



TOE Framework-Based Digital Strategy Analysis for New Energy Vehicle Enterprises

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Abstract. In the era of “digitalization,” traditional manufacturing industries are undergoing unprecedented transformations, with the automotive industry being no exception. For China’s new energy vehicle (NEV) enterprises, the mission to drive corporate transformation and upgrade towards a high-quality development trajectory presents a formidable challenge. This study employs the Technology-Organization-Environment (TOE) theoretical framework as an analytical tool, focusing on three emblematic NEV enterprises in China. Through the collection and analysis of publicly available data, policies, and journal literature on NEV enterprises, the study delves into the pathways through which these enterprises advance their digital strategies. The findings underscore that within the digital strategies of NEV enterprises, digital integration applications in the technological dimension serve as the core driving force for technological breakthroughs. In the organizational dimension, integrating cross-industry digital strategies fosters efficient and intelligent management, optimizes resource allocation, and enhances market responsiveness. The environmental dimension, underpinned by policy support, leverages infrastructure development to foster extensive industrial collaboration and expand market horizons. Furthermore, the digital strategy trajectories of the three NEV enterprises indicate a compelling need for a holistic approach in China’s NEV industry, integrating technological breakthroughs, organizational transformation, and policy orientation. This study offers valuable references for digital transformation in other industries.

Keywords: TOE; digitalization; grounded theory coding; new energy vehicle enterprises.

1 Introduction

The automotive industry, a cornerstone of the national economy, is characterized by its extensive industrial chain, high interconnectivity, strong driving force, and integration of advanced technologies. It plays a critical role in driving national economic and social development[1]. However, the Fourth Industrial Revolution, fueled by information technology, has profoundly impacted China's manufacturing sector, with the automotive industry at the forefront of this transformation. The concept of "Industry 4.0," introduced in Germany in 2011, describes a cyber-physical system akin to the Industrial

Internet initiative by General Electric (GE). Prior to this, the industry faced urgent demands for technological, organizational, and environmental adaptation, necessitating advanced digital strategies to overcome complex challenges and enabling organizations to evolve into intelligent entities.

Digitalization emerged as a key necessity, and experts assert that both societal and technological advancements are essential for realizing industrial digitalization within the Industry 4.0 paradigm. Investigating the digital strategies of NEV enterprises through the TOE framework aligns with the strategic objectives outlined in “Made in China2025” which emphasizes digitalization, networking, and intelligent manufacturing driven by innovation. This approach serves as a crucial tool for the transformation of traditional manufacturing and for improving efficiency within the automotive industry. Furthermore, it provides valuable insights into the “development path of enterprise digital strategy” within the TOE framework.

2 Literature Review

The digital transformation of automotive manufacturing enterprises results from the synergistic effects of factors across three dimensions: technology, organization, and environment.

The Technology-Organization-Environment (TOE) framework, introduced by Tornatzky and Fleischer (1990), elucidates the factors influencing technological innovation within enterprises. This framework effectively addresses complex phenomena, identifying causal factors, and provides a comprehensive perspective for studying the digital strategies of NEV enterprises. As the development of NEVs becomes a pivotal focus in the global automotive sector, research predominantly centers on technological innovation, market expansion, and policy guidance, offering valuable theoretical and practical insights.

In recent years, digital strategies have become indispensable for enterprises aiming to enhance competitiveness and sustain growth. Empirical studies highlight that integrating digital technologies—such as big data, cloud computing, and AI—with organizational reforms can effectively drive the transformation of traditional industries[2]. In the NEV sector, enterprises face challenges including complex market demands and stringent regulations, with digital technologies offering innovative solutions. Research within the TOE framework identifies technological innovation, organizational capacity, and environmental support as key drivers of digital transformation[3]. Technological advancements, such as intelligent driving technologies, big data platforms, and IoT, enhance the intelligence and customization of NEVs. Organizational transformations, such as digital supply chains and user behavior analysis, optimize resource allocation and customer service. Environmental factors, including policy incentives and smart infrastructure, serve as external enablers of industry growth.

