Analysis of Optimization Strategies for Tesla's Cost Management

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Abstract. In recent years, as the global emphasis on sustainable development has intensified, the new energy vehicle industry has emerged as a pivotal sector in economic transformation, with both government policy support and societal expectations driving increasingly fierce competition within the field. For new energy vehicle companies to stand firm amidst the intense market competition and enhance profitability, they must implement forward-looking strategic adjustments in cost management. This research, relying on the perspective of the value chain, delves deeply into the mechanisms of corporate cost management, aiming to broaden the scope of management insights and precisely identify cost reduction opportunities and value-added potential. Taking Tesla as a case study, this paper conducted a detailed analysis of the operational efficiency and management wisdom of each link in its value chain. Based on the theory of value chain cost management, this paper proposed a series of targeted optimization strategies, focusing on supply chain leanness and production process efficiency, in an effort to provide Tesla and its industry peers with a reference path for cost optimization. These efforts are expected to have far-reaching implications for promoting the sustainable development and profitability enhancement of the new energy vehicle industry.

Keywords: Automobile, cost management, battery technology.

1. Introduction

A major change is taking place in the automotive sector today, as new energy vehicles are gradually replacing fuel vehicles in the market. Tesla came out in Silicon Valley in 2003 and raised Series A funding led by Elon Musk the following year. After 16 years under Musk's leadership, Tesla Inc. has become the world's leading electric vehicle company, with the launch of new models and business development widely followed. In 2008, Tesla released the first Roadster coupe. However, the Roadster's development costs were much higher than expected, and Musk had no choice but to raise the price from $100,000 to $110,000, a move that also caused consumer dissatisfaction. 2012-2016 is the development period of Tesla. Tesla went public in June 2012 and gradually started delivering Model S. Along with the delivery of Model S, Tesla's profit increased significantly and in the first quarter of 2013, Tesla made profit for the first time. In 2014, Tesla entered into a strategic partnership with Panasonic, which supplies batteries for its models, and the Nevada Superfactory handles the production of all of Tesla's power trains. From 2017 to the present, Tesla achieved mass production and went international. In July 2017 Tesla began delivering the Model 3, a mid-sized luxury sedan for the mass market, and it was a huge success with its cost-effectiveness, however, due to the difficulty of climbing the Model 3 production capacity, it was once in a ‘capacity crisis ’in 2018, and in order to break through the production capacity, Musk temporarily built a new assembly in the Fremont factory production line, and finally solved the problem of lack of capacity in 2018 with the highest delivery volume in history. Along with the large-scale mass production and delivery of Model 3, Tesla's revenue has grown by leaps and bounds, and its net profit loss has shrunk, with revenue reaching $21.461 billion in 2018 and net profit loss shrinking to $976 million [1]. This paper will analyze Tesla's cost management optimization by looking at the technical aspects, the product aspects and the value chain to see how Tesla manages costs effectively.

2. Cost Optimisation Strategies

2.1. Technical Aspects

Tesla's cost optimisation in the technical aspect is mainly technical innovation and design optimisation to reduce the number of hardware and continuously update and iterate to achieve cost reduction. This paper will analyse Tesla's optimization strategy in technology from the following four points.

Firstly, Tesla is reducing the amount of precious materials by finding low-cost materials instead. 2017~2022, Tesla's strategy to reduce its dependence on rare earth by optimising its design to improve efficiency. The amount of rare earths used in its new Model 3 drive module has been reduced by 25%. Currently, the main rare earth elements used in Tesla's car motors are dysprosium, terbium, and neodymium, with a content of 10g, 10g, and 500g, respectively [2]. In addition, Tesla's CEO Musk has claimed that the next-generation permanent magnet motor technology will realise the use of rare earth materials with no loss of energy efficiency with a ‘0 ’use.

