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Business Model Sustainability under Mature Market Competition in China's New Energy Vehicle Industry A Comparison of BYD and NIO

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Abstract. China's new energy vehicle market has shifted from rapid expansion toward mature-market competition, placing simultaneous pressure on pricing, research and development expenditure, and service investment. Using comparative case analysis, this study applies Porter's Five Forces, value-chain analysis, and the value, rarity, imitability, and organization (VRIO) framework to compare BYD's vertically integrated model with NIO's ecosystem-based operating model. The findings indicate that BYD's coordination of batteries, electric drives, power semiconductors, and vehicle manufacturing creates cost and iteration advantages from key components through large-scale production. These benefits are nevertheless constrained by multi-brand complexity, service demands, and technology-path lock-in. NIO differentiates itself through battery swapping, direct service channels, software, and user communities, thereby sustaining post-purchase engagement; however, the durability of this model depends on user density, network utilization, and open standards. Under current conditions, vertical integration is more resilient in cost control, profitability, and overseas replication, whereas ecosystem operations offer greater potential in intelligent technologies, software, and user relationships. Manufacturing-oriented firms should pursue selective integration while strengthening software-enabled services. Ecosystem-oriented firms should improve the utilization of energy-replenishment assets, expand standards-based collaboration, and convert user experience into recurring revenue.

Keywords: new energy vehicles, business model sustainability, vertical integration, ecosystem operations, BYD–NIO comparison

1. Introduction

1.1. Research background

Globally, new energy vehicles (NEVs) are moving beyond pilot adoption in a limited number of markets and entering the mass market. The International Energy Agency's Global EV Outlook 2025 reports that global electric-vehicle sales exceeded 17 million units in 2024 and accounted for more than 20% of worldwide new-car sales. Although adoption rates vary across countries, policy, technology, model availability, and charging infrastructure continue to drive the electrification of the

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automotive industry. China is among the fastest-growing markets and possesses one of the most complete industry value chains [1].

Against this backdrop of global growth, China's NEV sales have continued to rise, but operating performance has not improved at the same pace. In 2025, national NEV output reached 16.626 million units and sales reached 16.490 million units, representing 47.9% of all new-vehicle sales; NEVs also accounted for more than 50% of domestic new-vehicle sales. As penetration increases, the remaining pool of unmet incremental demand narrows, and competition shifts from acquiring first-time incremental buyers to contesting existing demand. Mature-market competition does not imply that sales have stopped growing. Rather, firms can no longer rely on market expansion alone and must compete through pricing, products, channels, and services [2].

As the basis of competition changes, price reductions, richer feature packages, and faster model renewal become more common, while expenditure on research and development, distribution, and service continues to increase. These pressures compress profits and shift managerial attention from sales volume alone toward cost, quality, service efficiency, and sustainable profitability—in other words, toward the quality of operations. Corporate strategies have consequently diverged. Some firms internalize more critical activities and use scale manufacturing to reduce costs, whereas others emphasize the ownership experience and maintain user relationships through direct sales, energy-replenishment networks, software, and communities. BYD and NIO broadly represent these two approaches.

1.2. Research question and significance

This study asks how vertically integrated and ecosystem-based operating models generate advantages after the NEV market enters a mature phase, and which conditions constrain the sustainability of each model. Rather than judging the models directly by sales volume, the analysis compares industry pressures, value-chain linkages, resource configurations, cost and profitability, intelligent technologies and software capabilities within a common framework.

Business model sustainability is defined here as a firm's ability, under prevailing market and technological conditions, to create and capture value continuously, cover necessary investment, and sustain operations amid demand volatility, technological substitution, and intensifying competition. This concept is distinct from sustainability in the environmental or environmental, social, and governance sense; the present study focuses on the economic and competitive durability of a business model.

Theoretically, prior studies have examined corporate strategy, supply-chain integration, and battery-swapping services, but vertical integration and ecosystem operations are often studied separately. By placing the two models under the same industry conditions and combining value-chain analysis with the value, rarity, imitability, and organization (VRIO) framework, this study examines how resources shape costs, value creation, and durable advantage, thereby extending research focused on a single firm or model.