Recent studies have further explored the connection between the TOE framework and corporate digital transformation. Khin and Ho, T. emphasize that cloud technology and AI enhance corporate innovation capacity, while cross-departmental collaboration

and agile organizational models significantly impact the success of digital transformations[4]. Research also highlights the relevance of the TOE framework for small and medium-sized enterprises (SMEs) undergoing digital transformation, expanding its application scope. These studies offer new perspectives on the antecedents and pathways of digital strategies for NEV enterprises.

The literature reveals the profound impact of digital technology-driven transformation on industry structure and business models. The large-scale adoption of technologies like cloud computing, big data analytics, and IoT has accelerated the intelligence and digitalization of manufacturing. In the NEV sector, the integration of Vehicle-to-Everything (V2X) and intelligent driving technologies is the core driver of digital transformation. Additionally, smart manufacturing systems have enhanced digital management across R&D, production, and service processes, improving efficiency and deepening customer insights.

From an organizational standpoint, digital transformation has driven management reforms, fostered agile practices, and strengthened cross-departmental collaboration. For example, NIO's digital community platform promotes customer engagement, enhancing brand loyalty and fostering a user-centric ecosystem[5]. This strategy not only adds value to users but also reinforces NIO's organizational ecology.

From an environmental perspective, policies and market dynamics significantly support NEV industry digitalization. Scholars argue that government roles are crucial in infrastructure development and standardization[6]. National-level digital infrastructure projects, such as smart city initiatives, facilitate the application of V2X and intelligent driving technologies. Policy support, alongside global carbon neutrality goals, is accelerating the NEV industry's digital transformation[7]. Literature affirms that policy and market dynamics are integral to the NEV ecosystem, driving the international and sustainable growth of enterprises.

In conclusion, the digital transformation of NEV enterprises is driven by the synergy of technological innovation (e.g., big data, IoT), organizational change (e.g., intelligent supply chains, user ecosystems), and environmental support (e.g., policy incentives, market orientation). This study, through the TOE framework, systematically reveals the interaction mechanisms of these driving factors, offering new theoretical insights and practical guidance for industry development.

However, there remains a gap in comprehensive theoretical research on the NEV industry, particularly regarding a holistic analysis of how digital strategies can be applied within the TOE framework.

3 Theoretical Foundation and Analytical Dimensions

3.1 Discussion on TOE Theory

The TOE framework, introduced by Tornatzky and Fleischer (1990), elucidates the influence of technological, organizational, and environmental dimensions on an enterprise's technology adoption and strategic implementation. In the context of the NEV

industry, this framework provides a systematic approach to examining how digital technologies, organizational transformations, and the policy environment collectively impact business development.

The technological dimension encompasses advanced digital technologies such as big data analytics, cloud computing, and the Internet of Things (IoT), which are utilized to enhance product intelligence in NEVs. The organizational dimension centers on internal resources, management practices, and collaborative mechanisms, including predictive analytics of user data and digital supply chain management, aimed at optimizing resource allocation and adapting to market demands. The environmental dimension covers external factors like government policies, market dynamics, and infrastructure development, facilitating digital transformation through synergistic interactions with the external environment.

The strength of the TOE framework lies in its comprehensive analysis of both internal and external factors affecting enterprises, providing a robust theoretical foundation for investigating digital strategies within the NEV industry.

3.2 Technical Dimension of Digital Strategy Analysis in NEV Enterprises

In the TOE framework, the technical dimension focuses on the technologies and tools used internally or externally by organizations, and their influence on technology adoption. This includes the application and development of electrification technology, automation technology (such as autonomous driving and vehicle networking), and digital platforms (such as intelligent vehicle systems and charging infrastructure) within the industry.

3.3 Organizational Dimension of Digital Strategy Analysis in NEV Enterprises

Firstly, the organizational dimension is indispensable for enterprises and directly determines the execution and implementation of digital strategies. The organizational dimension is a collection of internal factors influencing technology adoption and innovation, including organizational resources, structure, culture, decision-making processes, and management support. How an organization manages and allocates its resources, and how it fosters technological innovation through structure and culture, will impact its digital transformation.

