The Comprehensive Analysis of Business Model Innovation within the Electric Vehicle Industry

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The electric vehicle industry has developed rapidly in the last decade. With the emergence of new technologies related to electric vehicles (EV) and the common need to meet the goal of sustainability, governments and companies have tried to participate in the business of the EV industry in a resilient and creative way. Among these players, China, Europe, and America have occupied almost 90% of the global sales of the EV market (Yang, 2023). Besides, during the year 2022, the growth rate of electric car sales in Europe was about 15%, meaning for every five automobiles sold, there is one which is electric (Moon, 2023). Over half of the production of electric vehicles has been sold on the soil of China, which has been the biggest EV market. In America, the growth rate of electric vehicles was 55%, occupying 8% of global EV sales (Yang, 2023). In new emerging markets like India, Thailand and Indonesia, the sales of electric cars have doubled by 2022. According to the prediction made by EVI, due to the increasing and unstable price of oil, governmental incentives for the EV industry, and the advances and development of related technologies and infrastructure, the global sales of EVs will increase continuously till 2030 supposedly. Despite the positive prospects of the EV industry, many topics regarding logistics, supply chain management, business administration and communication have been discussed again during and after the emergence of COVID-19. Many businesses have started to think about innovation in the process of producing electric vehicles, controlling costs, and new ways of selling. In addition, the changing and competitive environment requires EV companies to accelerate their way of developing new models, increase production, and meet the goal of sustainability. Hence, this paper, in a comprehensive way, analyzes the innovation that happened in different sectors of the global EV industry, along with the discussion of the consequences of COVID-19.

Evolving Competitive Strategies

A firm's survival cannot depend on the environment of the market itself, rather, the core competencies of a firm provide a solid and safe foundation for a firm to compete in a changing and rapidly growing market like the EV industry. Core competencies are "a set of integrated and harmonized abilities that distinguish the firm in the marketplace. If a corporation is like a tree, then core competencies are like the soil for it to grow. It is also a significant source of competitive differentiation (Schilling, 2020). The idea of "differentiation" means that a firm could have competitive advantages through the products, services or different abilities over other firms or stand out in the industry. Particularly pre-COVID-19, in the EV industry, one of the expectations of consumers would be solving range anxiety[1]. Hence, automobile manufactories need to increase the speed of charging and capacity of batteries. The technology of fast charging, therefore, would differentiate the company from other ones. For example, NIO, founded in 2014,

[1] The concern of battery charge

is a leading EV company, with more than 1500 related patents in the field of electric cars. It has soon become one of the biggest EV companies in China. In 2022, it occupied more than 75% of the high-end EV market. One of the core competencies of it is the battery swap model. It is used in a way such that car owners could drive to the Power Swap stations when their batteries run low. With the help of the Power Swap stations, the old battery could be replaced by a fully charged battery within five minutes. By 2023, NIO have implemented over 1700 Power Swap stations across the major highways and cities across China (Shenvi, 2021). Furthermore, it has been integrated with the idea called NIO Power. It is a combination of internet-based power solutions which involve Power Swap, Power Charger, and Power Mobile. It also "provides a pick-up and drop service for recharging an NIO vehicle within the shortest time based on the best option" (Shenvi, 2021). This set of services largely relieves customers' range anxiety. In addition, the other consumer expectation of electric cars is the cost. Many consumers think that it is not only inconvenient to drive electric cars since the less development of supplementary infrastructure, but also because the cost of owning one is relatively higher. NIO launched the "Battery as a Service" (BaaS) service for its consumers. BaaS is "a subscription model or leasing service that aims to reduce costs for consumers. The consumers who opt for this service can choose not to own the battery but rent it" (Shenvi, 2021). It could save money on the very expensive part, which is the battery when buying it, and utilize the use of it based on different solutions. The BaaS service is based on the idea of Battery Swapping. The large scale of investment for the model battery swap provides the foundation for the BaaS service. Although the BaaS service is not the optimal solution for reducing costs, as it depends on the preferences and conditions of various buyers (Guan & Zhou, 2022), it provides consumers with a reliable and alternative buying option. However, because of the Covid19, many customers are changing their expectations to a more comprehensive way, meaning that potential and current consumers are not only focusing on traditional shortcomings which are about range anxiety and cost, but also, they will focus on the healthy and efficient way of interacting with different companies. In the EV industry, with the spread of COVID-19, digitalized technologies and cloud services have been commonly used and utilized. Car companies started to sell and advertise online, building internet showrooms and extra. In addition, digitalized technologies would indeed promote autonomous driving in the EV industry in the era of post-COVID-19. It also matches consumers' expectations of a more "intelligent" way of travelling and driving[2].