Practically, price competition has compressed automakers' margins, making sales volume an insufficient indicator of operating stability. At high levels of market penetration, factories, stores, research programs, and energy-replenishment infrastructure all require dependable revenue. Comparing the two models can help automakers reassess resource allocation and clarify the relationships among internal production, external collaboration, service investment, and financial pressure.

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1.3. Research methods and data sources

This study combines case analysis with comparative analysis. Case analysis is used to examine the two firms' activity systems, resource commitments, and operating outcomes. Comparative analysis evaluates six dimensions on a consistent basis: cost structure, profitability, risk resilience, replicability, intelligent technologies and software capabilities, and overseas adaptability. Cost structure covers fixed investment, variable costs, and scale-based cost allocation; profitability covers revenue, gross margin, and profit or loss; risk resilience covers exposure to supply, demand, technology-path, and cash-flow risks; replicability covers entry barriers arising from capital, scale, processes, and organizational capabilities; intelligent technologies and software capabilities cover hardware-software coordination, feature deployment, and user-feedback loops; and overseas adaptability covers the cross-market deployment of products, capacity, standards, and service networks. Industry data are drawn from the International Energy Agency and the China Association of Automobile Manufacturers. Company data come from annual reports, earnings releases, and other public materials. Monetary amounts are presented in renminbi (RMB), and the analysis focuses primarily on 2025 data.

Although BYD and NIO operate in the same industry, they differ in scale, corporate age, product price range, brand portfolio, and capital position. The cases are selected to compare two resource-allocation mechanisms rather than to establish statistical causality. Operating differences are therefore treated as the joint outcome of business model choices and firm development stages, and the resulting judgments are limited to these two cases and the market conditions prevailing around 2025.

2. Literature review and theoretical foundations

2.1. Competitive strategy and business model research

Business model research primarily explains how firms create, deliver, and capture value. Teece argues that technology does not automatically generate returns; firms must connect technology with markets through a business model [3]. Research on the NEV industry further emphasizes the need to identify changes associated with electrification, intelligent technologies, and shared mobility and to reconfigure complementary resources accordingly [4]. Chinese studies find that ecosystem-based business models can influence brand competitiveness through customer-perceived value [5], while automakers' choices between process innovation and business model innovation are jointly shaped by innovation costs, market structure, and policy conditions [6]. These findings indicate that automakers should be assessed not only by product technology or short-term sales, but also by the relationships among production, sales, service, and revenue.

Existing research provides a basis for identifying corporate activities, yet it often treats technology, marketing, and financial outcomes separately, making it difficult to explain how activities jointly create enduring advantage. The present study therefore integrates industry competition, value-chain linkages, and firm resources into a single analytical process and focuses on how the two business models organize distinct activities into sustainable value-creation systems.

2.2. Vertical integration and ecosystem operations

Research on vertical integration examines firm boundaries and make-or-buy decisions. Harrigan conceptualizes vertical integration as a strategic choice involving direction, degree, and form and

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argues that firms must determine which stages to control in light of industry conditions [7]. D'Aveni and Ravenscraft further show that integration can create synergies and economies of scale while also increasing bureaucratic costs [8]. These studies clarify the sources of cost advantages, supply stability, and technological coordination. However, simply counting the number of stages controlled by a firm does not establish whether those stages reinforce one another. This study therefore traces linkages among research and development, procurement, key components, vehicle manufacturing, sales, and service, while also identifying the asset burden and organizational complexity created by integration.

Research on ecosystem operations expands the unit of analysis from a single firm to multiple actors coordinated around a value proposition. Jacobides et al. emphasize the role of modularity and complementors in ecosystem formation [9], whereas Adner defines an ecosystem as a multilateral structure of partners required to realize a focal value proposition [10]. Studies of battery swapping find that the model can reduce replenishment time and support the separation of vehicle and battery ownership, but large-scale adoption remains constrained by infrastructure investment, interface standards, and utilization [11]. Chinese research on vehicle-battery separation likewise finds that consumer acceptance, leasing fees, and subsidy arrangements jointly affect adoption [12]. Although this literature explains the value of networks and user experience, it less often evaluates service investment, software feedback, and stable revenue together. This study treats NIO's battery-swapping network, direct services, software, and user community as an interdependent activity system and evaluates the conditions under which it creates value and the boundaries of its cost structure.