Second, Tesla has now launched three generations of cylindrical batteries, 18650 [3], 21700 and 4680, which the numbers represent the diameter and height of the cylindrical battery. For example, the 4680 battery has a diameter of 46mm and a height of 80mm. In 2008, the Tesla Roadster was launched, which was equipped with 18650 batteries made by Panasonic, and Tesla thus pioneered the application of cylindrical batteries in the field of power batteries. In 2017, Tesla and Panasonic jointly introduced 21700 cylindrical batteries and applied them to Model 3, and in September 2020, Tesla released 4680 large cylindrical batteries. From 2022, some Model Y has been equipped with 4680 large cylindrical batteries. In terms of performance, Tesla's 21700 batteries have a 50% increase in energy per cell compared to 18650 batteries, and 4680 batteries have a five-fold increase in energy and a six-fold increase in power compared to 21700 batteries, with a corresponding 16% increase in range. In addition, as the size of the battery increases, the number of structural components required for a battery pack of the same electrical capacity decreases accordingly, and the overall space utilization of the battery pack increases, thus reducing costs.

Third, Tesla improves the manufacturability of its products by integrating hardware through material selection, technology, process, and equipment innovation. The number of parts and the complexity of the process have been significantly reduced. This innovation contributes directly to the reduction of labour costs. The production cycle and efficiency are increased, thus reducing the cost of the production process.

Fourth, Tesla maximizes the potential of the hardware by replacing hardware stacks with highly optimised two-stage software algorithms. Tesla’s Autopilot, for example, uses purely visual routes that are recognized using software. This strategy avoids high-performance sensors such as LIDAR, reduces reliance on electronic meta-parts, and significantly lowers production costs. In addition, it also adopts the development idea of software-hardware integration, which can be compatible between generations, i.e., the software can be reused after the hardware has been replaced.

2.2. Product Strategy

Tesla uses software services and accurately grasps customer needs to achieve differentiated competition among products. Meanwhile, in terms of cost reduction, Tesla has adopted a series of innovative strategies, which are mainly reflected in the following three aspects [4].

First, Tesla insists on simplicity and efficiency in product design, and is committed to minimizing the cost of each feature, focusing on meeting the needs of most users in the mainstream market. For example, Tesla found through the study of user data, that the car sunroof frequency is low. Increasing the sunroof not only increases the manufacturing cost, but also compresses the headspace inside the car, so Tesla decided to cancel the sunroof configuration, this decision not only reduces the cost of production, but also makes the car space layout more reasonable.

Second, Tesla is actively promoting the generalisation and platformisation strategy of its hardware to achieve economies of scale. The hardware commonality between Model 3 and Model Y has

reached 75%, not only do the electrodes, battery packs, high-voltage electrical parts, subframe, and another hardware share, but the front and rear suspensions and bodywork are also partially common. This high degree of versatility not only simplifies supply chain management, but also significantly reduces research development and production costs.

Third, Tesla has further deepened its cost reduction strategy by sharing software systems and platform architectures across models. This sharing of software not only improves development efficiency but also makes it easier to update and maintain the software, bringing owners a more consistent and continuously optimised experience. At the same time, the reuse of software systems also reduces the software cost of a single car, which provides strong support for Tesla to maintain its price advantage in the market competition.

3. Tesla Value Chain Analysis

3.1. Concept Explanation

Grigorescu pointed out that cost management in the value chain can help companies more clearly understand the gap between themselves and their competitors, thereby better identifying their strengths and weaknesses in the market [5]. Chen Yaxiang believes that analyzing enterprise cost management from the perspective of the value chain can effectively break down the enterprise's operating process into every link, making it easier for managers to formulate appropriate cost management measures for each link [6]. Cost management based on the value chain aims to achieve resource conservation, profit improvement and market core competitiveness, so as to achieve the goal of cost reduction and efficiency improvement [7]. Therefore, this study uses the value chain as a model to analyze the cost situation of each link of Tesla and provide optimization measures.

Porter's value chain model divides an enterprise's activities into basic activities and supporting activities. The basic activities include the following six aspects: inbound logistics, operations, outbound logistics, marketing and sales, and service as shown in figure 1. Support activities include four aspects: company infrastructure, human resource, technology development and procurement. This article mainly analyzes from the perspective of basic activities, which will help companies better formulate cost management policies.