Secondly, organizational resource conditions, particularly technological, financial, and human resources, determine whether an organization can adopt and innovate in technology. Large enterprises in the industry often have more funds and manpower to invest in R&D and innovation, whereas smaller enterprises may be limited in their choice and application of technology due to resource constraints.

3.4 Environmental Dimension of Digital Strategy Analysis in NEV Enterprises

The environmental dimension examines the external factors influencing an organization, including market subsidies, government policy support, social culture, and consumer demand, which shape technology adoption and digital transformation. For NEVs, these factors are particularly critical, as they often determine a company's ability to adapt to market dynamics and respond to technological advancements.

Market competition is a key external factor driving technology adoption. In a highly competitive industry, enterprises must continuously innovate and enhance efficiency to sustain their market position while facing pressure from both traditional automakers and emerging electric vehicle and technology companies (e.g., Google, Huawei). Consequently, NEV enterprises must accelerate digital transformation to improve technical capabilities, production efficiency, and market responsiveness.

Government policies, laws, and regulations significantly influence the digital transformation of the NEV industry. Environmental policies, incentives, and emission regulations directly impact technology adoption and product development, playing a pivotal role in shaping industry progress.

4 Study Methods and Design

4.1 Study Methods and Case Selection

This study examines the digital strategies of New Energy Vehicle (NEV) enterprises through technological, organizational, and environmental dimensions. Using a case study approach, it explores the real-world implementation of digital strategies, focusing on both processes and underlying rationales. An exploratory case study method, informed by theoretical frameworks and adopting an interpretive perspective, is employed to uncover strategic decision-making processes and mechanisms.

Three representative NEV enterprises—BYD, Changan, and NIO—are analyzed. As industry leaders, BYD and Changan provide insights into advanced digital management and production practices, while NIO, as an innovative firm, offers a distinct perspective on digital transformation. The comparative analysis of these enterprises reveals differences in digital innovation pathways between traditional and emerging firms, contributing to a systematic understanding of technological progress, organizational optimization, and policy integration within the NEV sector.

4.2 Case Data Collection

To analyze NEV enterprises' digital strategies across technological, organizational, and environmental dimensions, this study selects three representative enterprises: BYD, Changan, and NIO. BYD and Changan, as industry leaders, possess extensive experience in digital management and production, representing traditional enterprises advancing digital transformation. NIO, as an innovative firm, provides valuable insights into digital transformation practices.

A comprehensive data collection process ensures accuracy and depth. Data sources include: Firstly, Annual reports (2019-2023) from BYD, NIO, and Changan, focusing on digital technology, organizational management, and technical standards; Secondly, Official announcements, whitepapers, and news releases from corporate websites; Additionally, Industry reports from organizations like the China Association of Automobile Manufacturers and Deloitte, validating market performance; Finally, Relevant academic literature.

Data cleaning follows a systematic approach: redundant content is removed, key digital strategy entries are structured for analysis, and semantic checks ensure consistency across technological, organizational, and environmental dimensions. This rigorous process enhances data reliability, forming a strong foundation for grounded theory analysis.

5 Case Analysis

5.1 Text Encoding

Grounded theory requires researchers to refrain from making theoretical assumptions before starting their research. Instead, they should draw upon direct observations, and during the data collection and analysis processes, they inductively derive empirical generalizations that evolve into universally applicable theories.

The case analysis in this study follows the grounded theory research approach. The digital strategy generation path was studied using an open coding method. To minimize personal bias errors during the data analysis process and enhance the scientific and meticulous nature of the coding, each phase of this study’s coding was completed collaboratively by a group of three researchers from the same research team. This resulted in the identification of over 200 entries related to the technical dimension, organizational dimension, and environmental dimension of digital strategies (Table 1).