The two research streams explain internal coordination and interorganizational collaboration, respectively, but rarely compare them directly under common market pressures. Rather than presenting a separate critique of the literature, this study addresses the identified gaps within each analytical theme: it holds the industry environment constant, uses value-chain analysis to identify activity linkages, and applies VRIO to assess whether those linkages can produce sustained advantage.

2.3. Business model analytical framework

Porter's Five Forces framework evaluates industry competition through rivalry among existing competitors, the threat of new entrants and substitutes, and the bargaining power of suppliers and buyers [13]. This study uses the framework to identify the pricing, supply, demand, and technological-substitution pressures shared by NEV firms and then assesses whether each pressure favors vertical integration or ecosystem operations.

Porter's value-chain framework distinguishes primary activities—including inbound logistics, operations, outbound logistics, marketing and sales, and service—from support activities such as procurement, technology development, human resources, and infrastructure [14]. Rather than treating the value chain as an inventory of activities, this study identifies which linkages are reinforced by each business model, where those linkages create cost or experiential value, and where they create additional burdens.

Barney's resource-based view provides the foundation for the VRIO framework, which assesses whether a resource is valuable, rare, difficult to imitate, and supported by the organization [15]. After identifying critical resource combinations through value-chain analysis, the study applies VRIO as a counterfactual test: where competitors possess similar technologies or networks, does the advantage derive from a single asset or from the accumulated combination of scale, processes, and organizational coordination?

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The three models operate at different but complementary levels. Five Forces identifies industry constraints; value-chain analysis explains how a firm organizes activities; and VRIO evaluates whether the resources underlying those activities can sustain advantage. This sequence avoids a disconnected application of frameworks and creates an integrated analytical chain from industry structure to corporate activity and competitive advantage.

3. Industry environment of new energy vehicles

3.1. Current industry conditions

NEV sales continued to grow in 2025 as both battery-electric and plug-in hybrid vehicles expanded their markets. Large industry scale, however, did not translate into broad profitability. Vehicle price reductions, richer feature packages, research and development expenditure, and distribution costs occurred simultaneously, compressing automakers' margins. Meanwhile, NEV exports reached 2.615 million units, an increase of 103.7% year on year. Overseas markets thus became an important source of growth, even as tariffs, certification, local service, and supply-chain development increased costs [2]. Table 1 summarizes these industry indicators.

Table 1. Key indicators for China's new energy vehicle industry in 2025

Indicator	2025 value	Year-on-year change	Interpretation
NEV production	16.626 million units	+29.0%	Manufacturing scale continued to expand
NEV sales	16.490 million units	+28.2%	47.9% of total new-vehicle sales
NEV exports	2.615 million units	+103.7%	Overseas markets grew rapidly
NEV share of domestic new-vehicle sales	More than 50%	Continued increase	The domestic market reached a high-penetration stage

Source: Compiled by the author from the China Association of Automobile Manufacturers' January 2026 press conference [2].

3.2. Porter's Five Forces analysis

Rivalry among existing competitors has expanded from price reductions to feature upgrades, financing incentives, intelligent functions, and service benefits. Vertically integrated firms can use internally supplied components and shared platforms to reduce marginal costs and accelerate hardware iteration. Ecosystem operators rely more heavily on software, energy replenishment, and service differentiation to reduce commoditization. The former are constrained by fixed assets and multi-product management, whereas the latter must convert differentiated investment into price premiums or retention.

Regarding supplier bargaining power, traction batteries, automotive-grade chips, and hardware and software for intelligent driving can remain bottlenecks. Vertical integration converts some market transactions into internal coordination and improves control over cost and supply, but it also internalizes technology-path and capacity risks. Ecosystem operations preserve flexibility through

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external collaboration but depend more heavily on interface standards, stable partnerships, and key suppliers.

Regarding buyer bargaining power, a broader model range and greater information transparency make it easier for consumers to compare prices, features, and services. Vertical integration supports competitive value propositions in price-sensitive markets, while ecosystem operations use continuing services and account systems to raise switching costs. If service value is unclear, however, the latter model's high investment can intensify profitability pressure.