Furthermore, because of COVID-19, many issues such as the shortage of manufacturing parts and raw materials seriously disrupt the production and supply of electric cars. Many electric car companies had to face the situation where the desired production plan cannot be achieved, as well as the essential auto parts like semiconductors[3]. In this context, COVID-19 indeed accelerated the increasing nationalism and trade protectionism. The integrated global market started to be reconsidered by politicians from the perspective of safety. For example, the political, economic, and technological tensions between China and the United

[2] The intelligent platform allows customers to gain much more information

[3] It is important in a lot of electronic fields as well

States increased the barriers for automotive manufactories to rebuild and resign their supply chain impacted by COVID-19. The United States launched "the chip-specific controls attempted to ban Chinese entities from procuring advanced AI chips based on fixed performance thresholds. The ban applies not just to U.S.-made chips, but also to any chip produced using U.S.- origin technology, software, or equipment" (Fist, et al., 2023). With the shortage of global semiconductors, the ban would make Chinese EV companies more difficult to maintain the inventory as the chip manufacturing companies are not able to expand more. In addition, American companies providing necessary equipment and software like Applied Materials, Lam Research and KLA Corp. may also be reduced their market shares and revenues in China.

Value Chain Re-design

The concept of a value chain invented by Harvard Business School Professor Michael Porter refers to "the various business activities and processes involved in creating a product or performing a service" (Schilling, 2020). It effectively helps to evaluate a firm by doing an internal analysis of the firm with identifying the firm's strengths and weaknesses (Schilling, 2020). The stability and cost-effectiveness of the supply chain in the EV industry are truly important when providing raw materials and industrial parts for the factory to manufacture and assemble. A typical EV supply chain usually consists of "material suppliers, component suppliers, automakers, distributors and consumers" (Wen, et al., 2021). Each of the factors could drive the cost and price of the product to increase or decrease, meaning that it could stimulate or lower the demand side as well. In addition, if a firm wants to maintain its sufficient inventory and augment its production when needed, a cost analysis of its supply chain is necessary. In addition, for example, Tesla, in the recent decade, has been developing at a fast pace in terms of the high market demand for its products. When maintaining the huge number of sales, the good-shaped economic condition allows them to keep investing in Research and Development (see Appendix A), focusing on automation, material costs and software updates. "One of the company's strategic objectives is to increase investment in R&D to develop new products that satisfy market demand for enhanced renewable energy solutions, such as batteries for various purposes" (Furrier, 2020). The consistent investment in R&D helps Tesla to lead the EV industry worldwide, and as a result, their different models with various prices attract more and more consumers; however, there is a problem regarding setting the price, and price relates to cost control. Keeping a reasonable price for different models means that Tesla needs to pay attention to controlling the cost. As mentioned above, supply chain management is crucial to lower the cost. The other critical point is that increasing production could lower unit costs. When considering these two factors, Tesla started to build its Gigafactory in Shanghai in 2019[4]. Soon in less than three years, its output occupied half of the production of Tesla cars worldwide. The increasing output of Tesla relies on the combination of the environment of the market and the localization of its supply chain (Freed, 2023). One of the advantages of the Chinese EV industry is it is very complete, meaning that it has supplementary firms to provide the materials and