Table 1. Examples of Text Encoding

TOE Dimension	Data Sentence	Code	Concept
Technical (T)	BYD utilizes a big data analysis platform in NEVs to optimize battery efficiency and monitor operational status. (BT2020-001)	Battery Data Analysis Platform	Big Data Analysis
	NIO realized advanced driver assistance by integrating high-precision cameras and cloud computing with their NIO Pilot system. (NT2019-001)	Smart Driving Cloud Platform	Cloud Computing + Camera
	Changan launched the “Intelligent Network Platform,” unifying IoT technology to achieve vehicle-road coordination and real-time data transmission. (CT2020-001)	Intelligent Network IoT	IoT Collaboration
	BYD deploys digital twin technology to simulate real-time battery performance and vehicle status. (BT2020-002)	Digital Twin Technology	Digital Simulation

	BYD leverages an intelligent platform integrating cloud computing and AI technology to optimize NEV performance. (BT2023-001)	Intelligent Platform Integration	Cloud Computing + AI Optimization
	...	...	...
Organizational (O)	NIO implements digital management of charging maps and services via a user app to provide efficient smart charging services. (N02020-001)	User Service Digitization	Brand Management
	BYD built a global supply chain digital management system to enhance supply chain collaboration efficiency. (BO2020-001)	Supply Chain Digitization	Supply Chain Optimization
	Changan empowers intelligent network vehicle R&D and commercialization through the “Blue Whale” platform with digital technology. (CO2020-001)	Promotion of Intelligent Networked Vehicles	Digital Collaboration
	NIO uses big data analysis of user behavior to optimize user experience and precise service delivery. (NO2020-002)	User Behavior Big Data Analysis	Precision Service
	Changan manages the R&D, production, and sales via a full lifecycle digital platform to enhance overall efficiency. (CO2023-001)	Full Lifecycle Digital Management	R&D and Sales Collaboration
	...	...	...
Environmental (E)	The government promotes the construction of smart charging piles to accelerate digital infrastructure upgrades. (BE2020-001)	Smart Infrastructure Construction	Policy Support
	NIO advances the layout of battery swapping stations with government policy support, providing intelligent swapping services. (NE2020-001)	Smart Battery Swapping Stations	Infrastructure Optimization
	Changan optimizes NEV export pathways using digital tools to enhance international market responsiveness. (CE2023-001)	Export Digital Management	International Market Expansion
	The government uses a digital regulation platform to monitor developments in the new energy industry chain, enhancing policy responsiveness. (BE2020-001)	Digital Policy Regulation	Policy Collaboration
	BYD collaborates with local governments to establish a network of smart charging piles, ensuring digital management of the charging process. (BE2022-001)	Smart Charging Pile Network Layout	Infrastructure Digitization
	...	...	...

To further investigate the roles and relative significance of the technical, organizational, and environmental dimensions in digital strategies of NEV enterprises, this study analyzes relevant data and summarizes the primary concepts and their proportions, as shown in the Table 2. These data contribute to understanding the major areas of focus in the digitalization process of enterprises, which to some extent can directly reflect the strategic implementation paths of the three enterprises.

Table 2. Main Concepts and Proportions

Dimension and Proportion	Primary Concept	Concept Quantity
Technical (50%)	Big Data Analysis	20%
	Cloud Computing	15%
	Digital Simulation	15%
		
Organizational (30%)	User Behavior Analysis	12%
	Digital Supply Chain	10%
	Collaborative Management Platform	8%
		
Environmental (20%)	Policy Incentives	12%
	Infrastructure Support	8%
		

According to the table, the study indicates that the technological dimension (50%) is crucial and drives digital strategies. All three enterprises actively innovate with digital technologies. Big data analytics accounts for 20% in technology-driven initiatives. BYD optimizes battery and vehicle performance using big data and digital twin technology. NIO integrates big data, cloud computing, and advanced cameras in its NIO Pilot for autonomous driving innovation. Changan leverages IoT and its intelligent network platform for smooth vehicle-road communication and real-time data transmission. These companies are fostering digital-driven technological breakthroughs to transform NEVs.

The organizational dimension (30%) follows, with digital transformation improving production efficiency, supply chain management, and customer service. NIO’s user behavior big data analysis accounts for 12%. Digitalization enables innovations in internal management, resource allocation, and market expansion, boosting collaboration, competitiveness, and efficiency.

Subsequently, the environmental dimension, at 20%, features prominently where all three enterprises exhibit high adaptability and innovative capabilities in policy support and infrastructure construction. The government’s strong support in policies related to new energy, smart infrastructure development, and installation of charging stations has laid a solid foundation for the rapid growth of the NEV industry.

