of its goods over the Internet. The absence of dealer participation allows Tesla to intuitively determine the requirements of customers and provide tailored services (Zhou, 2017).

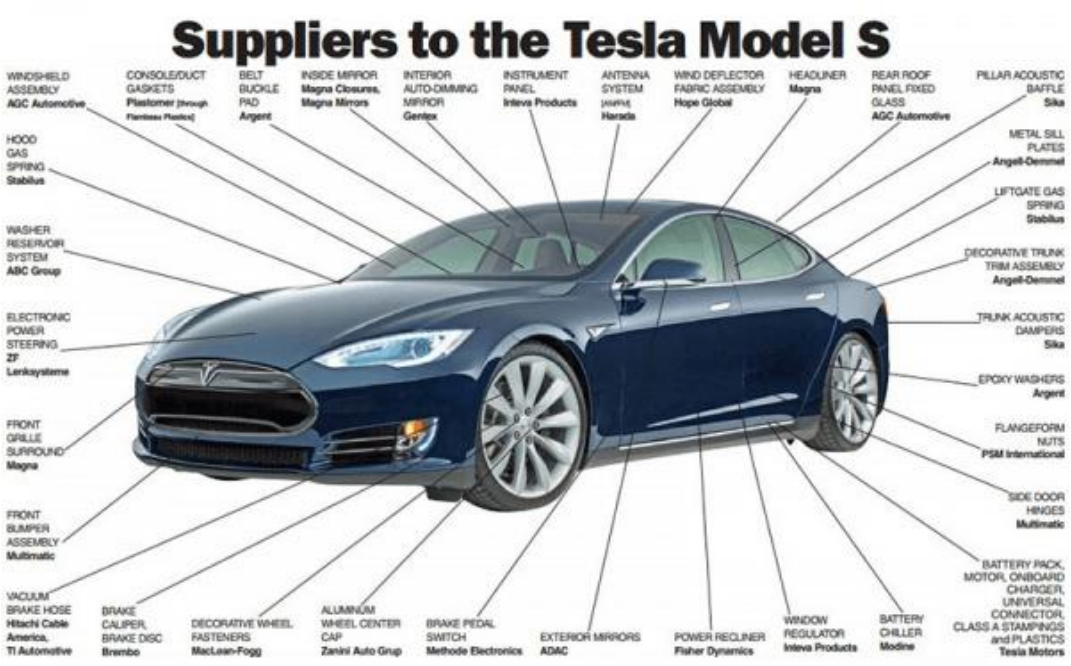
Outsourcing

Tesla sells its products directly to consumers, but it does not manufacture them all.According to sources, the system has outsourced as many as 16 significant parts of Tesla's Model3, resulting in procurement costs of 47 percent of the BOM. Tesla, as a high-end brand of new energy cars, seeks to make the automobile ideal in every way. However, Tesla has been dissatisfied with the comfort, quality, and usefulness of automobile seats since the introduction of the Model S.Under the business outsourcing approach, Tesla relinquishes control over the design and manufacture of additional elements, such as vehicle seats and conventional parts, and focuses solely on the creation of essential components. Outsourcing Tesla's operations has been shown to free up the company to focus on creating its own battery and intelligent system, a win-win situation for both suppliers and Tesla (Kenton et al., 2020).

As a matter of fact, Tesla's vertically integrated approach provides several fundamental features that may assist any organization. But this is mostly reliant on proximity and geographical location. Vertical integration may minimize transportation costs across the supply chain. Musk's goal is to develop a supply chain management complex that can monitor every stage of the supply chain, yet his automobile need 10,000 components to function. Integration may be eased in another manufacturing

environment without the need of 10,000 pieces.

Figure 3.10 Suppliers to the Tesla Model S



Supplies and components may be sent for less, but that's not all the money you'll save. Vertical integration of the supply chain may also save time and money. There are, however, certain drawbacks. Cost increases, restricted product design freedom, and challenges with balance are just a few examples. Due to the absence of competition, the costs of this strategy may rise. When several suppliers compete for business, the prices are cheaper, but there are added bureaucratic overhead and a lack of flexibility when a single provider is chosen. A lot of fresh development might make it harder to make design or model changes (Kenton et al., 2020).

