

# Strategic Quality Management in the Electric Vehicle Transition: A Case Study of CATL's Supply Chain Management

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**Abstract.** As global demand for electric vehicles (EVs) surges, the traditional internal combustion engine vehicle supply chain is undergoing significant structural adjustments. Batteries, being a core component of EV performance and a major cost factor in new energy vehicles, make advancements in battery technology crucial for industry growth. This study analyzes CATL's quality management strategies within the battery supply chain, focusing on procurement, research and development, and partnerships with suppliers. By examining CATL's strategies in increasing procurement volumes, boosting R&D investment, and collaborating with upstream and downstream suppliers, this study reveals how the company enhances production efficiency and quality control through innovation and management optimization. The study compares CATL with BYD, highlighting differences in supply chain management strategies and effectiveness. Research indicates that CATL has strengthened market competitiveness and addressed industry challenges by optimizing supply chain management, enhancing supplier collaborations, and increasing R&D investment. This study provides an effective quality management model for the battery industry and suggests future research directions.

## 1 Introduction

With increasing global demand for sustainable mobility, electric vehicles (EVs) have swiftly transitioned from being considered niche technology into becoming integral players within today's automotive landscape [1]. This transformation signifies not only significant shifts in consumer driving behaviors but also indicates substantial restructuring within automotive supply chains.

For years, traditional internal combustion engine (ICE) vehicles held central positions within these intricate networks due to their involvement in complex manufacturing processes requiring thousands of components for assembly. However, the emergence of electric vehicles has precipitated rapid alterations - compact drivetrains necessitate fewer components posing considerable challenges for conventional suppliers. The battery system is the key to the performance of electric vehicles, in the entire new energy vehicle cost composition, the battery accounts for 35%-50% of the vehicle cost; therefore, the

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development of battery technology and performance improvement are crucial determinants for the long-term development of new energy vehicles. Facing substantial market demand, Chinese battery enterprises should expedite intelligent battery manufacturing realization and enhance battery supply chain management to ensure safety and quality consistency in production. This will bolster their brand's market competitiveness and secure a larger market share.

As per Deloitte's 2023 Automotive Supplier Study projections indicate that revenues derived from ICE parts are anticipated to decrease by 44% come 2027 whereas earnings linked with electric vehicle-related components are projected to surge by an impressive 245%. Such disparities underscore fundamental transformations underway across automotive supply chains.

These transformations primarily revolve around structural reconfigurations among suppliers-newcomers ascend as industry frontrunners; accelerated technological innovations prompt heightened investments into R&D fostering closer collaborations between automobile manufacturers & suppliers aimed at collectively propelling industrial upgrades through the joint promotion of tech innovations; enhanced synergies throughout entire value chains necessitating tighter alliances between automakers & suppliers ensuring seamless operations & swift responses; reshaping raw material supply chains paving way for developmental prospects brought forth by emerging raw material providers.

Within this framework, innovation assumes paramount importance. Automobile manufacturers are actively exploring novel technologies aimed at streamlining production processes and enhancing efficiency [2]. A prime example is Tesla's Giga bit casting technology capable of producing large vehicle parts in one operation thus significantly simplifying complexities. This groundbreaking advancement hasn't merely altered methods but profoundly impacted associated supply chains. Automakers are increasingly internalizing their supply chains to exert greater control over production quality and costs. Thus, the role of traditional suppliers is evolving requiring them to adapt to new realities by fostering innovative collaborations within revised business models.

## **2 Literature Review**

According to the value chain theory, the early value chain primarily encompasses vertically integrated activities related to production and operations within an enterprise, including procurement, product research and development, warehousing, sales, and transportation [3]. As research deepens, the value chain extends beyond the enterprise to encompass upstream and downstream enterprises as well as competitors in the same industry. The internal value chain involves creating value for all departments within an enterprise. Analysis of the internal value chain can stimulate value-added activities, improve non-value-added activities, and enhance overall enterprise benefits [4]. Integration of the internal value chain promotes rational resource allocation, facilitates collaboration among various departments, and enhances overall efficiency. The external value chain focuses on the upstream and downstream industry chains. Through analysis of the external value chain, appropriate upstream suppliers can be selected while understanding downstream customer needs to expand sales. The competitor's value chain theory involves comparative analysis between an enterprise's cost management practices and those of its industry competitors to comprehensively understand differences to leverage strengths and address weaknesses [5].

Furthermore, there exists a substantial amount of procurement funds supporting the extensive industrial chain. From 2015 to 2017, the annual purchase amount of major raw materials doubled, marking the most rapid growth period in CATL procurement.

In terms of major suppliers, the table illustrates that different companies offer a diverse range of supply products, with supplies totaling hundreds of millions of yuan. This demonstrates the extensive variety and substantial scale of suppliers.

Value Chain Strategic Cost Management combines both aspects of strategic cost control guided by the principles of the value chain. Utilizing strategic cost analysis tools such as Value Chain Analysis, Strategic Positioning Analysis, and Cost Driver Analysis helps identify optimal methods for cost control that contribute to enhancing overall enterprise value [6].

