Understanding Competitive Advantage Formation in the Automotive Industry: A Grounded Theory Study of Lighthouse Firms

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Abstract. This study examines competitive advantage formation in automotive industry lighthouse firms by conducting a multi-case analysis of representative listed companies, including CATL, GAC Group, SAIC Motor, and Guizhou Tyre. Based on textual data from annual reports covering the period 2020–2024, a grounded theory approach is employed to conduct three stages of coding: open coding, axial coding, and selective coding. Through this process, a pathway model of competitive advantage formation in the automotive industry is developed. The findings indicate that cost efficiency, technological and production innovation, brand positioning and market strategy constitute the three core pathways through which lighthouse firms build competitive advantages. Specifically, cost efficiency primarily supports cost leadership, technological and production innovation drives differentiation advantages, and brand positioning and market strategy strengthen focus advantages. In addition, industrial ecosystem collaboration and green and internationalization pathways play important supporting and reinforcing roles in sustaining competitive advantages. Within the theoretical framework of Porter's competitive strategy, this study systematically reveals the underlying mechanisms through which automotive lighthouse firms form competitive advantages and provide practical insights for manufacturing enterprises in formulating strategic choices under the context of digital transformation and high-quality development.

Keywords: competitive advantage; lighthouse firms; grounded theory; Porter's competitive strategy; automotive industry.

1 Introduction

The global automotive industry is undergoing a profound technological and industrial transformation, with its development focus gradually shifting from traditional internal combustion engines toward electrification, intelligent systems, and green development. In recent years, China's new energy vehicle (NEV) market has expanded rapidly. Significant progress has been made in areas such as battery power technology, intelligent manufacturing, and intelligent driving systems, and China has increasingly integrated

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into the global competition landscape. At the same time, the "Lighthouse Factory" initiative proposed by the World Economic Forum has set a benchmark for the digital and intelligent transformation of the manufacturing industry. They have demonstrated leading practices in automation, data-driven decision-making, and sustainable production.

The automotive industry is characterized by a long supply chain, high technical complexity, and capital-intensive operations. Under the dual pressures of global decarbonization and rapid technological iteration, it is facing continuous competitive pressure. Therefore, whether enterprises can establish stable competitive advantages through technological innovation, process optimization, and improvement of organizational capabilities has become a key issue in industrial upgrading. In recent years, a number of representatives "Lighthouse Factory" have emerged in the Chinese automotive industry. These enterprises have demonstrated unique development models in intelligent manufacturing, technological upgrading, and industrial collaboration, providing valuable empirical cases for studying the mechanisms of competitive advantage formation.

Existing research on firms' competitive advantages has laid a relatively systematic theoretical foundation. Classic strategic frameworks—most notably cost leadership, differentiation, and focus strategies—have been widely employed to account for firms' competitive positions. However, the vast majority of existing literature mainly focuses on classifying types of competitive advantages, while paying little attention to the dynamic process through which enterprises change their strategic actions and build their own advantages in the industry. Empirical research examining the formation process of competitive advantages under the conditions of digital manufacturing and industrial transformation is particularly scarce.

Against this background, this study focuses on automotive industry lighthouse firms and selects representative listed companies as case studies. Using a grounded theory approach, the study conducts a systematic analysis of firms' annual report texts to identify key strategic behaviors and trace their evolutionary pathways in the formation of competitive advantages. Specifically, this study seeks to address the following research questions: 1. What key behaviors do lighthouse firms exhibit in the process of forming competitive advantages? 2. How do these behaviors translate into competitive advantages through different strategic pathways? Through multi-case analysis, this study synthesizes the dominant patterns of competitive advantage formation in the automotive industry within a competitive strategy framework, with the aim of providing practical insights for manufacturing firms pursuing digital transformation and high-quality development.