Figure 3.11 Tesla Dominates The U.S. Electric Vehicle Market

The production and procurement linkages are mostly where Tesla's supply chain management challenges are located. Its supplier partnership suffers as a consequence of the urgency of the demand and the uniqueness of its product components, resulting in delayed part delivery and affecting production. If Tesla wants to succeed in the supply chain business, it must take the lead in resolving any conflicts or imbalances amongst its suppliers. Products, engineering and production teams must engage with suppliers on a regular basis so that they may develop harmonious and amicable relationships, exchange information about their profits and decrease supply chain expenses. They must also enhance the company's performance. The continuous expansion of vertical supply chain integration and internal integration production strategy delivers product leadership and consistent parts supply by continually penetrating the industrial supply chain upstream and manufacturing certain components ourselves.

Chapter4: The Investment Strategy on Internal Combustion Engine Cars and EV cars

4.1 The Investment Strategy on Internal Combustion Engine Cars

Electric vehicles are indeed the future of cars. According to a recent report from the International Energy Agency, global sales of light electric vehicles could reach 21 million units by 2030, or about 13% of total sales. In short, probably more than 80% of light vehicles will still be powered by a single internal combustion engine by 2030. In addition, according to the analysis, prediction and research of professionals in the industry, in the next 30 years, the automotive power reform still needs the

development of internal combustion engine to drive, in the global scope, at least more than 50% of light vehicles need to be equipped with internal combustion engine, internal combustion engine will not be seriously threatened by the automotive power reform. However, with the development trend of vehicle power electrification, internal combustion engine also needs to make corresponding changes, and its dominant position will be affected to a certain extent. Cars will change from a single internal combustion engine drive to a combination of internal combustion engine + motor drive(Bucher et al., 2020).

Toyota believes there is room for a four-cylinder internal combustion engine because the automaker has invested as much as $383 million in U.S. production. The funds will be distributed in four different locations around the country. According to the manufacturer, the engine is "at the heart of modern Lexus and Toyota," whose customers want fuel-efficient electric vehicles. The company plans to put most of that investment into Toyota's huntsville, Ala., plant, which will cost the company $222 million. A new four-cylinder assembly line will be developed there, including engines for hybrid and pure internal-combustion vehicles. In addition, the facility will expand by 114,000 square feet. Toyota's Alabama plant can produce 900,000 engines a year at an investment of about $1.5 billion. These expenditures enable them to meet customer expectations and quickly adapt to changing industries (Helmers et al., 2020).

Therefore, in the process of automotive power reform, relevant researchers need to be able to constantly adjust and optimize the internal combustion engine in the process of research and development, combined with the current demand and automotive power development trend. The following are actionable investment strategies.

4.1.1 Application Analysis of Hybrid Systems

The application analysis of the whole hybrid system is carried out to ensure the rational and effective application of the whole power system of internal combustion engine in the future development. And for the power source of the automobile, the development is completed. In the application process of the hybrid system, the work

efficiency is improved in the existing engine resources, so as to avoid working in the low efficiency area of the engine resources. Through the optimization and refinement of the traditional fuel engine in the hybrid system, the engine completes the work speed adjustment in the traditional system [3]. After centralized adjustment, in the whole engine management process, through the auxiliary cooperation between the engine and the motor, the whole working condition of the engine can be modulated to the maximum load, achieve the work efficiency, and reduce its fuel consumption. Small displacement engine with small cost, small displacement engine and large displacement engine under the same load, the engine itself has higher working efficiency. Therefore, the existing engine resources can be used to improve the fuel economy of the whole vehicle (Neugebauer et al., 2022).

4.1.2 Completed Extended Range Hybrid Special Engine Features

In the process of adjusting the working range of the hybrid engine, the working form and scope of the hybrid engine are obviously different from that of the traditional engine. In operation and design, must ensure that it has its own characteristics. In the process of development, new energy vehicles themselves run on electricity, so the whole cost is high. In addition, new energy vehicles in the range and performance, there has been a certain decline. Therefore, the hybrid system with generative functions will display its unique application advantages to ensure that it will become one of the trends of extended range hybrid in the future. In the research process, the engine of the whole extended range power system is analyzed, and the series configuration hybrid system of the extended range hybrid system is added. The engine of the range extender does not participate in starting the vehicle, but only completes the power generation of the engine, so as to ensure the increase of the power storage of the battery. In the case of insufficient power, the drive rate required by the car is generally low, for example, in the driving process, it is based on a three-compartment car weighing 1.6T. In order to maintain the three-compartment car with 1.6t weight at 120km/h, the range extender power should be set to 30kW. Therefore, in the range extender, the engine with smaller displacement can be selected,

and the whole engine characteristics of the range extender can be set as the advantages of high heating efficiency, compact structure and low cost. And through the related circulation system, make the engine to work efficiently, by improving the compression ratio and other methods. Adopt low friction technology, consider every two cylinder design and unique airway injection technology, to meet the overall design requirements of the car (Pero et al., 2018).