### **3 Case Analysis**

CATL (Contemporary Amperex Technology Cooperation Limited) was established in 2011, headquartered in Ningde, Fujian. The company focuses on the research and development, production, and sales of new energy vehicle power battery systems and energy storage systems, and is committed to providing first-class solutions for global new energy applications. The main industry of CATL is Automobile power batteries, which can be called the Unicorn in the new energy industry [7].

#### **3.1 Quality Management in CATL's Supply Chain**

##### *3.1.1 Quantity of purchase amount*

In operations, CATL has developed strategies to effectively integrate key raw materials and control costs. On the sourcing and manufacturing side, CATL has decentralized its supplier base by increasing its procurement volume year-on-year. This strategy aims to reduce costs by outsourcing non-core production while focusing on mastering the high-value aspects of operations to enhance overall production efficiency [8, 9].

CATL's implementation includes strengthening the corporate procurement system and optimizing supply chain management through standardized and integrated processes. The Purchasing department worked closely with the Engineering Center and Quality Management to establish an evaluation team. The team screens suitable suppliers and evaluates their technical capabilities and level of cost control before purchasing key equipment and raw materials. In addition, CATL has implemented a fully integrated production and manufacturing management system to match production schedules with actual sales orders, thereby minimizing waste. Throughout all phases of the operational process, CATL maintains strict controls while improving employee productivity. Through these measures, CATL has been able to increase sales productivity at a much lower cost.

##### *3.1.2 Research and development technology*

Highly educated team of R&D technicians. The company offers various incentive policies to attract outstanding talents from colleges and universities, including engineering salary subsidies and preferential housing and settlement policies. For instance, in 2022, CATL employed a total of 264 individuals with doctoral degrees and 2,852 with master's degrees, the majority of whom graduated from prestigious domestic or overseas universities.

Emphasis is placed on intellectual property rights and patents. In 2022 alone, the company possessed 5,518 domestic patents, and 1,065 overseas patents, with an additional 10,054 domestic and foreign patent applications pending.

Increase R&D expenditure. R&D expenditure has seen a consistent annual increase within the company, rising from 2.992 billion yuan in 2019 to an impressive figure of 15.51

billion yuan in 2022 - marking a five-fold year-on-year growth that underscores the substantial financial support provided.

Materials and materials system innovation. Materials innovation such as lithium iron phosphate batteries, high nickel batteries, sodium ion batteries as well as M3P and condensed matter technologies.

Structural innovation. Pioneer CTP battery technology launch along with Kirin battery introduction - both focusing on high performance at low cost. The top-tier R&D team has achieved cutting-edge technology standards encompassing “high specific energy”, “extended lifespan”, “super-fast charging capabilities”, “real safety features, and automatic temperature control” alongside intelligent management [10].

### *3.1.3 Driven sales and marketing strategies with downstream customers*

In terms of geographical layout, CATL relies on Ningde in Fujian Province as its central hub. The value chain is strategically distributed across the country's industrial layout, with raw material bases located near production facilities and finished products positioned close to terminal markets. This approach aims to minimize transportation costs and optimize logistics control. Furthermore, the company implements differentiated sales strategies tailored to diverse customer segments, addressing unique service and product requirements. For domestic small and medium-sized order volume customers, a heightened focus is placed on quality assurance, personalized needs, and after-sales services. In contrast, large order customers-particularly major new energy vehicle companies engaged through joint ventures and long-term cooperation agreements to expand sales channels while mitigating risks. Overseas clients are engaged through long-term strategic supply contracts; for instance, in 2023 CATL established an innovative cooperation model with Ford by leveraging technology output to provide technical support for Ford's lithium iron phosphate battery factory-a move that facilitated entry into the US lithium battery market and laid the groundwork for future development.

### *3.1.4 Focused partnership strategies with upstream suppliers*

Cooperation modes include joint ventures, technology investments, and long-term partnerships. CATL's battery manufacturing costs are significantly impacted by the core material of the power battery-the positive electrode. To optimize costs, CATL has deepened its collaboration with positive electrode suppliers through acquisitions and joint ventures and has invested in various projects related to ternary positive electrodes to enter the raw materials market. The assembly process also affects the cost of power batteries; winding is a crucial link in cell production where materials are processed to achieve suitable tension and meet safety quality requirements. Lead Intelligent Winding Machine holds a leading position in China with full line delivery capacity for lithium battery equipment, greatly ensuring scale and safety in battery production. Therefore, CATL's 2020 investment in Lead Intelligence made it the company's second-largest shareholder. CATL secures long-term and stable sales orders in exchange for more favorable production equipment terms. Amid increasing pressure to reduce industry-wide battery costs, CATL leverages its cost advantage through domestic upstream supplier chain development while continuously expanding into new markets-a key strategy for future competition.

