Research on the Transformation and Upgrading of the Automotive Industry: Focusing on China and Looking to the World

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Abstract. In the context of the global automobile industry facing multiple challenges, ranging from supply chain disruptions and stringent environmental regulations to the accelerating shift toward electrification and intelligent mobility, this study focuses on the core dilemmas and breakthrough paths of domestic and foreign auto companies' transformation and upgrading. Based on a systematic analysis of the current industry, this paper analysed the different pressure dimensions faced by domestic and foreign automakers: domestic enterprises mainly face constraints from critical technological bottlenecks in foundational domains, while international giants generally respond slowly to global market dynamics, especially China's unique demand and rapid tech route iteration. To navigate these hurdles, Chinese automakers leverage domestic scale advantages and policy-driven ecosystems, which foster collaboration across industry chain stakeholders and accelerate technological breakthroughs. Meanwhile, international firms are repositioning China as a key innovation frontier, establishing R&D centres and forging local partnerships to stay abreast of market trends. This study provides theoretical reference and practical guidance for strategic adjustment and policy formulation of related enterprises.

Keywords: Automotive Industry, Transformation, Technology.

1 Introduction

The automotive industry is the core of modern industry, and its development history reflects the direction of global economic and technological evolution. Since Karl Benz invented the internal combustion engine car in the late 19th century, the development paths of domestic and foreign car companies have shown different stages of characteristics. In the nascent stage, overseas automakers pioneered market dominance by capitalising on their technological first-mover advantages. For example, Ford in the United States was the first to use assembly lines to achieve large-scale production, while Volkswagen in Germany and Toyota in Japan consolidated their global position through refined management and continuous technological innovation. The history of joint venture car companies in China can be traced back to the 1980s, when the Chinese government adopted the strategy of "market for technology" and introduced numerous

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internationally renowned car manufacturers to establish joint ventures with domestic enterprises [1]. Later on, with the rise of independent brands, companies such as BYD and Geely achieved success through electrification strategies. However, as the global automotive industry enters a period of deep transformation, both established foreign car companies and domestic joint ventures and new domestic car companies are facing unprecedented development challenges.

Under the wave of "new four modernisations" of electrification, intelligence, and networking, many car companies are not transforming quickly enough, and their determination is not firm enough [2]. The traditional fuel vehicle technology system is facing disruptive challenges. In 2024, the sales of new energy vehicles reached 12.866 million units, accounting for over 60% of the global market. It is expected that the penetration rate will exceed 50% by 2025, officially making new energy vehicles enter the mainstream stage of the market [3]. In this context, transformation and upgrading have become the only way for car companies to survive and develop. This article focuses on the transformation practices of domestic and foreign car companies, aiming to systematically analyse the differentiation paths between domestic car companies and established foreign car companies. Through research, it has been found that Chinese car companies need to rely on their own technological upgrades and collaborative policy support for transformation, while the key to the success of international car companies lies in positioning the Chinese market as a global innovation frontier. In the future, the competition in the automotive industry will essentially evolve into a competition between technology ecology and user experience. Future automotive competition will fundamentally centre on technological ecosystems and user experience, compelling manufacturers worldwide to embrace open transformation through technical collaboration, cross-sector convergence, and globalised deployment. This study offers insights for strategic decision-making, technological research and development, and policy formulation in automotive enterprises by analysing transformation frameworks and case studies, facilitating the global automotive industry's shift toward sustainable and intelligent mobility.

2 Domestic Automotive Companies

2.1 Status and Challenges

Looking back at the development history of China's new energy vehicle industry, it can be seen that the advantages brought about by technological changes, such as better driving experience, lower fuel costs, less environmental pollution, and the ability to use cars as backup power sources, are the main reasons driving China's automobile consumption to gradually shift from fuel vehicles to new energy vehicles [4]. At present, Chinese car companies are continuously promoting scene innovation and releasing data dividends. With their huge market size and policy support, Chinese car companies are shifting from being "technology followers" to "standard setters". BYD's "Eye of Heaven" intelligent driving system adopts a BEV+Occupancy network fusion architecture, achieving a 95% no takeover pass rate in complex urban scene testing in Shenzhen.

Its unique "game algorithm" effectively solves the decision-making problem of Chinese-style congestion scenarios [3].