2 Literature Review and Theoretical Background

2.1 Research on Firm-Level Competitive Advantage

Research on firm's competitive advantage can be traced back to the seminal work of Porter, who proposed that firms may achieve competitive advantage through three generic strategies: cost leadership, differentiation, and focus.[1] (Porter, Competitive Strategy: Techniques for analyzing industries and competitors, 1980). Porter further introduced the concept of the value chain as an analytical tool for examining how firms

create value across different operational activities.[2] (Porter, Competitive advantage: Creating and sustaining superior performance, 1985) These contributions laid a foundational framework for subsequent studies seeking to explain the sources and mechanisms of competitive advantage

Following this line of inquiry, scholarly attention gradually shifted from external industry structures to firms' internal resources and capabilities. Barney and Grant advanced the resource-based view (RBV), arguing that competitive advantage stems from firms' possession of valuable, rare, inimitable, and non-substitutable resources and core competencies.[3] (Grant, 1991) The RBV significantly enriched the literature on competitive advantage by directing analytical focus toward capability development and resource accumulation within firms, rather than solely emphasizing market structure and competitive positioning.

With the advancement of digital technologies, digital transformation has become a critical source of competitive advantage for manufacturing enterprises. [4] (Fang Xue, 2022) Recent studies indicate that transformation enhances operational efficiency while simultaneously enabling differentiation through innovation and value creation.[4,5] (Fang Xue, 2022; Lu & Shaharudin, 2024)However, recent research indicates that competitive advantage should be understood as the outcome of dynamic strategic actions. Nevertheless, empirical studies capturing this formation process in the context of manufacturing remain limited. [6] (Sui, Jiao, Wang, & Wang, 2024)

Overall, existing studies have provided rich insights into the sources of competitive advantage from perspectives including strategic typologies, resource capabilities, and technological change. Nevertheless, two notable gaps remain. First, much of the literature focuses on identifying what competitive advantages firms possess, while paying limited attention to how such advantages are gradually formed through a sequence of strategic actions. Second, empirical research examining the formation mechanisms of competitive advantage in the automotive industry, particularly among lighthouse firms under conditions of digital manufacturing, remains relatively scarce. These gaps highlight the need for case-based analysis that derives competitive advantage formation pathways from firms' actual strategic behaviors, thereby providing a clear motivation and entry point for the present study.

2.2 Theoretical Foundation

Among the various theoretical perspectives on competitive advantage, Porter's competitive advantage theory remains one of the most influential and widely applied frameworks. This study adopts Porter's theory as its primary theoretical foundation because it provides a clear and systematic explanation of how firms develop competitive advantages through different strategic pathways. In particular, the framework offers strong analytical compatibility for examining the strategic behaviors of lighthouse firms operating in complex and technology-intensive industries.

Beyond the three generic competitive strategies, Porter's value chain analysis further emphasizes that competitive advantage does not originate from a single activity, but rather from the systematic coordination among multiple value-creating activities, in-

cluding procurement, production, research and development, and marketing. By optimizing key activities or strengthening the linkages among them, firms can enhance overall efficiency and differentiation, thereby achieving stronger and more sustainable competitive advantages.

Although alternative perspectives such as the resource-based view and dynamic capability theory provide valuable insights into competitive advantage—especially by highlighting firms' capability development and adaptability to environmental change—these theories tend to remain relatively abstract when explaining how specific competitive advantage formation pathways can be empirically identified. In contrast, Porter's competitive strategy framework offers a more explicit classification of strategic orientations, pathways, and behavioral mechanisms, making it particularly suitable for analyzing the concrete processes through which competitive advantages emerge.

Based on this theoretical foundation, the present study applies Porter's cost leadership, differentiation, and focus framework to analyze the strategic behaviors of four automotive industry lighthouse firms. By combining this framework with systematic analysis of publicly disclosed textual data, the study aims to extract concrete pathways of competitive advantage formation, thereby providing a solid theoretical basis for the subsequent case analysis.

2.3 Analytical Framework

As demonstrated in the preceding literature review and theoretical discussion, the three generic strategies proposed by Michael Porter—cost leadership, differentiation, and focus—provide a clear analytical lens for understanding how firms achieve competitive advantage. These strategies capture the primary ways through which firms position themselves in competitive markets. Building on this theoretical foundation, this study develops an analytical framework to examine the process through which automotive industry lighthouse firms form competitive advantages.