Regarding potential entrants, technology firms may possess software, traffic, or brand resources, but vehicle manufacturing still requires substantial capital, quality management, and after-sales infrastructure. Process experience, supply chains, and scale developed through vertical integration create high entry barriers. Network density, user relationships, and service processes in an ecosystem model can also create barriers, but these advantages emerge only after the installed vehicle base reaches sufficient scale.

Regarding substitutes, internal-combustion vehicles, plug-in hybrids, extended-range electric vehicles, public transportation, and continuing advances in ultrafast charging can all divert demand. Vertically integrated firms can mitigate dependence on a single technology path through multiple powertrain technologies and shared platforms. Ecosystem operators centered on battery swapping must continually demonstrate a time, asset-management, or service advantage over fast charging and adapt their networks as standards evolve.

Taken together, the five forces suggest that vertical integration has stronger advantages in supply control, cost, and entry barriers, whereas ecosystem operations offer greater potential for differentiation, user relationships, and software-enabled services. For either model, the decisive issue is not the number of activities performed, but whether the resulting advantages cover fixed investment and withstand technological substitution.

4. Company case analyses

4.1. BYD's vertical integration model

4.1.1. Company overview and strategic positioning

BYD built its original capabilities in batteries and electronics before entering vehicle manufacturing. Its internal activities gradually expanded to traction batteries, electric drive systems, power semiconductors, thermal management, and vehicle production. This configuration allows product designs and component improvements to enter mass production relatively quickly and eliminates some intermediate procurement margins. Once sales reach sufficient scale, common platforms and components can be deployed across multiple models, further reducing unit costs.

BYD's positioning is not based on low prices alone. The firm pursues both battery-electric and plug-in hybrid technologies and uses multiple brands to address family, off-road, and premium segments. A multi-brand strategy broadens the price range and permits repeated application of common technologies across models. However, as the portfolio expands, product differentiation, sales management, and after-sales service become more complex; close positioning among models may also create internal competition.

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4.1.2. Value-chain analysis

From a value-chain perspective, BYD's central linkage is "technology development–key components–vehicle manufacturing." Internal operations such as FinDreams Battery and FinDreams Power enable the joint design of batteries, electric drives, and vehicle platforms, allowing research outcomes to enter mass production rapidly and manufacturing feedback to return to technology teams. This closed loop reduces the coordination distance across firms and spreads development and production-line investment across multiple models. In 2025, BYD reported revenue of RMB 803.965 billion, of which automobiles and related products contributed RMB 648.646 billion, or 80.68% of the total. Research and development expenditure was RMB 63.441 billion, equivalent to 7.89% of revenue [16].

In procurement and inbound logistics, self-supply of key components reduces exposure to external supply volatility and intermediary markups, although upstream raw-material prices and internal capacity utilization continue to affect cost. In operations, coordination among platforms, components, and processes improves the efficiency of replication at scale and represents the most direct source of value from vertical integration. In marketing and sales, multiple brands broaden the addressed price range but also make brand differentiation and channel management more demanding.

The principal weakness of vertical integration appears in post-sale activities. As vehicle and technology combinations proliferate, maintenance training, software adaptation, and spare-parts management become more complex; manufacturing-side coordination does not automatically generate service efficiency. BYD's value chain therefore strongly reinforces "research and development–components–manufacturing," whereas "brand–software–service" still requires distinct organizational capabilities. Revenue growth of 3.46% alongside an 18.97% decline in net profit attributable to shareholders further indicates that scale and integration cannot fully offset price competition and expansion costs.

4.1.3. VRIO analysis and financial assessment

In terms of value, the combination of key components, vehicle platforms, and scale manufacturing reduces supply volatility, shortens development cycles, and preserves room for adjustment during price competition. In terms of rarity, no individual battery or electric-drive technology is unique to BYD; the relatively rare resource is the simultaneous operation of multiple capabilities at high sales volume.

Imitability requires a counterexample-based test. Geely has introduced a short-blade battery developed and produced in-house, while Changan is advancing proprietary battery cells, electric drives, and power-control systems. Competitors can therefore reproduce selected elements of vertical integration [17, 18]. Replicating BYD's overall effect, however, requires the simultaneous development of battery research, manufacturing yield, supplier systems, vehicle platforms, production volume, and cross-functional processes. Individual technologies can be purchased or developed, but path-dependent and complementary capability bundles cannot be established synchronously in the short term.