4.1.3 Improve Engine Thermal Efficiency

In the subsequent application process, the hybrid system itself puts forward higher requirements on the engine. Therefore, it is necessary to conduct further research on the existing basis to strengthen and improve the thermal efficiency of the whole engine. At present, in commercial use, the maximum heat rate of the whole gasoline engine is 37%, and the major automobile manufacturers are still committed to improving the thermal efficiency of the whole engine. In the research process, in terms of engine fuel consumption, the energy generated mainly includes the following five parts, including effective work, heat transfer loss, exhaust loss and combustion loss. Therefore, in order to comprehensively improve the thermal efficiency of the whole engine, the whole effective function can be completed by reasonable and effective adjustment method without changing the energy output, and the energy proportion of other parts can be reduced in the overall output. In the application of various technical means, the overall thermal efficiency can be well improved, and due to the high requirements of traditional models on the engine, the hybrid system can be based on the engine greater optimization space.

4.2 The Investment Strategy on EV Cars

According to Citi Research, the total cost of owning and operating an electric vehicle (EV) is now equal to that of owning and operating a car powered by an internal combustion engine (ICE). Consumers must first solve four significant challenges before they will fully adopt electric vehicles: range, infrastructure, battery degradation, and affordability. Car buyers want to know whether they can recharge it,

if the battery will last long enough to get them where they need to go, and if it is cheaper than the average gas or diesel passenger car. With regard to purchasing an electric vehicle, pricing is seen as the most important factor. Therefore, we believe it is important to assess when electric cars will be able to compete with gasoline-powered automobiles in terms of cost (Larminie & Lowry, 2003).