[4] The main goal is to increase production as the demand has been soaring

industrial products that Tesla needs. By localization of Tesla's supply chain, Tesla can lower the cost of its supply chain and logistics. Besides, the localization of Tesla's suppliers is also beneficial to Chinese suppliers, meaning that they could have more orders from Tesla which can maintain a high level of production (Kaur, 2023). Nonetheless, the global supply chain was hit and disrupted seriously by COVID-19. Tesla also tried to redesign the software system of its supply chain management, reducing the necessary need for the number of chips, and delaying the time of releasing its new model. Hence, the re-design of its value chain including investing in R&D, localizing the supply chain in China, and improving the design of its software system, Tesla tried hard to solve the issue of the shortage of production and maintain its competitive advantages. Furthermore, regarding the EV industry, minerals and battery supply chains have been critical to satisfy the high demand for electric vehicles, and the related innovation of technology of mining and battery also contributes to reducing greenhouse gases. In detail, it is a bit counterintuitive in the sense that EV sales have been continuously growing even during the pandemic. "In 2021, EV sales broke new records, with nearly 10% of global car sales being electric, four times their market share in 2019. Public and private spending on EVs doubled relative to 2020" (IEA, 2022). This trend of high demand and production of EVs will presumably grow in the near future till 2030. In this scenario, "batteries typically account for 30% to 40% of the value of an electric vehicle" (IEA, 2022). The minerals and metals like lithium and cobalt needed to manufacture them thus need to be supplied sufficiently to meet the demand for manufacturing more EVs. However, Russia's war in Ukraine "has further exacerbated matters with prices of raw materials such as cobalt, lithium and nickel surging" (IEA, 2022). Given the high demand and price of minerals, there are possible solutions by shifting the target toward mineral-intensive options. For example, "lithium iron phosphate cathode chemistry (LFP) does not require nickel nor cobalt, it is better suited for shorter-range vehicles. Innovation in new chemistries, such as manganese-rich cathodes could further reduce pressure on mining" (IEA, 2022). Besides, by recycling and encouragement from governments to private investment in sustainable mining, the need for raw materials can be fulfilled sustainably. In short, on one hand, the large EV companies, in the context of Tesla, tried to reduce the cost of supply chains by localization and updating software systems to maintain their production. On the other hand, raw materials needed to manufacture batteries required by EVs can be produced sufficiently by seeking replaced solutions of producing, technological innovation and private investment encouraged by local governments.

Emerging Models of Collaboration

Moreover, in terms of collaboration, in the EV industry, there are two steams of power collaborating and competing. The first group is traditional Original Equipment Manufacturers (OEM), including automotive manufacturers like Volkswagen, and BMW. The other group is so-called start-ups in the automotive industry[5], especially in the EV industry. The concept of automotive start-ups means the emerging automotive manufacturers focusing on

[5] They are also known as automotive new forces in China

building, designing, and innovating electric cars in an IT-based manner. Typically, these companies like XPENG and NIO make their companies integrate more with digitalized and intelligent technologies. As the global market of the EV industry is becoming more and more competitive, traditional car manufacturers start to seek to collaborate with newcomers. For example, the famous German brand Volkswagen signed an agreement with XPENG in 2023, trying to reach a long-term strategic partnership. It includes the deal of investing 700 million to XPENG, allowing Volkswagen to obtain approximately 4.99 shares of it. They also aim to collaborate and jointly develop two B-class battery electric vehicles in the Chinese market under the Volkswagen brand. (Lee, et al., 2023).

The German automotive manufacturer giant's core competencies including a strong supply chain management system, production capacity and solid brand popularity could enhance the stability of XPENG's survival in the extremely competitive EV market. In the 2023 financial year, XPENG's sales and revenues have dropped significantly and the investment from Volkswagen is important for them to maintain its finance healthy and supply chain more stable. In addition, traditional car manufacturers, though having a strong and deep understanding and accumulation of management skills in the traditional automotive market, usually lack related technologies and IT-based business models to compete with the newcomers. Thus, XPENG could, in turn, provide what Volkswagen might need when entering deeply into the Chinese EV market. According to He Xiaopeng, the CEO of XPENG, "the Volkswagen Group and XPENG each bring in highly complementary strengths. We will share Smart EV technologies and world-class design and engineering capability and learn from each other" (XPENG, 2023). Through this partnership, Volkswagen could, as commented by Mr. Ralf Brandstätter, Volkswagen AG Board Member for China, "we are leveraging the partners' core competencies, thus creating synergies to bring additional products to market faster. At the same time, we could significantly optimize development and procurement costs" (XPENG, 2023). Besides, the partnership generates the possibility of open innovation. By licensing the technologies, it provides the foundation of a new product to market which draws on deep and "difficult to imitate" expertise and other resources. In the context of the Chinese EV market, the chance of open innovation could help Volkswagen and XPENG provide new car models that best suit the needs of the customers and increases the shares of Volkswagen's market share in the Chinese EV market. Hence, by collaboration, the strategic partnership allows two forces to leverage their competitive advantages and gain mutual benefits.