First, the cost leadership strategy emphasizes reducing unit costs by improving production efficiency, lowering operating costs, and optimizing supply chains. In the context of the automotive industry, cost advantages are often derived from intelligent manufacturing systems, automation technologies, economies of scale, and effective resource integration. Accordingly, in the empirical analysis, cost leadership is operationalized as cost efficiency or operational efficiency advantages.

Secondly, the differentiation strategy focuses on the uniqueness of products and technologies. In the modern automotive industry, common sources of differentiation include advanced power sources, intelligent driving systems, innovative product designs, or digital entertainment systems. [5] (Lu & Shaharudin, 2024)Based on this logic, this study conceptualizes the differentiation advantage as technological innovation, product performance, and intelligent system capabilities, which reflect different manifestations of value creation beyond price competition.

Third, the focus strategy highlights firms' concentration on specific market segments or product niches to develop specialized capabilities. In the cases of automotive lighthouse firms, focus strategies are frequently reflected in sustained investments in particular segments, such as power batteries, commercial vehicles, or specific new energy

vehicle niches. Through long-term specialization, firms are able to build niche leadership or specialized competitive advantages within targeted markets.

Based on these three strategic orientations, this study integrates Porter's competitive strategy framework with qualitative data analysis. By conducting systematic textual analysis of annual reports from four automotive lighthouse firms, the study identifies concrete strategic behaviors and maps them onto different types of competitive advantage. Through this approach, the analytical framework not only explains the theoretical sources of competitive advantage but also captures the practical pathways through which such advantages are formed in real-world contexts, thereby establishing a competitive advantage framework tailored to the automotive industry.

The analytical framework is illustrated in Figure 1.

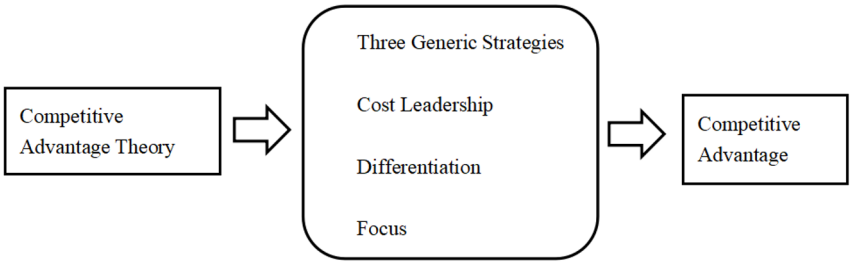

Fig. 1. Porter's Competitive Advantage Analysis Framework

3 Case Selection

To ensure the scientific rigor and representativeness of the research findings, this study follows four key principles in case selection: theoretical relevance, industry representativeness, data availability, and diversity.

First, in terms of theoretical relevance, this study focuses on the pathways through which firms form competitive advantages. Accordingly, it selects lighthouse factories with distinctive competitive advantages and clear strategic transformation characteristics as the research objects. Lighthouse factories are recognized as benchmarks of digital manufacturing jointly identified by the World Economic Forum and McKinsey & Company, representing leading practices in technological innovation, intelligent manufacturing, and sustainable development. As such, they are well aligned with the theoretical objectives of this study, which seeks to explore the mechanisms underlying competitive advantage formation.

Second, with respect to industry representativeness, the automotive industry is widely regarded as one of the most technology-intensive and complex manufacturing sectors, characterized by long industrial chains and strong interdependencies among upstream and downstream actors. Selecting automotive lighthouse firms as research samples allows this study to systematically capture how manufacturing enterprises build competitive advantages amid digitalization, green transformation, and intelligent

upgrading, thereby reflecting typical competitive and collaborative dynamics within advanced manufacturing industries.