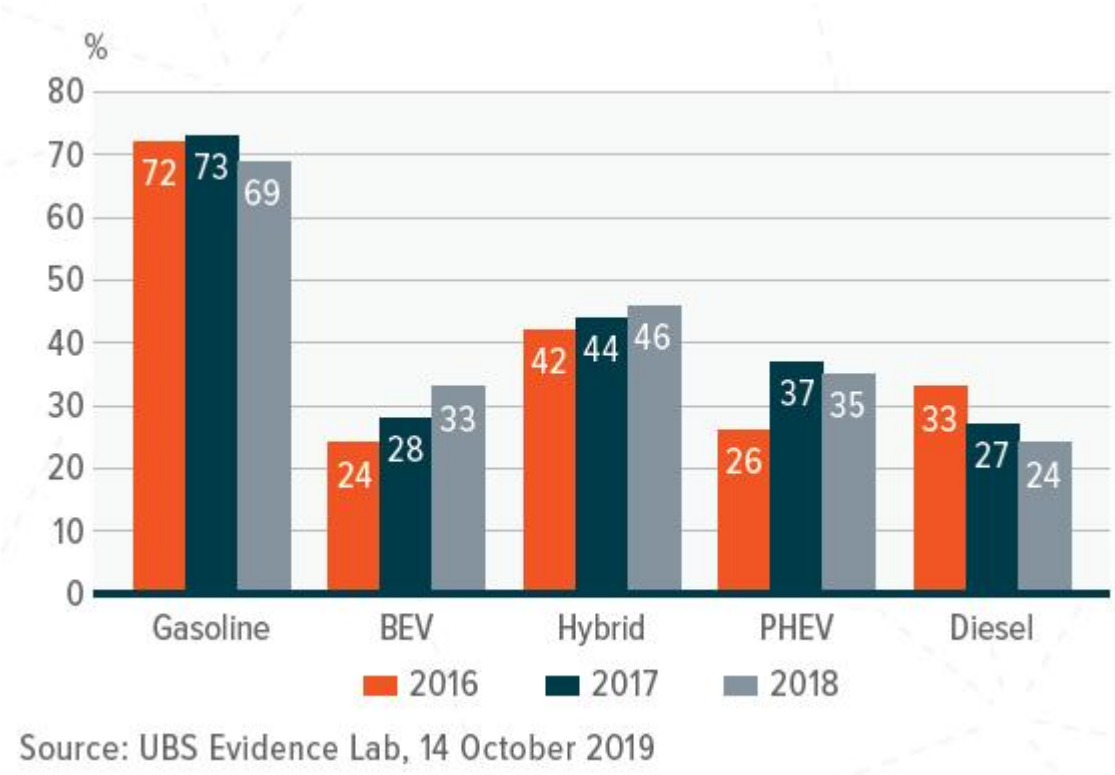


Figure 4.1 LIKELIHOOD OF PURCHASE CONSIDERATION BY VEHICLE TYPE

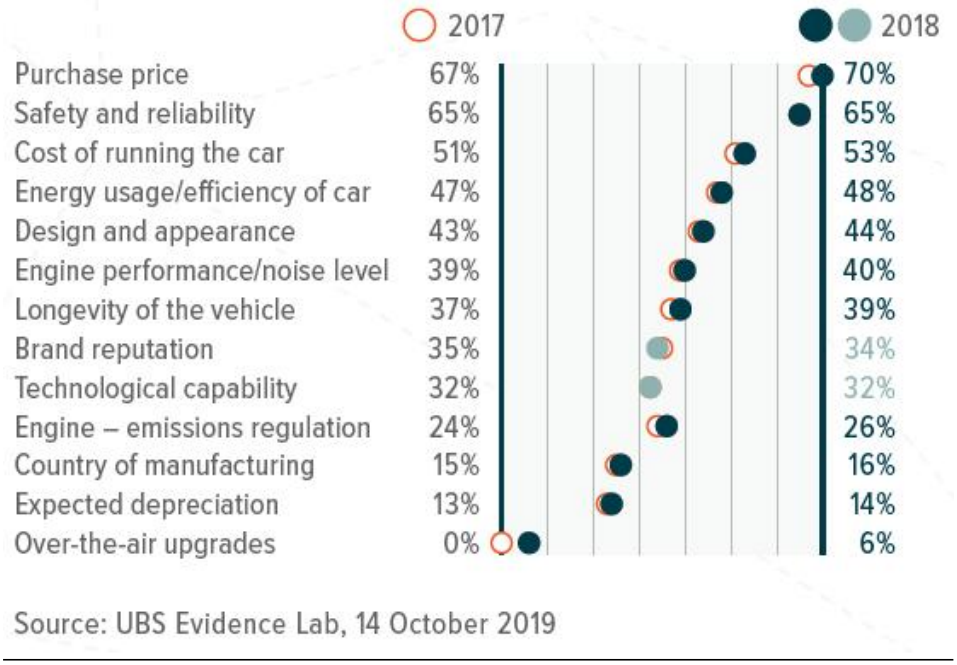


Figure 4.2 MOST IMPORTANT FACTORS WHEN PURCHASING AN EV

Demand 'pull' variables must take over for EV penetration to genuinely rise. An electric vehicle's usefulness must be seen as superior than that of a conventional vehicle by consumers. To do this, the cost of batteries must fall to the point where they are competitive with conventional cars. In addition to extending the range of electric vehicles, lower battery prices will also alleviate the issue of battery deterioration, which will be solved by improved technologies. If people are afraid about being "plugged in," a system of charging stations should be put in place. EVs are becoming more affordable because to recent breakthroughs in battery technology. Higher densities and cheaper prices are being made possible through advances in chemistry and design, as well as larger-scale impacts. Superior cathodes with increased nickel content, silicon-carbon composite anodes, and improved electrolytes that allow for higher voltages will all lead to considerable gains in energy density, specifically. 3–16 percent cheaper than the ICE versions of the VW Golf and Ford Focus during the next three years, according to Citi. An yearly mileage of 7,500 is used in the computation (based on the typical distance traveled by a privately owned car in the UK in 2016). Depreciation on EVs generally amounts for 97% of the

three-year total cost of ownership, whereas depreciation on ICEs accounts for 63% of the three-year total cost of ownership (Corbo et al., 2011).