Innovations in Human Resource Management

In Michael Porter's model of a value chain, human resource management belongs to support activities including hiring, recruiting, and training, extra. As the environment of the global EV industry is pretty dynamic, changing and stressed by COVID-19, the way of organizing and training new personnel is critical for the EV manufacturers to be competitive. Automotive manufacturers, including start-ups and traditional ones, are seeking digital transformation. The application of digital transformation relies on talented software or A.I.

engineers to collaborate with mechanical engineers. For example, Volvo is one of the earliest traditional automotive manufacturers entering into the EV field. According to Volvo's chief human resources officer Björn Sällström, "Technically, cars today are very different from ten years ago. Once, you needed mechanical engineers. Today, there is a greater need for software engineers because are computers more than anything else" (Charan, et al., 2018). In addition, CEO Stefan Jacoby and Björn both realized that "only an infusion of fresh talent could transform Volvo's culture into an entrepreneurial one" (Charan, et al., 2018). Given this strategy, Volvo started to seek talents outside of the company to get the talents and change the company needed. They would hire marketing people from Google, "who transformed Volvo's use of technology and social media in those disciplines. They would hire Nokia engineers to know what digital forms appeal to consumers. Besides, they developed a strong system to integrate and infuse the talents. They implemented over 300 key workers with personal coaches, shifting them to a more entrepreneurial mindset. A catalyst group was created to analyze and share ideas of how to do work differently" (Charan, et al., 2018). In short, the innovation of human resources management in the changing global EV market, given the context of Volvo, is somehow driven by the expectations of potential consumers and the development of artificial intelligence. Changing the traditional and mature framework within a large organization is challenging and painful. In terms of digital transformation, Volvo's strategy of looking for talents outside of the box could be worthwhile to learn.

New Product Development Strategies

Regarding new product development, affordability is the key to attracting consumers. Many potential consumers interested in buying electric cars are not willing to spend much money on electric cars, given that the EV market is not as mature and well-developed as the traditional one. According to the 2022 Global Automotive Consumer Study by Deloitte, "75 percent of consumers considering an EV purchase intend to spend less than $50,000, yet fewer than half of the options currently available meet this mark" (EXRO, 2022). The American giant in the EV market, Tesla, its strategy for new product development has proven very successful in the market. Notably, along with the marking and commercial goal of Tesla, Tela's vision is to "accelerate the transition from a mine-and-burn hydrocarbon economy towards a solar-electric one" (Simms, 2023). To meet these goals, Tesla developed a series of models ranging from different prices. Not only does this Tesla want to explore the high-end market, but also, they provide more affordable choices to the customers. The battery is the core component that makes an electric vehicle so expensive. Tesla aims to lower the cost by continuously investing in new battery technologies. In addition, they also work on integrated digitalized systems which allow the electric vehicles to be more intelligent. Thus, in the long-term, Tesla should still work on the innovation of battery technologies and try to promote the production of 4680 battery which will reduce battery costs by 50% and bring Tesla a game-changing advantage in terms of price. In the short term, Tesla, given its capability of technology innovation and the possession of a huge market share in many continents, should continuously try to increase production by managing the

supply chain. It may help if Tesla could collaborate with local traditional automotive OEMs to generate new models which best suit the local market. In short, new product development strategies should not only focus on evaluating commercial or business goals, but it is also important to generate an ecosystem from which intelligent software could better combine with the mechanical parts. In addition, when setting up a goal that the company wants to achieve, it should develop the product in a way which could be more inclusive, diverse, and cost-effective to attract more customers.