Third, in terms of data availability, all sample firms are publicly listed companies whose annual reports provide comprehensive and standardized disclosures on strategic planning, research and development investment, organizational transformation, and sustainability initiatives. This ensures the reliability and verifiability of the data sources. Annual reports from 2020 to 2024 serve as the primary data for analysis. In total, 20 annual reports were examined, from which 388 original text segments were extracted through sentence-by-sentence screening. These data were subsequently analyzed using grounded theory methods, including open coding, axial coding, and selective coding, until theoretical saturation was achieved.

Finally, regarding diversity and comparability, the selected cases encompass a range of firm types, including leading new energy battery manufacturers, large state-owned automotive groups, mixed-ownership enterprises, and medium-sized manufacturing firms. This diversified sample structure enables meaningful cross-case comparison while also revealing heterogeneous pathways through which different strategic orientations contribute to competitive advantage formation.

Table 1. Overview of Sample Firms

Firm Code	Company Name	Stock Code	Abbreviation	Industry	Description
A	Contemporary Amperex Technology Co., Limited	300750	CATL	New Energy	Global leader in power battery manufacturing
B	Guangzhou Automobile Group Co., Ltd.	601238	GAC Group	Automotive	State-owned automotive group
C	SAIC Motor Corporation Limited	600104	SAIC Motor	Automotive	Largest automotive group in China
D	Guizhou Tyre Co., Ltd.	000589	Guizhou Tyre	Automotive Components	Specialized tyre manufacturer

As shown in Table 1, the four sample firms differ markedly in terms of firm size, business structure, industry position, and strategic orientation. Such heterogeneity ensures both the representativeness and comparability of the sample, thereby strengthening the analytical value of this study.

First, Contemporary Amperex Technology Co., Limited (CATL) is a global leader in the power battery industry and has ranked first worldwide in installed power battery capacity for several consecutive years. It is widely regarded as a symbol of China's global competitiveness in the new energy sector. CATL has established a comprehensive layout across battery materials, system integration, and energy storage, and is well known for its intensive R&D investment and strong technological innovation capabilities. Given its central position in the new energy supply chain, CATL provides extensive and detailed disclosures, offering rich textual data for analyzing competitive advantage formation.

Second, Guangzhou Automobile Group (GAC Group) represents a typical large state-owned automotive enterprise. Its business scope covers vehicle manufacturing,

new energy vehicles, commercial vehicles, and automotive components. GAC Group's competitive strengths lie primarily in its system-level R&D capabilities, strong access to policy-related resources, and the organizational stability associated with state ownership, particularly in governance structures and supply chain management. As such, the GAC case enables an examination of how state-owned enterprises achieve transformation toward electrification and intelligent mobility based on a traditional automotive foundation.

Third, SAIC Motor is one of the largest automotive groups in China and among the earliest domestic firms to engage in international cooperation and overseas market expansion. Its long-standing joint venture experience with multinational automakers such as Volkswagen and General Motors has contributed to distinctive advantages in management systems, production standards, and quality control. At the same time, SAIC has actively pursued parallel development strategies in proprietary brands, intelligent driving technologies, and vehicle exports. As a representative mixed-ownership enterprise, SAIC offers valuable insights into diversified pathways of competitive advantage formation under complex organizational structures. Compared with GAC Group, differences in strategic configuration, organizational design, and market orientation further enhance its value for cross-case comparison.

Finally, Guizhou Tyre represents a medium-sized manufacturing enterprise, with its core products concentrated in niche segments such as specialty tires and engineering machinery tires. Although its scale is smaller than that of the battery and vehicle manufacturing giants, Guizhou Tyre exhibits strong typicality in areas such as product specialization, green manufacturing, and intelligent production line upgrading. Its case reflects the common transformation pathways of small and medium-sized manufacturing firms undergoing digital and green transitions, thereby complementing the sample structure in terms of firm size and ownership type.

In summary, the four firms respectively represent a core new energy supply chain leader (Firm A), a large state-owned automotive manufacturer (Firm B), a diversified mixed-ownership automotive group (Firm C), and a medium-sized specialized manufacturing enterprise (Firm D). This diversified sample structure not only facilitates the identification of common pathways through which competitive advantages are formed but also enables systematic comparison of differentiated strategic patterns across firm types, thereby enhancing the explanatory power of this study.

