



Take BYD as an Example to Analyze the Digital Transformation Strategy of China's New Energy Vehicle Enterprises

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Abstract. Amid the global automotive industry's shift toward electrification and intelligence, digital transformation has emerged as a critical driver for new energy vehicle (NEV) enterprises to boost core competitiveness. This paper focuses on BYD, conducting an in-depth analysis of its digital transformation strategy. The study reveals that BYD has constructed an end-to-end digital ecosystem spanning R&D(research and development), manufacturing, marketing, and services, developing distinctive models in key areas: virtual simulation in R&D accelerates product iteration by simulating vehicle performance and component interactions, intelligent factories integrate IoT and big data to optimize production lines, precision marketing leverages user data analytics to tailor strategies and predictive services use real-time vehicle data to preempt maintenance needs. These efforts have yielded remarkable results: R&D cycles shortened by 40%, production efficiency improved by 67%, and market competitiveness significantly enhanced. However, challenges persist, including data security vulnerabilities amid increased information sharing, a shortage of interdisciplinary talents proficient in both automotive engineering and digital technologies, and system compatibility issues between legacy and new digital platforms. BYD's experiences offer valuable insights for China's NEV sector, aiding the industry's high-quality development through replicable digital practices.

Keywords: New Energy Vehicles, BYD, Digital Transformation, Transformation Strategy, Enterprise Competitiveness.

1 Introduction

Globally, the auto industry is at a critical stage of profound change. According to the International Energy Agency, global sales of new energy vehicles will soar to 17.585 million units in 2024, hitting a record high [1]. However, the penetration rate of new energy vehicles in the global market varies significantly, which reflects the different pace of national new energy vehicle development strategies. In spite of this, the trend of electrification has been unstoppable, and many countries have increased their investment and layout in the field of new energy vehicles.

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Intelligentization has also become the core driving force of the development of the automobile industry. From the development and design stage, artificial intelligence algorithm is used to optimize automobile shape and performance, to the production and manufacturing process, the Internet of things is used to realize equipment interconnection, improve production efficiency and quality control, From marketing management to use big data to gain insight into consumer preferences and accurately push products, to after-sales service relying on intelligent network to monitor vehicle status in real time and provide remote diagnosis and maintenance suggestions, digitalization and intelligence run through the whole life cycle of automobiles. Taking high-level autonomous driving as an example, China has opened more than 32,000 kilometers of test roads across the country, issued more than 7,700 test licenses, and tested more than 120 million kilometers, keeping pace with the international advanced level. Intelligence and connectivity have strongly promoted the transformation to electric power.

As the world's largest new energy vehicle market, China is booming under the dual impetus of policy and market. Policies continue to "fertilize and water" the industrial ecology, The Government Work Report clearly proposed to vigorously develop intelligent and connected new energy vehicles, showing that the policy level attaches great importance to and strongly supports this industry [2]. From "consolidation and expansion" to "vigorous development", It means more resources will be invested in technology development, application promotion and infrastructure construction. In 2024, the annual output of new energy vehicles in China will exceed 13 million, and the penetration rate of L2 and above assisted driving and intelligent cockpit for passenger cars will reach 55.7% and 71% respectively. It is expected to further increase to 65% and 76% in 2025. Intelligence is moving from early introduction to full popularization stage [3].

This paper analyzes the logic of BYD's digital transformation through case study, literature analysis and data support. Theoretically, it can enrich the research on digital transformation in manufacturing industry, practically, it provides replicable experience for similar enterprises, and it is of great significance to promote the high-quality development of China's new energy vehicle industry.

2 Company Profile

2.1 History of Development

Founded in 1994, BYD is mainly engaged in four industries: automobile, electronics, new energy and rail transit, BYD's four core technologies are battery technology, automotive electronic control technology, energy storage technology and photovoltaic power generation technology, it also plays a pivotal role in these fields. In recent years, BYD Automobile's main research direction is intelligent driving. It occupies an important position in the field of new energy vehicles and builds a comprehensive zero-emission new energy overall solution from energy acquisition, storage to application.