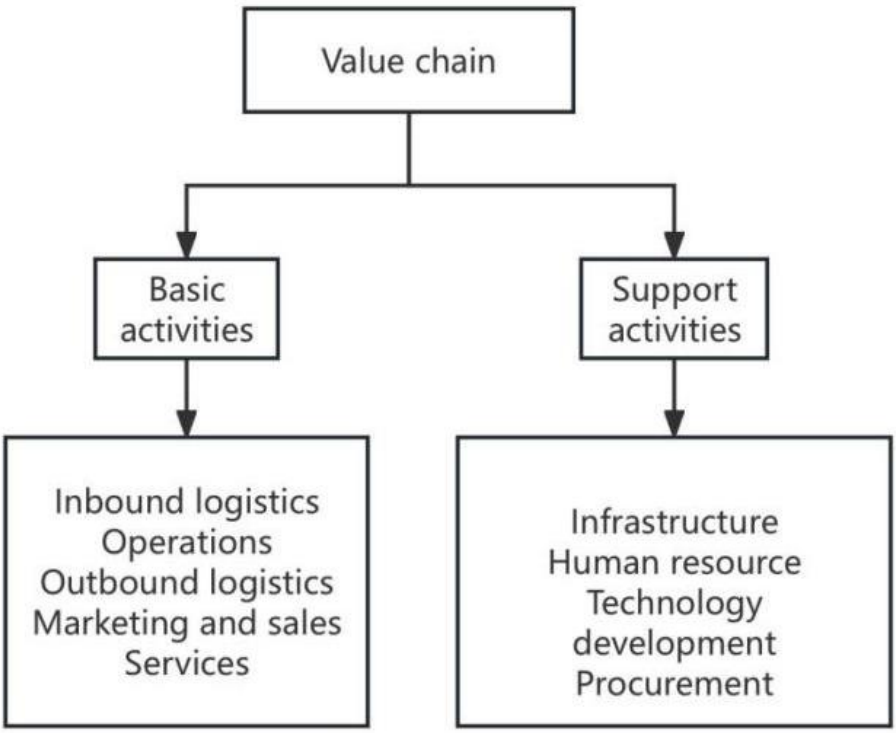

Fig. 1 Enterprise value chain

3.2. Analysis of Tesla's Cost Management Optimization Strategies

3.2.1. Inbound logistics

The price of products will affect the competitiveness of enterprises in the market. If a corporation intends to obtain an advantage over its competitors, it must consider the cost of raw materials required for its goods. Key raw materials such as lithium and cobalt in Tesla's batteries are usually purchased through suppliers. Semiconductor chips for vehicle electronic systems are mainly purchased from suppliers such as Intel. Tires are mainly provided by well-known suppliers (such as Michelin, Pirelli, etc.) Therefore, the production process of new energy vehicles involves a large amount of raw materials and parts, which makes unified management difficult. Given a huge amount of suppliers, coordination and scheduling are complicated, which can lead to delays and out-of-stock issues. On the other side, due to changes in production schedules and demand uncertainties, inventory management may experience excesses or shortages, resulting in capital waste or production disruptions.

As a result, Tesla should implement advanced internal management tools to monitor the supply chain and internal warehouse status in real time. It should also leverage IoT technology to monitor and gather data on equipment and systems in real time, as well as improve logistics operation visualization.

3.2.2. Operations

Tesla has Gigafactories in the United States, China, and Europe. Tesla employs die casting, assembly, and testing technology, as well as a significant number of robots and automated equipment, to aid in production. This can increase the manufacturing line's efficiency and uniformity while lowering labor expenses and mistakes. Simultaneously, Tesla uses economies of scale to minimize the fixed costs of each vehicle. However, instabilities in the supply chain, such as supplier delays and material shortages, may necessitate changes to production schedules and stop downs. High material costs and technological inputs raise manufacturing costs, reducing profitability.