4 Research Methodology

4.1 Research Method: Grounded Theory Coding

This study uses grounded theory as its main research methodology in order to provide a thorough knowledge of the crucial processes by which lighthouse enterprises in the automobile sector create competitive advantages [7] (Glaser & Strauss, 1967). Originally created by Barney Glaser and Anselm Strauss in 1967, grounded theory is a qualitative research methodology that prioritizes developing theories via methodical exam-

ination of actual data. Rather than testing predefined hypotheses, grounded theory derives concepts and theoretical insights directly from raw textual materials through continuous comparison, abstraction, and categorization.

The formation of competitive advantage in lighthouse firms is inherently process-oriented, evolutionary, and mechanism-based, making it difficult to explain solely through existing theoretical models. As such, it is necessary to extract original narratives from first-hand sources, such as firms' annual reports, and to identify recurring strategic behaviors through systematic coding procedures. Grounded theory coding provides an appropriate methodological pathway for capturing these dynamic processes and uncovering underlying strategic patterns.

In summary, given the complexity and dynamism of competitive advantage formation among automotive lighthouse firms, grounded theory offers a suitable and rigorous research tool. It enables the systematic extraction of competitive advantage formation pathways from large-scale textual data, thereby laying a solid methodological foundation for subsequent analysis.

4.2 Data Sources and Analytical Procedure

To ensure the reliability and representativeness of the research findings, this study employs publicly disclosed annual report texts as its primary data source. Compared with news reports or secondary materials, annual reports of listed companies are authoritative, comprehensive, and structurally standardized, providing detailed information on firms' strategic decisions, operational conditions, and future development plans. Consequently, using annual reports as the data foundation facilitates a more accurate capture of firms' strategic behaviors and underlying competitive logic.

The study focuses on four automotive industry lighthouse firms—CATL (Firm A), GAC Group (Firm B), SAIC Motor (Firm C), and Guizhou Tyre (Firm D). For each firm, five annual reports from 2020 to 2024 were collected, resulting in a total of 20 textual documents for analysis. (Table 2)

Prior to formal coding, all texts were subjected to an initial reading to familiarize the researchers with each firm's basic characteristics, strategic orientation, and key business developments. Subsequently, the texts were examined paragraph by paragraph, and statements related to strategic planning, R&D investment, organizational transformation, technological upgrading, ecosystem collaboration, and international expansion were selected for further analysis.

During the data preparation stage, a total of 388 original text segments were extracted on the analytical basis. Each segment was labeled with the source firm, year, and paragraph location to ensure traceability. Following the procedures of grounded theory, the data were then systematically analyzed through open coding, axial coding, and selective coding.

Throughout the analytical process, constant comparison was conducted to verify that the derived concepts and categories accurately reflected firms' strategic behaviors. Moreover, given the differences in firm type and scale among the four cases, their competitive advantage formation pathways exhibit a degree of complementarity, providing rich material for subsequent cross-case analysis.

Table 2. Word Count Statistics of Annual Reports

Firms	Year	Words	Total
CATL	2020	176,406	935,287
	2021	175,688	
	2022	185,863	
	2023	202,032	
	2024	195,298	
Guizhou Tyre	2020	156,467	894,916
	2021	169,012	
	2022	181,962	
	2023	197,554	
	2024	189,921	
SAIC Motor	2020	211,477	1,128,870
	2021	234,805	
	2022	227,805	
	2023	221,713	
	2024	233,070	
GAC Group	2020	206,489	1,071,117
	2021	209,263	
	2022	217,970	
	2023	221,439	
	2024	215,956	
Total			4,030,190

4.3 Open Coding Analysis

Open coding represents the initial stage of grounded theory analysis, during which raw textual data are systematically abstracted into conceptual categories. In this study, original text segments related to firms' strategic initiatives, technological progress, production models, organizational transformation, and business performance were examined line by line and subjected to segmentation, comparison, classification, and conceptualization.