In terms of organizational support, BYD has established a system spanning components, complete vehicles, and multiple brands, enabling technologies to be reused across models. Vertical integration is therefore better understood as a conditionally sustainable advantage than as an inherent one. When internal capacity utilization falls, organizational layers increase, or technology paths change rapidly, integration can become an asset burden.

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4.2. NIO's ecosystem operations model

4.2.1. Company overview and strategic positioning

NIO uses premium intelligent electric vehicles as the primary point of entry and extends its activities into energy replenishment, service, software, and user communities. Vehicle sales remain the principal source of revenue, but customers continue to use battery swapping, charging, maintenance, applications, and physical spaces after purchase, making the firm–user relationship more than a one-time transaction. Battery-as-a-Service separates the pricing of the vehicle and battery and lowers the initial purchase threshold for some users.

This positioning differs materially from the traditional dealership model. NIO seeks to maintain a consistent experience before purchase, at delivery, and during daily use, while user evaluations and community activities influence prospective customers. When service quality is high, user relationships become a brand asset. Once elevated service standards are established, however, the firm cannot reduce investment easily without users directly experiencing a deterioration in quality.

4.2.2. Value-chain analysis

From a value-chain perspective, NIO's central linkage is "technology development–direct customer touchpoints–energy replenishment and after-sales service–user feedback." By the end of June 2025, the company had built 3,445 battery-swapping stations and 187 NIO Houses worldwide and had completed more than 78.36 million battery swaps. The swapping network connects energy replenishment, vehicle use, and battery management, while direct stores, the mobile application, and the community extend the firm's involvement into the post-sale experience. Compared with a one-time vehicle transaction, this structure creates more opportunities to collect usage feedback and adjust products, software, and services [19].

Ecosystem operations reinforce marketing, sales, and service. Unified touchpoints help maintain a consistent brand experience, while software updates and community feedback shorten the path through which user needs return to research and development. The model's weaknesses are concentrated in operating costs and coordination across actors. Stations, reserve batteries, stores, and service personnel create high fixed expenditures. Vehicle chassis, battery dimensions, communications protocols, and safety requirements must also be compatible, and opening the network to additional models or brands requires coordination of standards, revenue sharing, and service responsibility.

NIO's value-chain advantage therefore lies not in any individual swapping station or store, but in the closed loop among vehicles, software, energy replenishment, and user operations. This loop converts experiential value into revenue or customer-acquisition efficiency only when the installed vehicle base, station usage, and service conversion rates reach sufficient levels. At low network density, the same activity system manifests primarily as continuing cost.

4.2.3. VRIO analysis and financial assessment

Financial data illustrate both the returns and costs of ecosystem operations. In 2025, NIO reported revenue of RMB 87.488 billion and a vehicle gross margin of 14.6%, up 2.3 percentage points year on year. Research and development expense reached RMB 10.605 billion, approximately 12.1% of revenue. Although the company recorded a full-year net loss of RMB 14.943 billion, it achieved an operating profit of RMB 807 million in the fourth quarter. Revenue and margin improvement

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indicate rising operating efficiency, while the annual loss shows that ecosystem investment has not yet been fully converted into stable returns [20].

In terms of value, battery swapping, software, and user services reduce the inconvenience of energy replenishment and create continuing touchpoints. In terms of rarity, large-scale passenger-vehicle swapping networks and the organizational experience surrounding user service remain uncommon, although battery swapping as a standalone practice is not rare.

Imitability again requires a reverse test. Contemporary Amperex Technology Co., Limited (CATL) is promoting battery-swapping standards and entered into a partnership with NIO in 2025 to advance network sharing and standards harmonization [21]. Basic swapping capabilities may therefore become industry infrastructure. NIO's distinctiveness will depend increasingly on the combination of station density, vehicle-integration experience, software data, service processes, and user relationships. Open standards may weaken the exclusivity of a closed network while increasing utilization and reducing unit costs, producing opposite effects on rarity and value.