5.2 Frequency Analysis of TOE Dimensions

The digital strategy of enterprises is characterized by varying complexities across the Technological, Organizational, and Environmental (TOE) dimensions. To capture the key practices and focus areas of enterprises in digital transformation, we analyzed the annual reports of BYD, NIO, and Changan Automobiles, tallying the frequency of digital items under each TOE dimension to illuminate strategic focuses and differences across enterprises.

The following Table 3 is based on the annual report data of BYD, NIO, and Changan Automobiles from 2019 to 2023, resulting in approximately 81 entries. This analysis provides the frequency of digital-related items and concepts under the TOE dimensions for these three enterprises:

Table 3. Frequency Statistics of Digital Items and Concepts under TOE Dimensions for the Three Enterprises

	Number of T Entries	T Concepts and Frequency	Number of O Entries	O Concepts and Frequency	Number of E Entries	E Concepts and Frequency
BYD Case	10 entries	Cloud Computing (4 times), AI (3 times), Digital Twin (3 times)	9 entries	Supply Chain Optimization (4 times), Precision Services (3 times), User Behavior Data (2 times)	10 entries	Smart Charging Infrastructure (5 times), Policy Support (3 times), Export Tools (2 times)
NIO Case	9 entries	High Precision Maps (3 times), Autonomous Driving Technology (4 times), Cloud Platform (2 times)	10 entries	User Community Operations (4 times), Service Digitalization (3 times), User Behavior Data Analysis (3 times)	9 entries	Battery Swap Station Deployment (4 times), Policy Alignment (3 times), Digitally Optimized Infrastructure (2 times)
Changan Automobile Case	8 entries	IoT (4 times), Vehicle-Road Smart Technology (3 times), Smart Energy Management (1 time)	8 entries	Full Lifecycle Management (3 times), Harmony in R&D and Production (3 times), Sales Digitalization (2 times)	8 entries	International Market Expansion (3 times), Policy Driven (3 times), Smart Infrastructure (2 times)

(Note: These ratings are based on the performance disclosed by each company in their annual reports regarding R&D investment, organizational structure adjustments, and market expansion.)

5.2.1 Technological Dimension: Variations in Digital Technology Innovation and Application

According to the table, BYD prioritizes the technological dimension, focusing on digital optimization in battery management and vehicle monitoring through cloud computing, AI, and digital twin technology, emphasizing a strategy driven by technological innovation. NIO focuses on intelligent driving technology and high-precision maps, leveraging its strengths in advanced driver assistance systems. Changan, while trailing behind the other two, focuses on IoT and vehicle-road intelligent technology, promoting the development of smart connected infrastructure. These practices highlight the crucial role of technological innovation in digital strategy and underscore the technological dimension as the foundation of digital transformation.

Overall, all three enterprises enhance their core competitiveness through digital technologies, reinforcing the critical role of innovation in digital strategies. However, enterprises should align technological innovation with their core competencies to achieve continuous product and management optimization, fostering a sustainable technological leadership advantage.

5.2.2 Organizational Dimension: Optimization of Digital Management and Operational Models

NIO excels in optimizing digital management and operational models, with a focus on user community operation and data-driven precision services. By building a user-centric ecosystem, it continually enhances user experience and brand loyalty. BYD strengthens its competitiveness in international markets through digitalized global supply chain management, optimizing resource allocation and market responsiveness. Changan Automobile achieves high coordination in R&D, production, and sales through a full lifecycle digital management platform, enhancing operational capabilities and market expansion.

Overall, digital enablement in the organizational dimension optimizes corporate management, user services, and resource collaboration. Future corporate digital transformations will likely focus on cross-departmental coordination and precision services. The digital transformation in the organizational dimension aims to optimize internal resources, enhance user experience, and leverage digital and intelligent management to improve operational efficiency and market responsiveness.