Despite significant progress, the digital transformation of the automotive industry still faces significant challenges. First, the existing pattern of interests is difficult to break. The traditional fuel vehicle industry, as an important engine for China's economic development, has a huge production scale, a complete supply chain system, and extensive market influence. Due to different core technologies, there is a substitute relationship between new energy vehicles and traditional fuel vehicles. The promotion and application of new energy vehicles will seize the market share of fuel vehicles, causing an impact on the industry chain, including traditional car manufacturers and component suppliers [5]. If industry turn to new energy power technology, it means giving up the core capabilities and market position mentioned above, which is difficult for traditional car companies to accept [1]. Secondly, the shortcomings in basic technology constrain the security of the industrial chain. As the core hardware of intelligent driving, automotive-grade AI chips have a localisation rate of less than 15%, and advanced processes below 7nm rely entirely on overseas foundries such as TSMC and Samsung. This predicament stems not merely from process generation gaps in wafer fabrication but more critically reflects institutional deficiencies in domestic chips' compliance infrastructure for functional safety certification and long-term reliability validation standards [6]. The third issue is that data governance affects compatibility. L4 level autonomous driving generates an average of 20TB of multimodal data per day (including 12 types of heterogeneous sources), but due to the lack of a unified data interface standard in the industry (sensor protocol difference rate of 68%), the effective utilization rate of data is less than 30%, and the fusion cost increases by more than 40%. At the same time, the inertia of traditional organisational structures is significant, with 78% of the top 50 global car companies having "digital islands", and the data sharing rate between R&D and marketing departments being less than 40%. Cross-national operational scenarios are particularly prominent. Such as BMW Shenyang factory, where production collaboration efficiency decreased by 27% and annual losses amounted to 240 million euros due to incompatibility between MES and the headquarters SAP-ERP system data standards. This type of problem reflects the disconnect between data governance capabilities and intelligent networking needs, as well as the deep contradiction between traditional hierarchical organisations and agile digital ecosystems. It should be resolved through unified data standards and digital middleware construction [3].

2.2 Strategic Transformation for Domestic Automakers

Technological Upgrading. Technological upgrading lies at the core of automotive enterprises' transformation. Digital technology has penetrated into every aspect of enterprises, from products to services, processes, customers, markets, and more.

Based on the current transformation status and best practices of automotive companies, the digital capability enhancement framework is centred on the ODTE (organisation reinvention, data lead, technology empowerment, ecosystem together) model. This can serve as a typical framework to form a four-dimensional collaborative closed-loop system [3]. In the transformation framework, organization reinvention (O) achieves

gradual change through a dual-mode architecture of "agile development unit and traditional manufacturing unit", supported by a composite talent matrix covering fields such as AI engineering and a chief digital officer mechanism, and strengthens strategic synergy through "digital sand table meetings" and OKR assessments (such as OTA activation rate and other indicators). Data lead (D) focuses on the construction of a global data platform to connect the entire chain of research and development, manufacturing, and service data, relying on federated learning platforms to achieve cross enterprise data security collaboration, and synchronously improving the data governance system to build a "data knowledge decision" closed loop. Technology empowerment (T) optimizes autonomous driving and simulation scenarios via Transformer architecture, forms a distributed computing system with edge computing and cloud supercomputing through Generative Adversarial Network (GAN) algorithms, and achieves technology stack decoupling and efficiency enhancement via AIoT platforms and digital twin engines (with R&D verification efficiency improved by over threefold). Ecological together (E) relies on cross-border alliances and open source communities to build an open and collaborative ecosystem, and achieves value extension through vertical alliances and standard systems [3].

Policy Supporting. Policy support catalyses enterprise transformation. Under the incentive of government subsidy policies, enterprises have increased their investment in the research and development of new energy vehicles, effectively promoting technological innovation and marketisation of products.

Under the dual effects of a more comprehensive regulatory framework and incentive mechanisms, the production capacity of new energy vehicle enterprises in China has steadily increased, and consumer recognition of new energy vehicles continues to rise. The new energy vehicle industry can now rely on endogenous market forces to achieve sustainable development. On this basis, the Chinese government has begun to adjust its policy focus and further optimise market mechanisms. As a continuation policy after the subsidy reduction, the "dual point" method was introduced in 2017 to incentivise traditional fuel vehicles to improve energy efficiency and promote the development of new energy vehicles through a point trading mechanism. In 2018, the restriction on foreign investment in the manufacturing of new energy vehicles was lifted, which not only posed challenges to China's independent brands of new energy vehicles but also provided opportunities for car companies to optimise related technologies and promote the internationalisation of independent brands.

Efficient and convenient charging facilities are the foundation for ensuring a good user experience for consumers. Therefore, the country vigorously promotes the construction scale of charging pile facilities. Observing the construction of charging infrastructure in China in recent years, it can be seen that by the end of 2023, the total number of charging infrastructure in China will reach 8.596 million units, an increase of 65% year-on-year. From an international perspective, China has built the world's largest number, the largest radiation area, and the most comprehensive charging infrastructure system for service vehicles [5].

3 Foreign Automotive Companies

3.1 Status and Challenges

Currently, the global automotive industry is experiencing a profound restructuring, in which the dynamics of the three core markets—namely the United States, Europe, and Asia—are of particular criticality. These markets collectively shape the transformation pressure and direction for international automobile enterprises. Electrification as the core trend is beyond doubt, but its path of advancement is full of twists and turns. Although Europe and the United States have significantly accelerated the popularisation of electric vehicles in recent years, as Klaus Stricker, Senior Global Partner and Chairman of Global Automotive Business at Bain&Company, pointed out in an interview, this momentum has shown signs of fatigue, with the US market progressing particularly slower than expected, and slowing growth becoming a significant obstacle [7]. In contrast, the Asian market, centred around China, driven by strong policies and supply chains, continues to lead the rapid increase in electrification penetration, forcing traditional European and American giants to accelerate their catch-up efforts.