Based on this procedure, a total of 26 initial concepts were extracted from 388 original text segments, capturing key behavioral characteristics associated with the formation of competitive advantages. These concepts reflect recurring patterns in firms' strategic actions and operational practices observed across the sample cases. The results of the open coding process, including the derived concepts and corresponding categories, are summarized in Table 3.

Table 3. Open Coding Concepts and Raw Data (Partial Display)

Initial Concept	Firm	Representative Raw Text
Patent accumulation	A	By the end of 2020, the company and its subsidiaries owned 2,969 domestic patents and 348 overseas patents
Breakthrough in NEV battery technology	A	The company released its first-generation sodium-ion battery
Increased R&D investment	A	R&D expenditure reached RMB 7.7 billion, accounting for 6.27% of operating revenue
Zero-carbon factory	A	The Yibin plant in Sichuan was recognized as the world's first zero-carbon battery factory
Battery technology breakthrough	A	The company launched Qilin battery with system integration efficiency reaching 72%
Growth in international revenue	A	Overseas revenue accounted for 41% of total revenue
Frontier battery innovation	A	The company introduced condensed-state batteries, improving energy density by 50%
Intelligent connected R&D	B	The group independently developed the ADiGO intelligent connectivity system
Breakthrough in driving range	B	AION LX Plus achieved a CLTC range of 1008 km
Brand independence	B	GAC Aion operates independently, establishing a premium intelligent EV brand positioning
Cross-industry collaboration	B	Signed deep strategic cooperation agreement with Huawei to jointly develop premium intelligent NEVs
Fuel cell application	C	SAIC MAXUS EUNIQ7 became the first to adopt a self-developed fuel cell system
Autonomous driving application	C	Robotaxi projects conducted pilot operations in Shanghai and Suzhou
R&D system development	C	Established the Innovation Research Institute, building seven core technology platforms
International expansion	C	Overseas sales exceeded one million units, increasing by 45.9% year-on-year
Battery technology collaboration	C	Joint venture with QingTao Energy to develop solid-state batteries
Product innovation	C	SAIC MAXUS launched MIFA X, opening a new era of electric off-road vehicles
Intelligent driving breakthrough	C	IM vehicles deployed urban NOA assisted driving functions
Intelligent manufacturing transformation	D	Implemented MES and APS systems comprehensively
Overseas production layout	D	Vietnam plant with annual capacity of 1.2 million all-steel tyres reached 70% completion
5G smart factory	D	Built a fully connected 5G factory in cooperation with China Unicom

Initial Concept	Firm	Representative Raw Text
Export growth	D	Export revenue accounted for 27.32%, increasing by 52.71% year-on-year
National green factory	D	Recognized by MIIT as a National Green Factory
Increased R&D investment	D	R&D investment reached RMB 263 million, accounting for 3.12% of revenue
NEV tyre products	D	Launched EV-specific tyres to serve the NEV market
Financial growth	D	Operating revenue exceeded RMB 10 billion

4.4 Axial Coding Analysis

Axial coding represents the second stage of grounded theory analysis, in which relationships and similarities among initial concepts are systematically examined in order to develop higher-level categories. Given the relatively large number of initial concepts and the partial overlap in their meanings, this study conducted logical comparison and conceptual refinement to integrate related concepts into more abstract categories.

Through this process, the 26 initial concepts were consolidated into nine main categories, including technological research and innovation, digitalization and intelligent manufacturing, green transformation, international market expansion, and scale-based cost control, among others. These main categories capture broader strategic dimensions underlying firms' competitive behaviors while preserving the essential meaning of the original concepts.

The results of the axial coding process, including the relationships between main categories and their corresponding subcategories, are presented in Table 4.