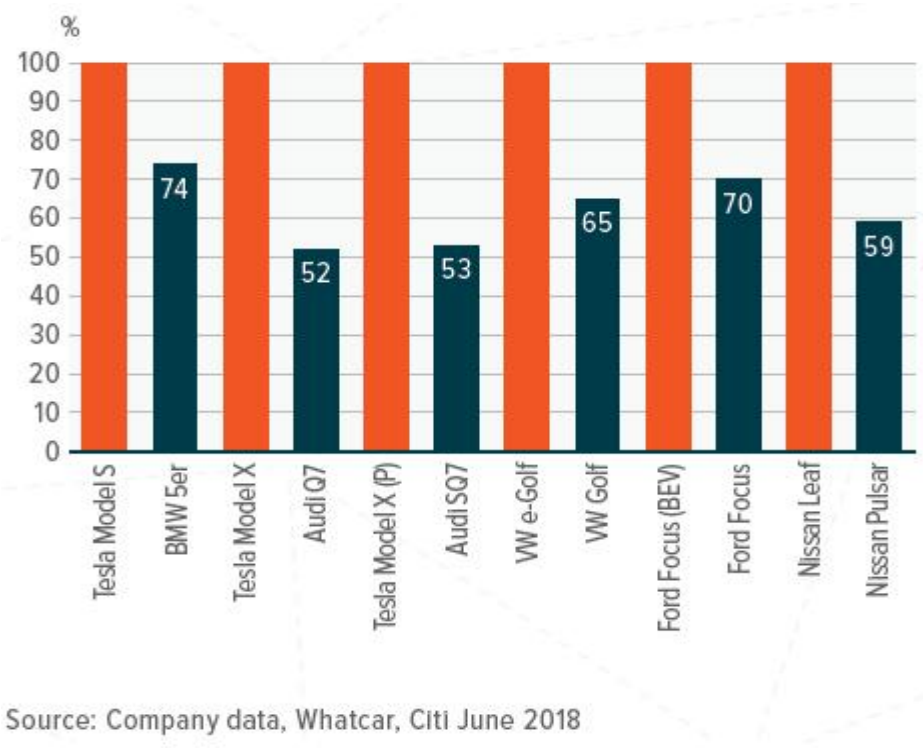


Figure 4.3 THE PRICE OF ICE AS AN ALTERNATE TO BEV MODEL

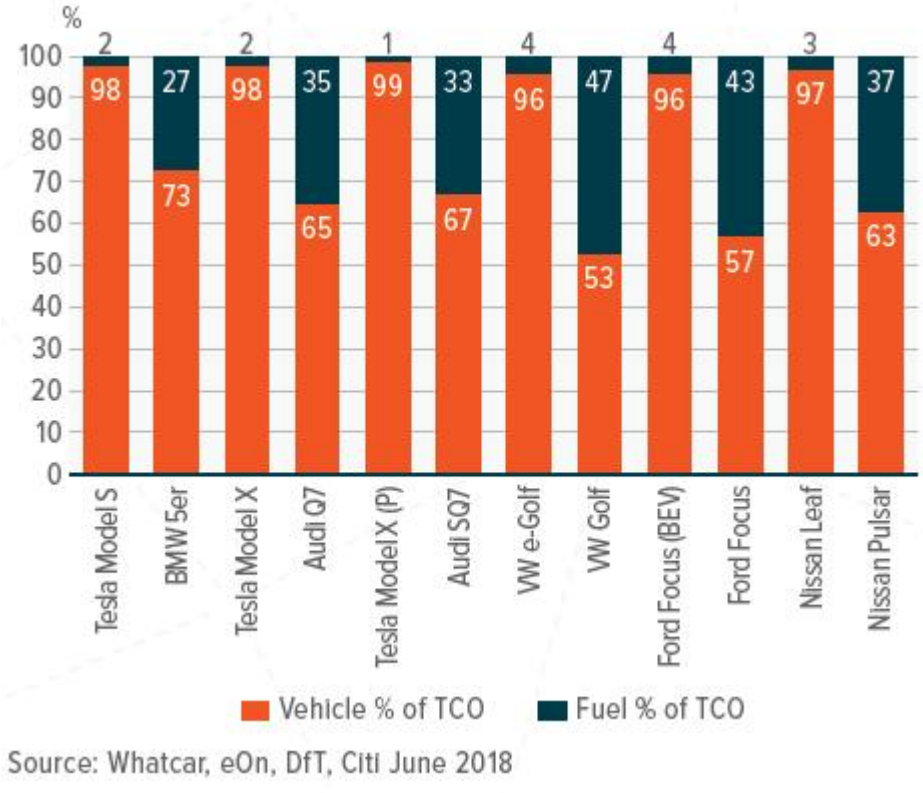


Figure 4.4 Vehicle depreciation and fuel costs account for three years of total ownership costs.

Most analysts believe that at the present pace of battery cost reduction, pure EVs from industry leaders will achieve upfront cost parity with ICE vehicles by 2022-23, while mainstream EVs will reach cost parity with ICE cars by 2024. By 2029, EVs are predicted to be more cost competitive than even the least compliant ICE vehicles worldwide. These estimates solely include initial expenditures and do not account for ongoing cost reductions (i.e. fuel and maintenance). If we add the latter, our total yearly savings would rise by
US$700-1150.