## **3.2 Comparison with competitors: take BYD as an example**

Table 1 provides a comparative analysis of CATL and BYD across three dimensions: business content, fundamental operations, and support activities. Notably, BYD excels in the

procurement process by completing all car production components internally, leading to significant reductions in logistics costs. The company controls 70% of car manufacturing costs and primarily purchases rubber and glass parts. While this approach allows for substantial cost control, it may impede quality improvement. In terms of production and manufacturing capabilities, BYD stands out for its independent production capacity. In the new energy vehicle sector, BYD has established a mold company and continues to expand its overseas presence to achieve large-scale professional production of all automotive molds. Its strong integration ability in auto production systems contributes to standardized cost management. Regarding sales strategies, BYD emphasizes its sales system development with differentiated sub-station type tour listings, precision marketing targeting specific markets and customers, as well as diversified expansion using the kangaroo theory model. In research and development comparisons between representative technologies from BYD and CATL, it becomes evident that BYD’s lithium iron phosphate blade battery is independently designed with complete intellectual property rights. It demonstrates strong technological innovation while delivering excellent performance in safety, sustainability, and economy. However, challenges exist due to the length of its battery cell which presents difficulties in design, manufacture, and application. Lastly, in human resources management, BYD has implemented a modern training and performance appraisal system based on its actual situation. It has improved the competition mechanism, and punishment incentive mechanism, and rationally optimized the human resources hierarchy. The management team is suitable for the company’s competitive advantages. Through key technology innovation, BYD is leading the company towards sustainable industry development.

**Table 1.** Comparison between BYD and CATL.

		BYD	CATL
Business content		Automotive, electronics, secondary batteries	R&d, production and sales, power battery system, energy storage system
Basic activity	Procurement process	Vertical integration model	Cooperate with suppliers
	Manufacturing process	The independent research, the independent assembly of vehicles	Outsourcing of low value-added processing
	The sales process	Establish a standard sales system	Differentiated sales service system
	Research and development process	Blade technology	CTP technology
Auxiliary activity	Human resource	mostly senior engineers with rich technical background	a young team with high-quality educational background and rich working background and management experience

## 4 The effectiveness and challenges of CATL’s supply chain strategy and cost control

### 4.1 Actual effect

CATL’s effective implementation of value chain-based cost management has significantly enhanced its operational performance. Notably, there has been a reduction in both unit

material costs as well as period costs associated with power batteries; this achievement is coupled with the successful mitigation of risks stemming from fluctuations in upstream raw material prices along with potential impacts on downstream automotive enterprises' costs. Consequently, CATL has experienced a decrease in exposure to declining gross profit margins while simultaneously enhancing operational capabilities leading to improved profitability. The company exhibits robust competencies across various domains including supply chain management, stringent cost controls, and talent acquisition strategies for fostering innovation-driven growth alongside superior after-sales services provision. Furthermore, CATL strategically deepens collaboration with both upstream suppliers as well as downstream customers through targeted investments or joint ventures aimed at bolstering production capacities whilst ensuring seamless integration across its value chains thereby enhancing specialized offerings that foster comprehensive competitive advantages driven by differentiated yet customer-centric costing strategies tailored for thriving within fiercely contested energy markets.

## **4.2 Risk and challenge**

In light of evolving market dynamics characterized by intensified competition within China's new energy sector marked by subsidy reductions alongside challenges posed by fluctuating raw material prices amidst ongoing capacity expansions; it becomes imperative for CATL to further optimize its manufacturing footprint whilst intensifying R&D efforts coupled with diversification into new business verticals aimed at mitigating inherent risks thus fortifying core competencies against future uncertainties. Moreover, in the international high-end new energy vehicle market, occupying the main market share is still the United States Tesla, CATL is still far from mass supply, especially in the case of battery raw materials are restricted, and the difficulty of technological progress is increased, and it is more necessary to improve the technical level [11].

## **5 Conclusion**

This study focuses on CATL as its research subject matter by examining both qualitative and quantitative dimensions within its supply chain analysis from upstream to downstream processes. A comparative analysis with BYD is conducted to underscore disparities between these two enterprises while emphasizing CATL's advanced approach toward its supply chains. Lastly, this paper briefly discusses potential impacts and risk challenges associated with CATL's supply chain management. In light of CATL's example presented here; it becomes evident that the power battery industry should align with national strategy by establishing an innovation chain around its industrial counterpart while allocating resources towards accelerating revolutionary breakthroughs in power battery technology. This support will enable China's power batteries to achieve industrial upgrading and sustainable development - a model that holds significant reference value for other new energy enterprises. As new energy technologies become mainstream trends alongside sustainable development under national strategic guidance; rapid growth within the electric vehicle industry underscores the heightened importance placed on supply chain management which will gradually extend its influence across various enterprises culminating in a high-tech-oriented industry pattern emphasizing quality management.

This study focused on CATL's complete supply chain process but did not consider external factors' impact on it such as personal relationships between enterprise management or external economic situations. In future endeavors related to all aspects of new energy batteries including performance enhancement, battery pack equilibrium maintenance, fast charging technology advancement as well as addressing concerns like spontaneous

combustion risk and material innovation through basic scientific research will be essential. Successful commercialization of newer batteries like lithium-sulfur could provide sufficient energy density with smaller volumes. Therefore re-innovation in technology remains an inevitable trend within this industry which warrants further exploration.

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