Table 4. Axial Coding Categories and Representatives Concepts

Main Category	Subcategories	Representative Concepts (Firm–Year)
Technological R&D and Innovation	Battery breakthroughs; fuel cell application; autonomous driving; R&D investment; new model development; diversified product lines	A–2021 (Sodium-ion battery) A–2024 (Condensed-state battery) C–2021 (Robotaxi) D–2024 (EV tyres)
Digitalization and Intelligent Manufacturing	Intelligent manufacturing systems; 5G factories; automated production	D–2021 (5G factory) B–2020 (Digital transformation)
Green Transformation	Zero-carbon factories; green product certification; NEV tyres	A–2022 (Zero-carbon factory) D–2022 (Green factory)
International Market Expansion	Export growth; overseas production; international revenue	A–2023 (41% overseas revenue) C–2022 (Overseas sales >1 million units)
Scale-based Cost Control	Capacity expansion; cost reduction; financial growth	B–2020 (NEV sales growth) D–2020 (Vietnam plant)
Brand and Organizational Capability	Brand independence; strategic integration; digital branding	B–2022 (Aion brand independence) C–2024 (MAXUS MIFA X)

Main Category	Subcategories	Representative Concepts (Firm–Year)
Industrial Ecosystem Collaboration	Cross-industry cooperation; supply chain collaboration	B–2024 (Huawei collaboration) C–2023 (QingTao Energy)
Capital Support	Financing expansion; capital operation; shareholder returns	C–2022 (Capital expansion) D–2024 (Revenue growth)
After-sales Service Enhancement	Channel optimization; service model innovation	D–2020 (Channel development) C–2020 (Service innovation)

4.5 Selective Coding Analysis

Selective coding constitutes the final stage of grounded theory analysis, in which the relationships among categories are systematically examined to integrate main categories into higher-level core categories. By conducting an in-depth analysis of the nine main categories and their underlying conceptual content, this study identifies clear clustering patterns in terms of directional orientation and functional roles among the categories.

As a result, the main categories were further integrated into five core categories, namely cost efficiency, technological and production innovation, focus positioning, industrial ecosystem collaboration, and green and internationalization pathways. These core categories collectively capture the key pathways through which automotive industry lighthouse firms form competitive advantages.

The results of the selective coding process, including the relationships between core categories and their associated subcategories, are summarized in Table 5.

Table 5. Selective Coding Categories and Competitive Advantage Outcomes

Core Category	Subcategories	Source of Competitive Advantage	Resulting Competitive Advantage
Cost Efficiency	Scale-based cost control; capital support	Cost Leadership	Co st advantage (cost control, expanded market share, improved capacity utilization)
Technological and Production Innovation	Technological R&D; intelligent manufacturing	Differentiation	Differentiation advantage (technological barriers, productivity improvement, product premium)
Green and Internationalization	Green transformation; international expansion	Differentiation	Differentiation advantage (global resource integration, sustainability, international competitiveness)
Industrial Ecosystem Collaboration	Supply chain collaboration	Focus	Focus advantage (resource sharing, ecosystem integration, systemic competitiveness)
Brand Positioning and Market Strategy	Brand capability; after-sales service; product diversification	Focus	Focus advantage (niche market focus, brand value, customer loyalty)

4.6 Analysis Results

This study finds five fundamental categories that describe the major paths by which lighthouse enterprises in the automotive industry establish competitive advantages, using the three stages of grounded theory analysis: open coding, axial coding, and selective coding. Importantly, these pathways exhibit a high degree of logical alignment with the three generic strategies proposed by Michael Porter—cost leadership, differentiation, and focus—and together constitute stable sources of competitive advantage. By integrating the results of grounded theory analysis with Porter's competitive advantage framework, a competitive advantage formation model is constructed, as illustrated in Figure 2.