Designing for Sustainability

Regarding the role of sustainability, on one hand, it is obvious that shifting from gasoline cars to electric cars is more sustainable for the development of transportation. On the other hand, the process of designing and producing electric vehicles could be more sustainable by adopting different methods. For example, in terms of the global EV market supply chain, the processing and exploiting of raw materials including minerals like lithium, cobalt and graphite can be harmful to the environment and sometimes less effective. According to the IEA report on the supply chain of EV batteries, recycling and innovation in new chemistries could lower the demand for minerals, reducing the pressure on mining. Furthermore, IEA also emphasizes the importance of governments which can help to strengthen cooperation between producer and consumer countries to facilitate investment, promote environmentally and socially sustainable practices, and encourage knowledge sharing. Besides, in terms of designing new models of electric vehicles, companies could take use recyclable and eco-friendly materials to produce cars[6]. For example, Tesla "has switched to a low-VOC, water-based paint, which is easier on the environment than paints with higher levels of VOCs" (Simms, 2023). In addition, it "has a recycling program that reuses a large portion of end-of-life batteries to manufacture new ones, cutting down on long-term emissions for production" (Simms, 2023). When generating the electricity required by plants and charging stations, the equipment could be replaced by on-site solar panels or enhancing the way of automation. For instance, Bentley Motors, a British car manufacturer producing traditional and hybrid electric vehicles, has achieved a carbon neutrality certification for its factories with 100% use of on-site solar panels to generate electricity. In short, not only should the designing of sustainability in the global EV market focus on designing electric vehicles, but also, it should comprehensively emphasize the issue of the supply chain of its core components like batteries and the way of generating electricity.

To conclude, the business innovation of the EV market is a rather complex topic which includes the innovation of nearly every prospect like the supply chain of production and raw materials, the mechanical part of the car, the platform powered by software, human resources management and the goal of sustainability. By sharing the stories and analyzing several leading examples, there are similarities regarding the direction of innovation. Many leading EV companies worry about the stability and resistance of their supply chains, especially in the post-COVID-19 era, which could be improved by enhancing local cooperation and decentralization.

[6] In addition, "Tesla used 100% renewable energy for its superchargers in 2021" (Simms, 2023).

Regarding the unit price of an electric car, many EV companies want to lower the cost by developing cost-effective batteries. In terms of the functions of the car, range anxiety and the capability of fast charge are the main directions emphasized by the EV market. In addition, the digital transformation of car design requires EV companies to focus on software systems, along with mechanical ones. In addition, the goal of sustainability requires EV manufacturers to update their materials to be more eco-friendly and use updated and automated technology to generate electricity in the process of production.

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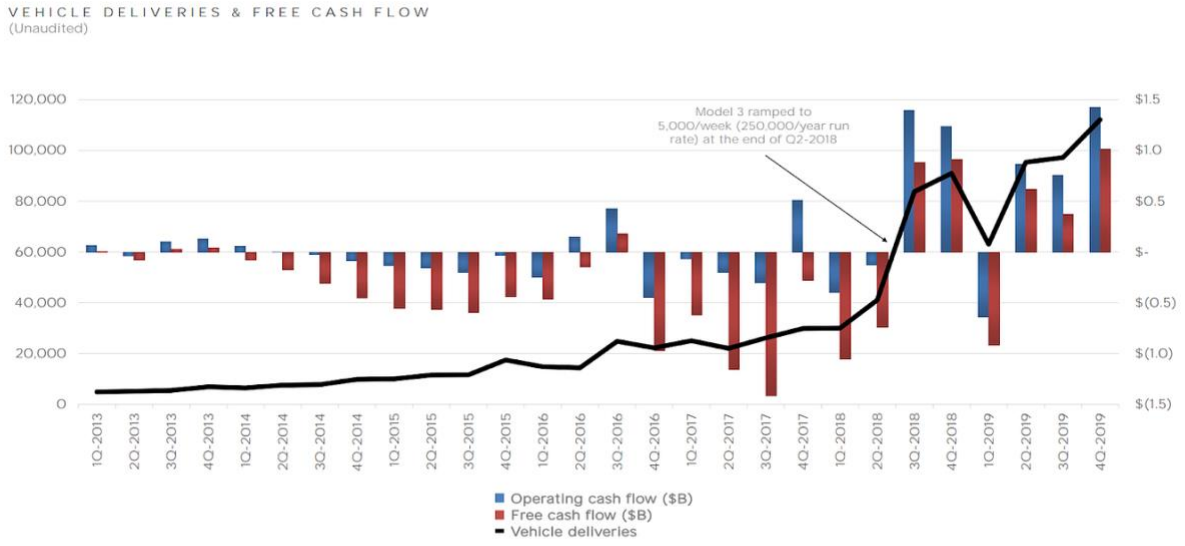
Appendix A


VEHICLE DELIVERIES & FREE CASH FLOW
(Unaudited)
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Model 3 ramped to 5,000/week (250,000/year run rate) at the end of Q2-2018
1Q-2013
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Operating cash flow ($B)
Free cash flow ($B)
Vehicle deliveries