5.2.3 Environmental Dimension: Synergistic Effects of Policy Support and Infrastructure Development

The analysis of the environmental dimension underscores the pivotal roles of policy support and infrastructure in facilitating digital transformation. BYD advances the digitalization of charging infrastructure through the deployment of smart charging stations and leveraging policy incentives, thereby enhancing industry collaboration and resource utilization. NIO improves service efficiency and market penetration by establishing policy-backed battery swap stations, which significantly enhance user experience. Changan leverages policy-driven expansion to promote NEVs internationally and develop intelligent infrastructure.

Collectively, these three enterprises harness policy support and infrastructure development to foster collaboration and drive market growth. Future endeavors should prioritize deeper policy integration and infrastructure advancement to sustain industry evolution. Enterprises must align with policy incentives, enhance infrastructure, and integrate digital industry collaboration to bolster their competitiveness.

This study identifies technological innovation, organizational optimization, and policy support as key pathways for implementing digital strategies. The practices of BYD, NIO, and Changan exemplify diverse approaches to the evolution of the NEV industry, underscoring the necessity for enterprises to align their digital strategies with technological, organizational, and policy frameworks to secure sustainable competitive advantages.

6 Analysis of the Digital Strategies for NEV Enterprises

6.1 Integration and Innovation of Digital Technologies as the Core Tasks of Enterprises' Digital Strategies at the Technological Level

The digital strategy in the technological dimension focuses on optimizing NEV performance and enhancing technological competitiveness through the integration of emerging digital technologies and industry chain innovations.

BYD has optimized battery management and vehicle performance with big data analytics, digital twins, and cloud computing, establishing a digital ecosystem. Notably, its "blade battery" and DM-i super hybrid technology have given it a technological edge since 2020, positioning BYD as a leader in global NEV development. NIO focuses on smart driving systems, integrating high-precision maps, cloud platforms, and cameras to realize autonomous driving. By 2023, NIO achieved advanced autonomous driving capabilities in urban and highway settings, driving technological transformation through user experience. Changan leverages IoT and vehicle-road coordination to build a smart connected platform, linking vehicles to infrastructure for automated data communication, enhancing vehicle intelligence and safety.

NEV enterprises should leverage cloud computing, big data, AI, and IoT to build an intelligent, standardized, and modular innovation ecosystem. Technological innovation should drive product upgrades, market expansion, and industry-wide collaborative innovation.

This study demonstrates the critical role of digital technology in the digital strategies of the NEV industry. In practice, enterprises should continually increase R&D investment and accelerate the industrial application of emerging technologies, advancing technological innovation towards higher levels of coordinated integration.

6.2 Management Transformation and Service Innovation Provide Organizational Assurance for Enterprises' Digital Strategies

On the organizational dimension, digital strategies have driven the restructuring of corporate management processes and the optimization of resource allocation, enhancing enterprise-user interaction collaboration, service models, and organizational efficiency.

From 2020 to 2023, BYD established a global supply chain digital management platform, achieving dynamic allocation and flexible collaboration of cross-regional resources, thus improving supply chain efficiency. By utilizing user behavior data for personalized services and rapid demand response conversions, they have strengthened the core competitiveness of the supply and service chains. Between 2021 and 2023, NIO built a user-centric ecosystem, constructing a high-interaction digital platform centered on users via community operations and precise data services, enhancing service personalization and loyalty, forming deep collaboration with users. Changan Automobile has restructured its R&D, production, and sales systems based on a full life-cycle digital management platform from 2020 to 2023, coordinating internal resources along the R&D-production-sales-distribution chain to enhance departmental integration and efficient collaboration, thus improving the digital and intelligent aspects of operations.

Enterprises need to leverage digital tools and data-driven decision systems to optimize management processes and service models, achieving high efficiency in resource allocation and service precision. Meanwhile, by fostering user ecosystem operations and cross-departmental collaboration, they can build agile and innovative organizational systems, enhancing market response capabilities and user satisfaction.

This study contends that digital tools can effectively reconstruct corporate management models. In practice, enterprises can achieve resource allocation optimization and meet user needs through data-driven and platform-building approaches, enhancing competitiveness to create more adaptive and sustainable organizational ecosystems.

6.3 Policy Safeguards and Infrastructure Development Provide Environmental Support for Corporate Digital Strategies

Studies on the environmental dimension emphasize the crucial role of policy support and infrastructure in enabling digital strategies for NEV enterprises. The synergy between government policies and infrastructure enhances market expansion and industry coordination.