2.2 Core Technology

Blade battery is BYD's core technology. It adopts the flat design of square aluminum shell long cell, which significantly improves the space utilization rate of battery pack. With lithium iron phosphate as the positive electrode and artificial graphite as the negative electrode, combined with high-performance adhesive, it has both strength and body structure strengthening function. It has excellent safety performance, can withstand the pinprick test and can withstand the crushing of 46 tons of heavy trucks without structural damage, greatly reducing the risk of fire and explosion. In terms of endurance, it can help the Han EV and other models to have a range of more than 600 kilometers. The energy density of the second-generation product is better than that of ternary lithium battery, which can be charged and discharged for more than 3,000 times and support a driving range of 1.2 million kilometers. After 400 cycle's at-10°C low temperature, the capacity retention rate is more than 80%, and it has strong adaptability to extreme climate [4].

The core advantage of BYD's e-platform 3.0 is its standard eight-in-one electric powertrain, which is highly integrated. Excellent performance in range and charging, with a maximum range of over 1000km and a range of 150km after 5 minutes of charging. The first direct cooling and heating technology of power battery and wide temperature range high efficiency heat pump system improve battery thermal management and winter range. The new electric four-wheel drive power system has fast zero-100 acceleration and low energy consumption. The efficient integration of the platform also expands the interior space and optimizes the driving experience [5].

2.3 Product Assortment

BYD has built a rich and diversified new energy product matrix, covering different market segments and meeting the diverse needs of various consumers. The dynasty series is named after Qin, Han, Tang, Song and Yuan dynasties to highlight the cultural heritage. Qin series, as a pioneer launched in 2013, pioneered the era of new energy vehicles in China. Now Qin PLUS DM-i has a fuel consumption of 3.8L per 100km, The Han series is positioned in the middle and high-end cars, and the Han EV has a blade battery range of more than 600 kilometers, The Tang series covers fuel, hybrid and pure electric, and the Tang DM-i is suitable for family travel, Song products are diversified, Song PLUS DM-i is the world's first wide-body super hybrid SUV, The original series has performed well in the small SUV market.

The ocean series has distinct highlights: Based on e platform 3.0, the seagull is the A00 class sales crown, with excellent endurance and 16 standard over-grade configurations, which is the preferred choice for urban commuting, The destroyer 05 Glory Edition is equipped with DM-i technology, which has low fuel consumption and long range due to low power loss. The standard DiLink system improves the family travel experience, The Seal 06DM-i, as an electric hybrid mid-size sedan, has outstanding appearance and economical fuel consumption, with a wheelbase of 2790mm to provide spacious driving space, The Haixi 05DM-i is positioned as a family hybrid SUV with a fuel consumption of 3.93L/100km under low power consumption, featuring a

2712mm wheelbase for spacious interior layout. BYD actively expands into the premium market: The Tensei brand (jointly established with Daimler, currently 90% owned by BYD) covers SUVs, MPVs, and sedans, with notable models including the N7 and D9. Its flagship Z9GT and the N9 (over 5.2m long with 925 horsepower) are equipped with the Yunnian A system and Yifang technology. The Fangdian Leopard focuses on niche markets, with its Leopard 5 gaining significant attention. The Yangwang brand targets higher-end segments, standardizing China's first mass-produced four-motor drive "Yifang" technology in models U8, U9, and the upcoming U7, balancing safety and performance.

2.4 Global Strategy

By leveraging its self-built fleet to ensure logistics efficiency and accelerate overseas factory construction, BYD aims to circumvent tariff barriers. On the product front, the company strategically deploys diverse products and technological reserves tailored to regional needs. Through enhanced brand influence, it continues expanding into markets across Europe, South America, and Southeast Asia, aspiring to become a global leader in new energy vehicles. In 2023, BYD ranked ninth globally with a 3.5% market share. During the first half of 2024, its market share surged from 6.4% in 2020 to 25.7% in Q2 alone—more than double Tesla's market share during the same period. As of September 2024, BYD's cumulative vehicle sales reached 2.7479 million units, marking a 32.13% year-on-year increase. Ranking sixth globally with 2.2122 million units sold, BYD holds 4.2% of the world's automotive market share.

3 Digital Transformation Strategy

3.1 SWOT Analysis

SO (Leverage strengths to seize opportunities). Leveraging its technological innovation capabilities in core sectors such as batteries, motors, and electronic control systems, BYD can accurately capture the growth opportunities in the global new energy vehicle market. The company continuously develops new models tailored to regional consumer demands. Meanwhile, by capitalizing on its integrated advantages across the industrial chain, it optimizes its global supply chain layout through bulk procurement and localized production, effectively reducing costs. This enables BYD to establish a dual advantage in both pricing and quality in international competition.