In terms of organizational support, NIO has configured corresponding activities around vehicles, energy, digital platforms, and user services. Its sustainable advantage nevertheless depends on the organization's ability to convert experience metrics into utilization, retention, and service revenue. If ultrafast charging narrows the time advantage, collaborative standards progress slowly, or user density remains insufficient, both the value and imitation barriers of the swapping network will decline.

5. Comparison of the two business models

Both models create value through feedback among activities, but the focal loop differs. BYD uses manufacturing scale to accelerate technological iteration, whereas NIO uses user feedback to connect software and services. Figure 1 illustrates the two feedback loops, and Table 2 compares their implications across the six evaluation dimensions.

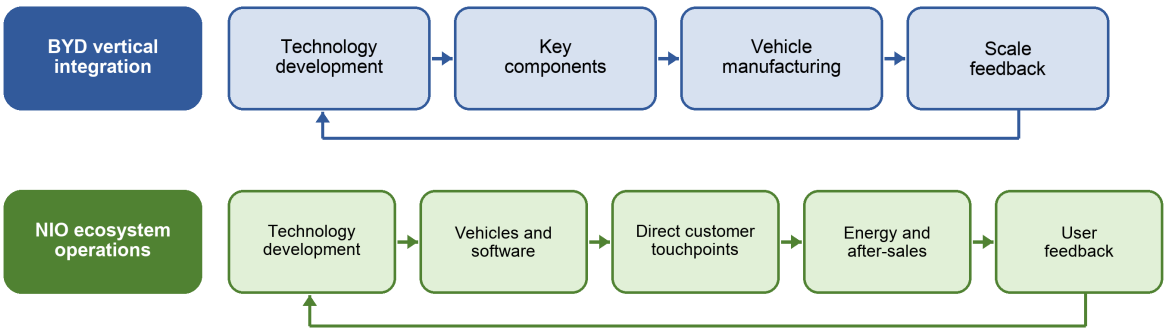

Figure 1. Value-chain feedback loops in the two business models

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Table 2. Comparison of BYD's and NIO's business models

Dimension	BYD: vertical integration	NIO: ecosystem operations	Overall assessment
Cost structure	High fixed investment in manufacturing and research; unit costs decline with scale	High investment in swapping, stores, and service; utilization strongly affects cost	Both models are asset-intensive, but recover cost through different mechanisms
Profitability	Scale and internal supply provide support, although price competition remains material	Gross margin is improving, but the firm remained loss-making for the full year	BYD is currently more stable
Risk resilience	Strong supply control, but the firm internalizes part of the technology-path risk	Strong user relationships, but greater pressure from cash flow and continuing investment	Both must balance control and flexibility
Replicability	Requires an industrial base, capital, and volume; difficult to replicate in the short term	Requires brand strength, user density, and sustained service; also difficult to replicate	In both models, advantage arises from system-level complementarity
Overseas adaptability	Exports and localized production can be expanded progressively with sales	Swapping standards, stations, and service systems must be rebuilt in each market	Vertical integration offers a more direct path to overseas expansion
Intelligent technologies and software	Hardware platforms and a large installed base support rapid deployment, but software experience and cross-brand coordination require strengthening	Software, applications, and user feedback create continuing touchpoints, but research intensity and monetization efficiency remain demanding	NIO has a stronger user loop; BYD has a stronger scale-deployment base

5.1. Cost and profitability

Differences in cost structure follow directly from the business models. BYD internalizes investment in batteries, electric drives, and platforms, allowing fixed costs to be allocated across more models as sales expand, while also bearing the risks of idle capacity and technology transitions. NIO's swapping, store, and service networks likewise exhibit economies of scale, but stations, equipment,

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and personnel must be funded before user density rises. When demand growth slows and price competition is intense, BYD can therefore absorb costs more readily through its existing scale, whereas NIO remains more dependent on financing capacity, operating cash flow, and network utilization.

5.2. Risk resilience and replicability

Risk resilience also reflects each model's trade-offs. Vertical integration reduces dependence on critical suppliers but increases exposure to fixed assets and technology paths. Ecosystem operations exercise less control over production and retain flexibility through partnerships, but they incur continuing service costs and network-utilization risk. Neither model can be reproduced simply by copying visible assets. Building a factory, producing a battery, or installing a swapping station is only a starting point; the difficult-to-replicate advantage lies in the long-term coordination of technology, scale, processes, and organization.