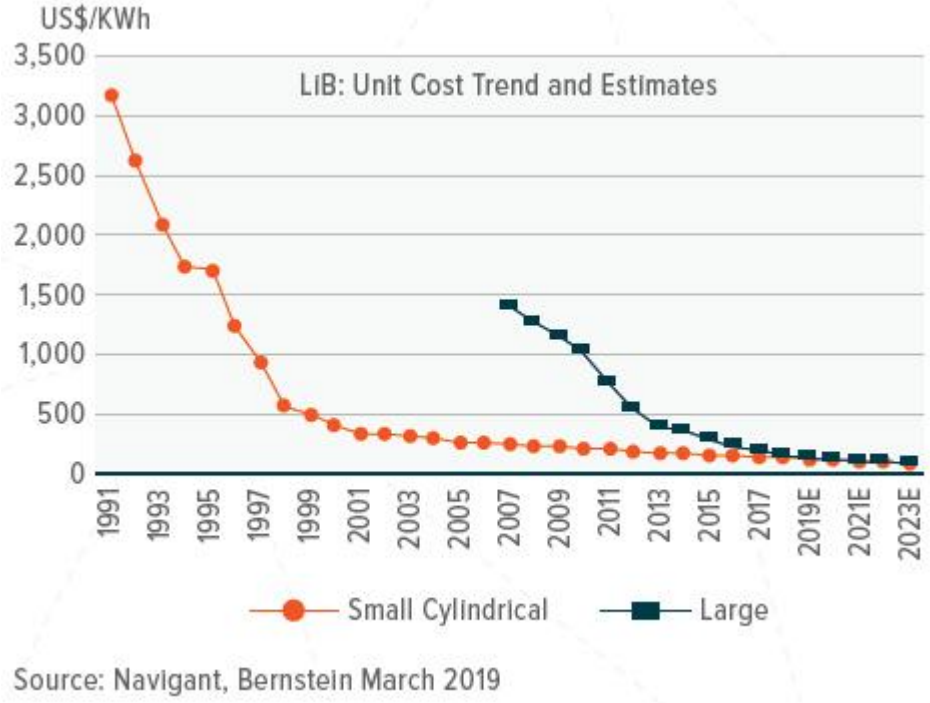
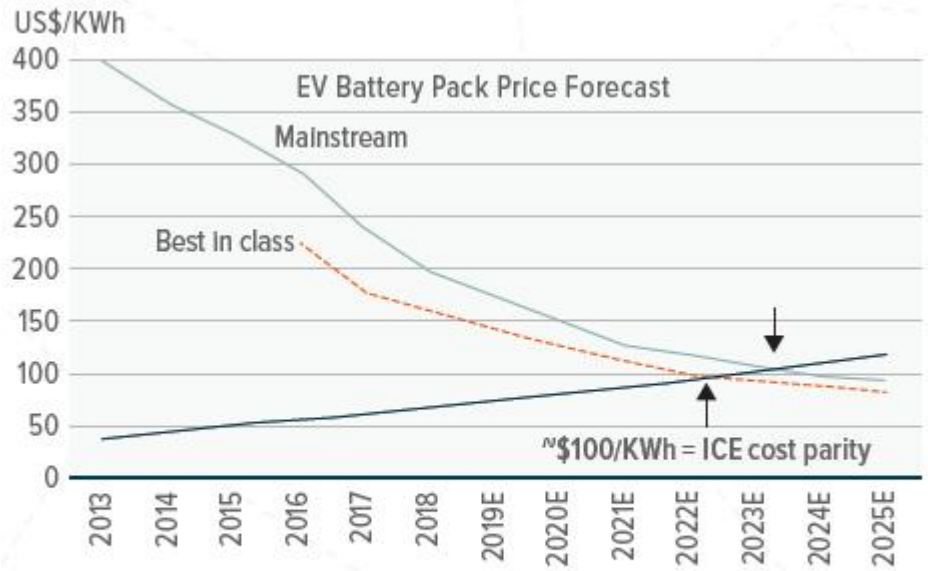
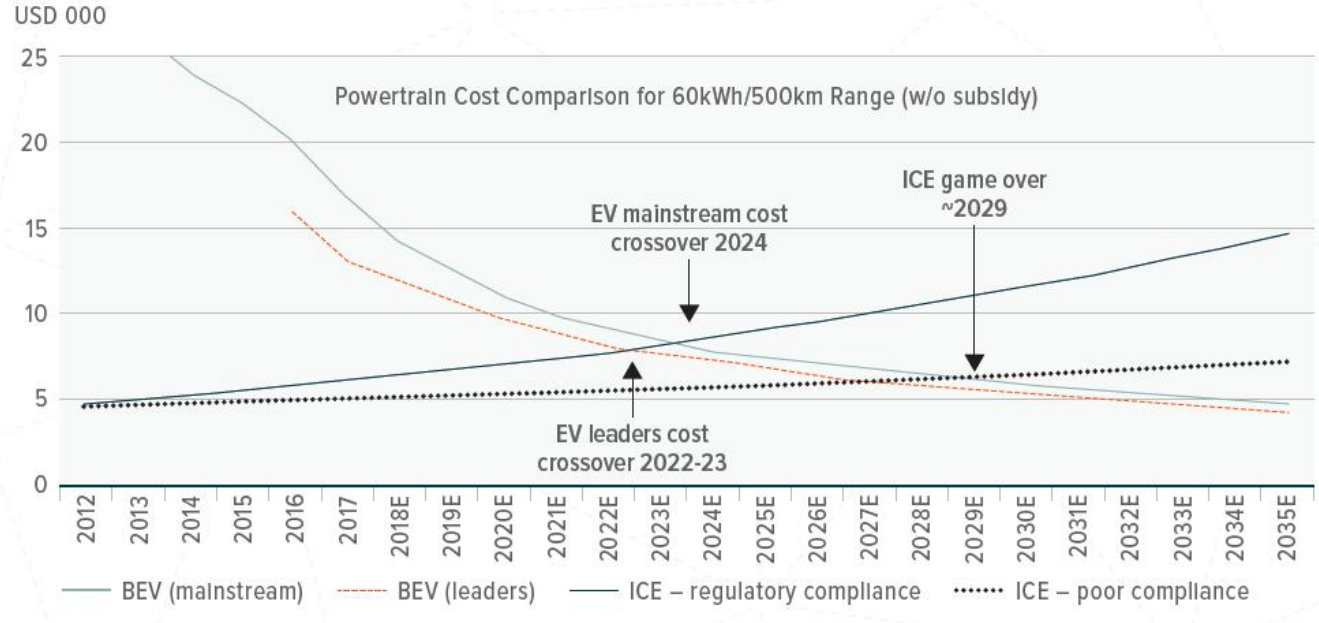