ST (Use advantages to reduce threats). With its robust industrial chain integration capabilities, BYD has established a closed-loop management system spanning from upstream raw material procurement to downstream manufacturing. This enables flexible response to significant price fluctuations of critical materials like lithium and cobalt. Through large-scale procurement and vertical integration, the company effectively mit-

igates cost volatility while providing stable pricing support. Meanwhile, BYD continues to strengthen its premium and tech-driven brand image globally. By participating in top-tier international auto shows and expanding overseas R&D centers, it enhances brand recognition and reputation. These efforts gradually build a brand moat across diverse trade environments, reducing market expansion impacts from geopolitical shifts and trade policy changes.

WO (Overcome the disadvantage and seize the opportunity). BYD should proactively expand its product portfolio by developing a diversified product matrix that includes microcars, mid-to-high-end sedans, SUVs, and commercial vehicles. This strategic diversification will precisely address the needs of different consumer segments, enabling the company to fully capitalize on the growing opportunities in the new energy vehicle market. Concurrently, BYD must intensify brand promotion through cross-border marketing campaigns, technology showcase initiatives, and customer reputation building to enhance brand recognition. Leveraging global expansion trends, the automaker should establish robust sales and service networks in emerging markets such as Southeast Asia and Europe, thereby achieving steady market share growth.

WT (Overcome the disadvantage and reduce the threat). BYD can diversify its product portfolio to cover various categories, price tiers, and application scenarios. This strategy helps reduce dependence on specific markets while effectively mitigating cost impacts from raw material price fluctuations in individual markets. Furthermore, by optimizing existing sales channels and expanding into emerging markets through online e-commerce platforms and localized overseas distribution networks, the company can enhance its adaptability to changing international trade conditions and strengthen market penetration capabilities, thereby ensuring stable overall revenue growth.

3.2 Digital R&D, Manufacturing and Marketing

BYD's digital transformation spans the entire value chain, redefining business logic through technological empowerment. In R&D, the company has established a dual-driven system combining "virtual simulation + data platform". By leveraging CAE (computer aided engineering) simulation technology to create digital twin models, the Han EV's body structure underwent 100,000 virtual crash tests during development, reducing R&D cycles by 40%. A cross-regional R&D cloud platform enables real-time data sharing among six global R&D centers, tripling the iteration speed of blade battery material formulations [6].

Xi 'an Base has set a benchmark in "dark factory" manufacturing by introducing 1,000 industrial robots to automate 95% of production processes. Through an IoT platform connecting 28,000 production nodes, it collects real-time data including welding currents and painting temperatures from 3,000 parameters. Combined with AI algorithms for predictive maintenance, this system reduces downtime by 60%. Meanwhile, Changsha Base's flexible production system enables model switching within two hours,

supports mixed-line production of 12 vehicle models, and cuts order delivery cycles to just 15 days [7].

The marketing field built a "private domain traffic + precision conversion" system. Based on the CRM system with 20 million user data, the customer groups were subdivided through the RFM model, and the 7-seater version information of Song PLUS DM-i was pushed to family users, resulting in a 27% increase in conversion rate [8]. An online "live broadcast cloud exhibition hall + VR test drive" matrix has been set up. In 2024, live broadcast sales accounted for 35% of the total volume. Offline experience stores have been connected with AR configurators to enable customers to intuitively preview personalized selection effects.

The after-sales service has been upgraded to a "predictive response" model. The onboard T-BOX system continuously uploads 120 vehicle condition data points in real time, while the backend AI diagnostic model can issue battery degradation warnings up to 30 days in advance. The newly launched DiLink Smart Service enables users to schedule maintenance through voice commands, with LBS technology coordinating nearby service vehicles to reduce on-site response time to just 2 hours. In 2024, remote fault resolution reached 82%, and customer satisfaction scores soared to 96 points [9].

4 Impact and Potential Risk

4.1 Positive Impact

In terms of production efficiency, Xi'an Base's "lights-out factory" has achieved 95% automation through 1,000 industrial robots. Coupled with IoT platform real-time monitoring of 28,000 production nodes, the production line cycle time has been reduced to 51 seconds per vehicle, with total capacity in 2024 increasing by 67% compared to pre-transition levels. The flexible production system supports mixed-line manufacturing for 12 vehicle models, reducing delivery cycles for hit models like the Song PLUS DM-i from 45 days to 15 days while boosting inventory turnover rates by 40% [7].