5.3. Intelligent technologies and software capabilities

Intelligent technologies and software capabilities complement the conventional manufacturing perspective. BYD's vehicle platforms, electrical and electronic architecture, and large installed base support rapid feature deployment and cost control through hardware coordination. Its challenge is to maintain software consistency across numerous brands and models and to ensure that the manufacturing system continuously absorbs user-side feedback. Vertical integration can therefore facilitate hardware-software coordination, but an effective software experience does not arise automatically from in-house hardware production [16].

NIO connects in-vehicle software, its mobile application, battery swapping, and user services into continuing touchpoints, allowing user feedback to enter product and service iteration more readily. This arrangement is consistent with the logic of ecosystem operations. Its strengths lie in the experiential loop and user relationships; its limitations include high research and development expenditure, the monetization efficiency of data and services, and dependence on partners and technical standards. Ignoring this dimension would judge ecosystem-oriented firms through manufacturing scale alone. Once it is included, NIO's long-term opportunity appears to derive primarily from recurring value created through software and services rather than from the simple expansion of physical facilities [20, 22].

5.4. Overseas conditions and sustainability assessment

In overseas markets, BYD can begin with vehicle exports and then develop factories and supply chains as sales grow, creating a relatively clear sequence of expansion. To maintain an experience comparable to that in China, NIO must also establish battery-swapping, maintenance, and community-service infrastructure. Its entry cost per market is therefore higher, while land, grid, and battery standards vary across countries. Under current industry conditions, the vertically integrated model is consequently more sustainable, especially in price-sensitive, high-volume markets. Ecosystem operations are not inherently unsustainable; they are better suited to markets with concentrated premium users and clear replenishment needs and can improve asset utilization through multi-brand sharing, co-investment in stations, and service charges.

Sustainability assessments should also distinguish among time horizons. In the short term, cash flow and gross margin determine whether a firm can continue investing, making the scale benefits of

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vertical integration more immediate. In the medium term, firms must adjust internal capacity or service networks as technologies change, requiring organizational flexibility under both models. In the long term, vehicles may become more closely integrated with energy, software, and mobility services, potentially increasing the value of ecosystem operations. Realizing that potential still requires the core business to generate sufficient funding.

6. Conclusion and implications

The analysis shows that once the NEV industry enters mature-market competition, business model sustainability depends on whether activities form mutually reinforcing relationships. BYD connects research and development, key components, and scale manufacturing to create strong cost and replication advantages, but faces constraints from multi-brand service, software experience, and technology-path lock-in. NIO connects software, battery swapping, direct operations, and user engagement into an experiential loop with greater potential in intelligent technologies and user relationships, but network utilization and continuing investment define its financial boundary. For the two cases and the market conditions prevailing around 2025, vertical integration is more resilient overall in cost, profitability, risk resistance, and overseas adaptability. When intelligent technologies and software are included, the long-term value of ecosystem operations becomes clearer, but realizing it requires sufficient user density and recurring revenue.

For BYD, selective integration should continue to focus on activities with high cost, substantial supply risk, or a direct effect on product performance. At the same time, the firm should strengthen software experience, after-sales processes, and coordination across brands rather than equating manufacturing advantage with whole-value-chain advantage. For NIO, station-level utilization, user retention, and service revenue should serve as constraints on expansion. Multi-brand sharing, jointly developed stations, and open standards can reduce network unit costs while preserving a consistent software and service experience. Other automakers should avoid treating the two models as a binary choice and should instead determine the boundary between internal control and external collaboration according to their sales base, capital capacity, user density, and the pace of technological change. The study relies primarily on public information and lacks internal data on costs, user retention, and software usage. Differences in company scale, development stage, price range, and capital position cannot be fully controlled. The conclusions therefore support case-based explanation of mechanisms and should not be generalized as universal causal claims about all vertically integrated or ecosystem-oriented firms. Future research could incorporate longer time-series data and compare firms of similar scale and price positioning across different technology paths.

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