Figure 4.5 THE LIION LARGE BATTERYPACK PRICE IS EXPECTED TO FALL TO US$100/KWH BY 2023



Source: Bernstein March 2019

Figure 4.6 EV ECONOMICS ARE IMPROVING WITH BETTER AND CHEAPER BATTERIES



Source: Bernstein March 2019

Figure 4.7 THE MAINSTREAM EVS COST CROSSOVER VS ICE CARS IS EXPECTED TO BE IN 2024

Running cost savings for EVs	USA & CA	Europe France	China
Fuel cost savings per year ($)	(1,024)	(779)	(675)
Saving ($ cents)/km	(5)	(6)	(7)
• *Electricity cost ($ cents per km)*	2.14	3.34	1.24
• *Gasoline cost ($ cents per km)*	7.26	9.82	7.96
Distance/year (km)	20,000	12,000	10,050
+ Maintenance savings/year ($)	(124)	(75)	(62)
Total savings ($/year)	(1,148)	(853)	(738)

Source: Bloomberg, Energy Information Administration, Bernstein March 2019

Figure 4.8 ANNUAL SAVINGS PER YEAR FOR FUEL AND MAINTENANCE BY REGION

In the field of future new energy investment, investment is mutual. Traditional auto giants are still investing in China. Mercedes-Benz has invested in a research and development center in Shanghai that focuses on software big data. Benz has signed a strategic cooperation intention with Ningde Times, and ningde Times' batteries will be carried in the upcoming Benz electric cars. As the epidemic continues to ravage all over the world, localization will be the first follow-up measure and development trend of Mercedes-benz in China, which can greatly reduce production and transportation costs. Mercedes-benz already produces EQC battery systems at its battery manufacturing plant in China, and will subsequently produce and supply battery systems for EQC, EQA, EQB and EQE (Maggetto & Mierlo, 2001). The factory has been upgraded to produce all electric vehicles, including all the technological elements of the high-end electric model EQS. In the future, specific models will be put into production according to the market situation. At present, due to the impact of the epidemic, the automobile industry has seen the phenomenon of chip supply failure, and as time goes by, there is no sign of a solution. In order to realize the implementation of Mercedes-Benz China's future strategy, stable and sustainable

supply should be maintained in all supply chains, including not only chips, but also all kinds of imported parts. At the same time, Chinese manufacturers have also started to build battery factories in Germany, including CATL, SVOLT and Farasis Energy. At present, 80% of the world's vehicle-mounted batteries are produced by China and South Korea, and There are no large battery factories in Europe.