Digital transformation has significantly boosted product competitiveness. Virtual simulation technology in R&D has cut Han EV's body development cycle by 40%, while the Blade Battery optimized its formula through digital twin modeling, achieving a 20% energy density increase. In 2024, BYD accelerated new car launches by 35% year-on-year, reduced intelligent driving system iteration cycles from six months to three months, and achieved a Net Promoter Score (NPS) of 68—the highest in the industry [6].

4.2 Potential Risk

In terms of data security, the on-board T-BOX system uploads 120 items of vehicle condition data every day, and has more than 20 million users worldwide [10]. In 2024, there were three regional data transmission interruption incidents, which did not cause information leakage, but exposed cross-border data compliance loopholes. The talent gap is equally prominent. Only 12% of the experts in the digital team have a composite background of AI algorithm and automotive engineering, resulting in the actual fault

prediction accuracy rate (82%) of the AI predictive maintenance system in Changsha plant being lower than the design value (90%). Furthermore, system compatibility issues have become increasingly apparent. Data synchronization delays between overseas factories' ERP systems and the domestic headquarters have been identified, with configuration errors in European market models being 1.8 times higher than those in China. Over-reliance on digitalization has also introduced new risks. In 2024, a brief cloud server outage caused logistics scheduling for 5,000 vehicles in transit to be halted for three hours, highlighting operational vulnerabilities stemming from technological dependence.

5 Outlook for Future Trends

BYD's digital transformation will advance to a "fully intelligent" stage. Technologically, the R&D department will upgrade its digital twin system by integrating vehicle-road coordination data, enabling real-time synchronization between virtual testing and actual road conditions. This is expected to reduce new car validation cycles by 25%. In manufacturing, BYD will implement the "Lighthouse Factory 2.0 Plan" through 5G + edge computing to achieve autonomous equipment decision-making. The goal is to surpass 98% production line automation rate by 2026, with single-plant capacity reaching the million-unit level. In the global layout, digital systems will strengthen regional adaptability. For the European market, a distributed data center that meets GDPR (General Data Protection Regulation) standards will be developed to solve the problem of cross-border transmission delay; in Southeast Asia, a "lightweight digital solution" will be implemented to reduce dependence on local network infrastructure through cloud-edge collaboration. Meanwhile, BYD plans to build an intelligent service network covering 30 countries by 2025 and improve the remote diagnosis response speed to seconds. Ecological synergy represents another core focus. By opening the DiLink system interface and collaborating with developers to build an automotive application ecosystem, BYD aims to integrate over 100,000 third-party services within three years. Through partnership with photovoltaic and energy storage companies, a digital energy platform is being established to enable intelligent coordination between vehicles, homes, and power grids. The "Light-Storage-Vehicle Closed-Loop" solution, which has already served 500,000 pilot users, will now be rolled out globally. The intelligent security system will be upgraded simultaneously; quantum encryption technology will be introduced to ensure the transmission of vehicle cloud data, and an AI-driven real-time risk monitoring network will be established. The incidence of data security incidents will be reduced to less than 0.1 times per year, setting a digital security benchmark for the industry.

6 Conclusion

BYD's digital transformation practices have set a benchmark for China's new energy vehicle industry. Through establishing a comprehensive digital ecosystem spanning R&D, manufacturing, marketing, and service, the company has achieved remarkable

results: cutting development cycles by 40%, boosting production efficiency by 67%, and securing a 96-point customer satisfaction rating. These accomplishments underscore how digitalization plays a pivotal role in overcoming efficiency bottlenecks in manufacturing.

During its transformation, BYD has demonstrated both technological integration capabilities—such as combining digital twin technology with battery innovation to boost energy density by 20%—and common challenges including data security and talent shortages. This reveals that digital transformation is a systematic endeavor requiring balancing technological innovation with risk management, while ensuring global standard alignment and local adaptation in its worldwide expansion.

For the industry, BYD's experience reveals three strategic pathways: leveraging a data-driven platform to integrate value chains, employing flexible manufacturing to mitigate market volatility, and reconstructing user relationships through predictive services. Moving forward, Chinese new energy vehicle enterprises should adopt its "technology foundation + ecosystem synergy" strategy. By strengthening core technological autonomy while building a globally adaptable digital resilience system, they can gain competitive advantages in international markets and drive the industry's transition from scale expansion to high-quality development.

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