Concurrently, the harsh economic landscape is exerting substantial pressure on the entire industry. The persistently escalating inflation rate has not only substantially augmented raw material, energy, and manufacturing costs but also notably elevated household living expenses. This dual impact has suppressed consumer purchasing propensity and capacity, thereby compressing the profit margins of automotive enterprises from both supply-side cost increases and demand-side consumption restraint. In this context, the profit landscape of the automotive industry chain has been undergoing subtle transformations. The bargaining power and profit distribution between traditional suppliers and vehicle manufacturers are facing pressures for restructuring. Amid the superimposition of multiple challenges, international automakers urgently need to seek breakthroughs in accelerating electrification, optimising cost structures, and adapting to the new industrial chain ecosystem. Transformation is no longer an option but a necessary path for survival and development.

3.2 Strategic Transformation for Foreign Automakers

Position Defining. Faced with operational challenges stemming from delayed technological transformation on the global stage, legacy automotive manufacturers and affiliated sectors must first strategically reassess their position. This necessitates measured compromises to achieve essential cost reduction and operational efficiency objectives.

Many companies related to the vehicle industry have closed their factories, for example Audi's factory in Brussels officially closed in February 2025. This 76-year-old factory, which once undertook the important mission of Audi's electrification transformation, is coming to an end [2]. The reduction of business premises will inevitably lead to a large number of layoffs, and many well-known car companies and component suppliers have announced large-scale layoff plans. Data shows that in 2024, the number of layoffs announced by various car companies has exceeded 10 thousand [8].

In the long term, electrification transformation is still a consensus among multinational car companies. Honda believes that pure electric vehicles will remain its core

pillar after 2030 [9]. However, due to the high cost of transitioning to electric vehicles, some car companies have had to slow down their pace of electrification. For example, Honda is reducing research and development of pure electric vehicles while focusing on increasing investment in hybrid vehicles. It plans to launch 13 next-generation hybrid models worldwide within four years starting from 2027. Honda will also upgrade its dual motor hybrid system and e: HEV hybrid platform to develop a hybrid system for large vehicles, with plans to launch it in the second half of the 2020s. It can be seen that many traditional foreign brands have made necessary adjustments for the survival of enterprises in the transformation and upgrading of car companies based on reality.

Market Focusing. Reducing costs and increasing efficiency is far from enough to allow these old foreign car companies to return to their peak. Many car companies that cooperate with Chinese companies to form joint venture brands have focused their transformation on the Chinese market.

Many enterprises are restructuring their research and development models, engaging in equal dialogue with China to promote mutual creation and win-win outcomes, which has become a common concept and pursuit for both domestic and foreign parties. In the context of innovative development, multinational brands are increasing investment in establishing automotive research & development & design centres in China, emphasising cooperation in research and manufacturing, and achieving a transition from "one-way input" to "joint output". For example, in March 2025, China's FAW and Volkswagen Group signed a strategic cooperation agreement in Germany. The two sides decided that from 2026, FAW Volkswagen and Jetta brands will add 11 new models tailored for the Chinese market in multiple segmented markets [2]. In April 2025, Toyota's wholly-owned Lexus pure electric vehicle and battery R&D and production company project in Shanghai officially landed, and announced the launch of a new R&D mechanism and the Chinese Chief Engineer system at the same time. This means that Toyota will integrate its research and development resources and fully consider the demands of the Chinese market, allowing local Chinese engineers to lead the development of new vehicle models [10].

Valuing China's R&D capabilities not only enables joint venture car companies to better align their products with the Chinese market but also helps multinational brands seize the initiative in the global automotive revolution and become a new engine driving global business growth to a certain extent.

4 Conclusion

Global car companies are facing profound transformation and upgrading pressures in the era of electrification, intelligence, and green transformation. Anchored in a dual perspective encompassing both domestic and international dimensions, this study analyses the core challenges faced by car companies and targeted solutions. From a domestic perspective, car companies are gradually breaking through key technological bottlenecks and building industrial development advantages through continuous increases in

technology research and development investment and strong support from policy systems. The comprehensive application of subsidy policies and other policy tools has created a good environment for industrial development, promoting domestic car companies to achieve overtaking in the transition to electrification. Under the challenges of slowing growth, high costs, and supply chain restructuring in the local market, foreign car companies have adopted more pragmatic strategic adjustments. By deepening their understanding of market trends and actively expanding cooperation with the Chinese market, foreign companies have responded to the dual pressures of technological change and market competition. This strategic reflects not only a clear judgment of the changes in the global industrial landscape, but also the important position of the Chinese market in the transformation of the global automotive industry. The conclusion of this study reveals the profound evolution of the global competition pattern in the automotive industry, offering guidance for policy formulation and corporate strategy.

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