Nowadays, with the upgrading of consumption, consumer demand is rising greatly. They not only value the use value of products, but also care more about beauty and comfort, and even more about the brand and grade of products. The same is true for automobile consumption. At present, the development of electric vehicle industry is not mature and stable, so it is necessary to increase investment in technology, carry out scientific and technological innovation, improve industrial value and increase consumer confidence. In the case of frequent safety problems of electric vehicles, the vehicle safety is placed in the top priority. EQC's battery pack sacrifices battery life performance and leaves space as a buffer zone in case of impact. This protection structure can effectively absorb external impact and protect passengers and drivers. EQC also improves crash safety in the vehicle structure, dedicating more interior space to crashproof structure and structural deformation buffer. In the event of a collision or combustion accident, the EQC's high voltage system automatically deactivates the power according to the severity of the accident, and also supports manual deactivation. Compared with Tesla, which frequently suffers from poor quality control, uncontrolled driving, spontaneous combustion and a series of quality problems, Mercedes is expanding rapidly to increase its market share, while steadily promoting the launch of new products to ensure that every car can win with quality and reputation (Shang, 2014).

Electric vehicles are closely combined with digital networks. For the electric vehicle market, the new market brings a brand new purchasing experience and marketing mode. In order to improve the value of differentiation and customers' consumption power, the development of digital economy is also needed as the basis of enterprise development in marketing.

Different from fuel vehicles, electric vehicles need to change the original sales model, use new media to explore new channels, and improve customer purchasing and service experience. Electric vehicle companies can set up special electric vehicle sales team to focus on the new electric vehicle sales model. Use big data to tap potential consumer groups and target groups. Open an e-commerce sales platform, infiltrate from online to offline, and feedback relevant auto products to customers by means of accumulative points. In the early stage, due to low market demand and low output, the order-based production mode can be adopted to constantly improve the freshness of customers, which can also effectively streamline inventory. Customized and personalized products will increase car buying experience, improve consumer satisfaction and enhance brand value.

Guide consumers to attach importance to brand value. Brand is always a powerful guarantee for automobile sales. The brand value that consumers care about is not only an effective guarantee for product quality, grade, maintenance and after-sales, but also an added value that will run through the whole product life cycle. For new energy vehicles, new entrants to the enterprise if it has already been in fuel car market is brand awareness, so when entering new energy automobile industry still has certain advantages, has a certain viscosity of consumption on the one hand, the original owners, on the other hand history of mouth to play a positive role in attracting potential consumers, And customers' worries about brand life will be greatly reduced. For new car manufacturing forces, it takes a lot of marketing and cost and a certain amount of time to acquire brand value, which is a challenge with a high threshold.

Chapter5: Conclusion

In the automobile dynamic changes, by a certain impact on the development of internal combustion engine, also pointed out the development direction for it, to its at the same time of accepting challenges from all sides, to firm its development direction, toward diversification, strengthen the power to save energy and fuel, prolong service life, lower quality, smaller volume, simplify the maintenance operation and so on rapid development direction. Based on this, it is necessary for relevant researchers to

constantly improve the internal combustion engine based on the drawbacks of the current internal combustion engine and the demand for automotive power reform, so as to achieve the desired results of the development of internal combustion engine as soon as possible and provide guarantee for the development of the automotive industry.

Although new energy vehicles occupy a small market share, from the trend of market share growth year by year, new energy vehicles have broad prospects for development. At present, most countries in the world are in the situation of oil shortage and fossil fuel shortage, and the burning of fossil energy has caused great harm to the environment. Acid rain, acid fog, haze and other weather conditions appear more and more frequently, and the proportion of people suffering from respiratory diseases in the world is also increasing year by year. Countries urgently need to find a new energy to replace fossil energy, and the use of new energy has correspondingly driven the development of new energy vehicles. Because of new energy vehicles will not discharge gas pollution, and energy sources, solar energy, wind energy, hydropower, nuclear power can be directly or indirectly used in generating new energy cars, reduce the dependence on fossil fuels, and even make a few countries to get rid of the "oil control politics", to their long-term stable development and construction is of great significance.

Electric vehicles have come a long way in the past few years, with the encouragement and support of the government, the auto industry has begun to move from the era of internal combustion engines to the era of electrification. After one hundred years of development, the market share of mature diesel locomotive is the largest. However, with the development of technology, the proportion of diesel locomotive decreases, so the industry shrinks and production declines are inevitable. This does not mean that the internal combustion engine will withdraw from the historical stage, but that the strong are left after the elimination of the weak through fierce market competition. While the ownership rate of new energy vehicles is low, they will develop rapidly in the future, seize a large number of market shares in a short time, and become the golden period of new energy development.

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