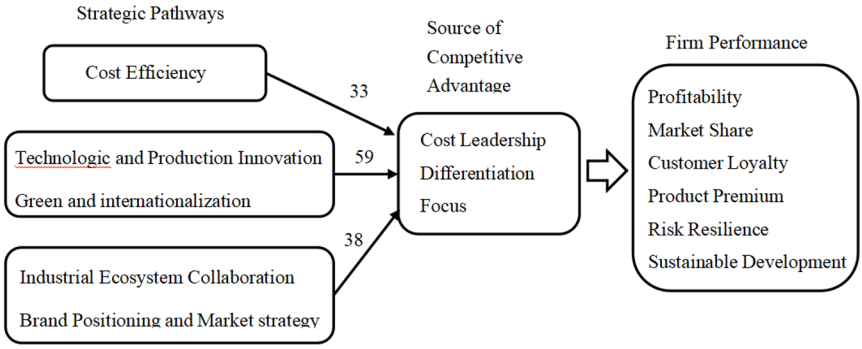

Fig. 2. Pathways of Competitive Advantage Formation in Lighthouse Firms

Firstly, cost-effectiveness can bring about a cost leadership advantage. This path includes subcategories such as cost control, capacity expansion, and capital support. By expanding production scale, improving operational efficiency, and reducing unit costs, enterprises can gain a low-cost advantage, thereby increasing market share and price competitiveness.

Secondly, technological and production innovation, along with the green and internationalization paths, helps to form a differentiated advantage. This finding is consistent with recent studies suggesting that sustainability-oriented digital transformation can reinforce firms' long-term competitive advantage. [8] (Van Hoang, Thi Hien, Van Thang, Nguyen Truc Phuong, & Thi-Thuy Duong, 2025) Unlike cost-based competition, a differentiated advantage stems from value premiums brought about by technological barriers, superior product performance, green attributes, and the integration of international resources. Case evidence clearly illustrates this path. For instance, CATL's Qilin battery technology, SAIC Motor's autonomous driving platform, and GAC Group's breakthroughs in ultra-fast charging and solid-state battery technologies all demonstrate differentiation driven by technological and production innovation.

Finally, focus positioning and industrial ecosystem collaboration jointly foster focus advantages. These pathways strengthen firms' deep engagement in specific market segments, customer groups, or industrial ecosystems, thereby reinforcing focus strategies.

Focus advantages are achieved through mechanisms such as brand independence, service specialization, and ecosystem-based collaboration, which raise entry barriers within niche markets. Representative examples include the independent branding strategy of GAC Aion and collaborative initiatives in solid-state battery development involving SAIC and clean energy partners.

In addition, among the 388 original text segments analyzed, the distribution of coded statements across the four sample firms is summarized in Table 3**,** providing further empirical support for the relative prominence of different competitive advantage pathways across firm types.

5 Conclusions

Based on the annual reports of four automotive industry lighthouse firms, Contemporary Amperex Technology Co., Limited, Guangzhou Automobile Group, SAIC Motor, and Guizhou Tyre, covering the period from 2020 to 2024, this study systematically examines the process through which firms form competitive advantages using grounded theory. Through open coding, axial coding, and selective coding, five competitive advantage formation pathways are identified and subsequently mapped onto the cost leadership, differentiation, and focus strategies within Michael Porter's competitive strategy framework. On this basis, a theoretical model of competitive advantage formation for automotive industry lighthouse firms is constructed.

The findings indicate that competitive advantages among automotive lighthouse firms do not arise from a single strategic choice but rather emerge through the synergistic interaction of multiple pathways. The competitive advantage formation pathways identified in this study are also aligned with recent discussions on structural transformation and digital upgrading in the global automotive industry. [9] (Bernhard Koelmel, 2025) Among these, the cost efficiency pathway, the technological and production innovation pathway, and the brand positioning and market strategy pathway are the most prominent and constitute the core mechanisms through which competitive advantages are formed.

In summary, the formation of competitive advantages among automotive industry lighthouse firms is a multi-path, co-evolutionary process, in which cost efficiency, technological and production innovation, and brand positioning and market strategy constitute the most decisive pathways. These findings not only deepen the understanding of the applicability of Porter's competitive strategy framework in the context of digital transformation in manufacturing but also offer practical insights for automotive firms and manufacturing enterprises more broadly when formulating competitive strategies during periods of industrial upgrading and high-quality development.

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