Based on the above problems, Tesla should improve supply chain stability, extend its supplier network, minimize reliance on a single source, and increase supply chain flexibility and stability. Tesla should conduct in-depth negotiations with suppliers by implementing a large-scale procurement strategy, striving to reduce raw material procurement costs and enhance cost competitiveness while ensuring quality. Furthermore, Tesla should enhance its investment in research and development of automated manufacturing line technologies. By increasing the intelligence and automation of the manufacturing line, lowering labor costs, considerably boosting production efficiency and product quality, and cementing its market leadership position.

3.2.3. Outbound logistics

In terms of logistics, Tesla operates regional distribution facilities in major regions to transport and store entire automobiles. It has created specialized supply chains in major worldwide markets, including the Shanghai facility in China. Taxes and other expenses associated with logistics can be decreased by localized sourcing. In addition, Tesla improves its transportation network and collaborates with premier global logistics companies such as CEVA Logistics and XPO Logistics to increase transportation efficiency and dependability while lowering expenses associated with transportation delays.

Tesla should utilize an intelligent transportation management system (TMS) to optimize routes and minimize delays. It should also deploy a Just-In-Time approach to align manufacturing and logistics activities with market demand and eliminate inventory backlogs or shortages.

3.2.4. Marketing and sales

In the marketing and sales process, Tesla promotes its brand and products using digital marketing, social media, and offline activities. Tesla combines offline direct storefronts and internet official websites for direct sales, reducing the expensive cost of traditional advertising which can accurately target potential buyers and improve marketing efficiency. However, brand awareness and market

penetration still need to be improved. Although Tesla has a strong reputation in the electric car sector, it still needs to increase brand recognition in some specific areas and regions. Tesla's higher prices among new energy vehicles may limit the purchasing power of some potential customers, and competitors' continuous introduction of more cost-effective electric vehicles has also intensified market competition.

Tesla should enhance its marketing efforts to raise its reputation, such as advertising, cooperative marketing, free trial days, and other initiatives. Showcasing cutting-edge technologies and products can boost the brand's image. Furthermore, Tesla could develop an optimal pricing strategy, launch additional models in different price ranges, or raise models in different price ranges to fulfill the demands of more customers. The corporation should provide additional discounts and financing alternatives to decrease the barrier for people to purchase automobiles.

3.2.5. Services

Tesla's customer service has dramatically improved over the last few years. Tesla uses remote diagnostics and OTA software upgrades to minimize the frequency of visits to the service center as well as follow-up service costs. Tesla offers mobile services in select places, and experts can come to the owner's specified location to do simple repairs and maintenance. However, due to the great demand for Tesla's services, certain Tesla service facilities may have extended wait times for servicing appointments. This may create inconvenience for automobile owners during the wait time. In addition, Tesla's repairs may be affected by insufficient parts supply, especially some less common parts may require longer waiting times. Therefore, Tesla should actively expand its service network and increase the number of service centers to shorten waiting times and improve service coverage. Tesla should also improve its parts supply chain management to reduce service delays caused by parts shortages.

4. Conclusion

Tesla's continuous research and development in reducing material costs, battery technology, vehicle integration, and overall vehicle intelligence have also made great achievements and progress, which has enabled Tesla to win a leading position in the tram market. While Tesla is holding a leading position in the market, Tesla is committed to improving operational efficiency and reducing production costs through various means, including internal management systems, production operations, and external logistics. This approach aims to at optimize supply chain management. In terms of marketing, Tesla's direct sales model and digital marketing strategy have further improved its market competitiveness. Although Tesla has advantages in market position and technology, the stability of its supply chain and production capacity remains a concern. With the increasing attention to global environmental protection and new energy issues, Tesla needs to continuously improve and innovate its technology to meet market changes and competitors' challenges to maintain market competitiveness and consolidate its market leadership. Overall, Tesla's continuous technological innovation and efficient cost management have allowed it to maintain a strong competitiveness in the new energy vehicle market. Looking ahead, Tesla must continue to optimize its technology and market strategy to further strengthen its leadership position.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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