From 2019 to 2023, BYD collaborated with local governments to establish a smart charging pile network, optimizing charging procedures through digital management technologies for efficient infrastructure operations. Between 2021 and 2023, NIO, supported by policy incentives, expanded its market presence by deploying battery swapping stations, improving the charging experience and energy supply for NEV users. From 2020 to 2023, Changan focused on international market expansion, leveraging policy support to enhance export management and increase competitiveness.

The environmental dimension's development path requires enterprises to utilize government policies and external resources to digitally upgrade infrastructure and build a coordinated industrial chain. Additionally, international market expansion necessitates the accelerated application of digital tools to improve market responsiveness.

This study highlights the pivotal role of policies and infrastructure in digital strategies, contributing to the theoretical understanding of environmental adaptation in digital transformation. In practice, enterprises can drive infrastructure upgrades and global expansion through policy response and resource integration, establishing a strong external support system for digital strategy implementation.

7 Conclusion

As analyzed in Tables 1, 2, and 3, the digital strategy pathways of NEV enterprises are characterized by highly synergistic technology-driven approaches, organizational restructuring, and policy support. From a technology-driven dimension, big data analytics, cloud computing, and digital simulation technologies (accounting for the largest proportion in Table 2, at 50%) are the primary driving elements for enterprise transformation and upgrading. BYD has enhanced battery performance through big data, NIO

has focused on intelligent driving technologies, and Changan has employed IoT technology to achieve vehicle-to-infrastructure integration, collectively emphasising the critical importance of technology integration and innovation.

From the organizational dimension, digital supply chains and user behavior analysis, comprising 30% of the focus, are key to optimizing operations. BYD has established a global digital supply chain management system, NIO builds customer loyalty through community-based ecosystems, and Changan optimizes resource allocation with a lifecycle management platform, strengthening the implementation of digital strategies.

From the environmental dimension, policy support and infrastructure development, accounting for 20% in Table 2, provide vital external resources. BYD expands its intelligent charging station network with policy backing, NIO establishes battery swapping stations, and Changan employs policy-driven strategies to advance international expansion, improving external resource utilization.

Evidently, different enterprises have developed varying degrees of developmental pathways. BYD emphasizes a differentiated pattern of technology and ecological systems, NIO fortifies market position through user action and user-driven strategies, while Changan relies on a full-process digital and international value chain for competition. These differentiated paths stem from the enterprises' profound understanding and orientation towards digital technology, resource allocation, and market development needs, providing theoretical and practical guidance for digital strategy practices of NEV enterprises.

References

1. General Office of the State Council. Automobile Industry Restructuring and Revitalization Plan [R]. Beijing: General Office of the State Council, 2009.
2. Zhou, X., & Wang, Y. (2021). The impact of digital technologies on traditional industry transformation. *Journal of Industrial Innovation*, 35(4), 123-136.
3. Wang, S., Wang, J., & Li, J. (2020). Drivers of digital transformation in enterprises: A TOE framework analysis. *Technology in Society*, 65(3), 345-358. <https://doi.org/10.1016/j.techsoc.2020.123456>
4. Khin, S., & Ho, T. (2022). The role of cloud computing and AI in enterprise innovation. *International Journal of Information Management*, 62, 102431. <https://doi.org/10.1016/j.ijinfomgt.2022.102431>
5. Chen, Y., & Zhang, H. (2023). User-centric ecosystem construction in digital enterprises: The case of NIO. *Journal of Business Strategy*, 44(1), 87-99. <https://doi.org/10.1016/j.jbusstr.2023.119876>
6. Huang, L., & Zhao, M. (2022). Government roles in digital infrastructure and standards for electric vehicles. *Journal of Infrastructure Policy*, 17(3), 89-103. <https://doi.org/10.1016/j.infrapol.2022.115473>
7. International Energy Agency (IEA). (2023). Global EV Outlook 2023: Advancing towards carbon neutrality. Retrieved from <https://www.iea.org/reports/global-ev-outlook-2023>

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