ISSN: 2688-9323

The Impact of Digital Transformation on Enterprise Performance: The Case of Tesla

Qingyin Huang*

School of Economics and Management, Xiamen University of Technology, Xiamen, 361024, China

*Email: maggie2210111112@163.com

Abstract

Under the dual background of the fourth industrial revolution and the goal of global carbon neutrality, digital transformation has become the core path for enterprises to build sustainable competitive advantage. This paper selects Tesla, a world-renowned electric vehicle and clean energy enterprise, as a case study, and uses the case study method to deeply analyze its systematic digital transformation practice through technology, organization and business model. Through the vertical and horizontal analysis of the financial reports, industry data and official documents of enterprises, this paper reveals how the digital transformation can significantly improve the financial and non-financial performance of enterprises through the four key paths of "intelligent manufacturing cost reduction and efficiency increase", "software defined automobile to create sustainable income", "direct marketing mode to strengthen user direct connection" and "energy ecological synergy". The study found that Tesla's digital transformation not only realized the optimization of revenue structure, the improvement of profit margin and capital efficiency, but also built a technical barrier and brand moat with data assets and algorithm capabilities as the core. At the same time, its digital ability effectively enables the performance of Environmental (E), Social (S) and Governance (G) dimensions, forming the synergy between business value and sustainable development goals. Under the background of digitalization, this study expands the application scope of resource-based view and dynamic capability theory, and provides systematic transformation enlightenment covering technical route, organizational change and ecological construction for traditional manufacturing enterprises, especially the automotive industry.

Keywords

Digital Transformation; Enterprise Performance; Tesla; ESG.

1. Introduction

1.1. Research Background and Practical Significance

With the rapid development of artificial intelligence, Internet of things, big data and other technologies, the world is stepping into the fourth industrial revolution characterized by digitalization and intelligence[1] . In this case, enterprises are under the pressure of strategic transformation from efficiency oriented to innovation oriented. Digital transformation has gone beyond the scope of pure technology upgrading. It involves the all-round remodeling of organizational capabilities, business models and value networks. Especially in the automotive industry, a typical capital and technology intensive industry, the trend of electrification, intelligence and networking has accelerated the disintegration and remodeling of the traditional value chain. Digital transformation has become the key path for enterprises to obtain sustainable competitive advantage.

ISSN: 2688-9323

At present, with the global initiative to achieve the goal of carbon neutrality and the growing awareness of corporate social responsibility, ESG performance has increasingly become an important dimension to measure the long-term value of enterprises. How to coordinate digital transformation with ESG goals has become a new topic for enterprise strategy formulation and academic research. This study selects Tesla as a typical case to systematically explore the multi-dimensional impact of digital transformation on enterprise performance, which has both theoretical and practical significance[2] .

As a typical capital and technology intensive industry, the digital transformation of the automotive industry is characterized by "hardware softening, service value-added and ecological extension".As shown in Table 1 although traditional automobile manufacturers, such as Toyota and Volkswagen, have started digital transformation, they still face deep challenges such as organizational inertia and technological path dependence. The new power enterprises represented by Tesla, relying on their innate digital genes, have built an integrated ecosystem of "vehicle energy data", realizing the transition from product providers to mobile service platforms. This differentiated transformation path and its differentiated impact on enterprise performance provide a natural experimental field for academic research[3].

Table 1. Comparative Analysis of Digital Transformation in the Global Automotive Industry

Dimension	Traditional Automobile enterprises (take Toyota as an example)	New power auto enterprises (take Tesla as an example)	Difference in Transformation Effect
Technology Approach	Gradual improvement, relying on suppliers	Radical innovation and vertically integrated R&D	Tesla technology iteration speed is 3-5 years ahead
Business Model	Focus on hardware sales, dealer system	Hardware + software + service, direct selling mode	Tesla software has a gross profit margin of more than 80%
Data Application	Local data collection, limited analysis	Full lifecycle data closed loop	Tesla processes more than 100pb of data annually
Organizational Structure	Clear hierarchy and division of departments	Flat, cross functional team	Tesla decision making efficiency increased by 40%

1.2. Research Objectives and Theoretical Value

This study selects Tesla as a typical case to systematically analyze the mechanism of its digital transformation on enterprise performance, aiming to achieve three levels of goals:

At the theoretical level, this study attempts to expand the interpretation boundary of resource-based view and dynamic capability theory in the digital context. Traditional theories mostly focus on tangible resources and static capabilities, but in the era of digital economy, data assets, algorithm capabilities and digital ecology have become new sources of core competitiveness. This study provides a new theoretical perspective for understanding the competitive advantage of enterprises in the digital era by constructing the analytical framework of "Digital Resources - Dynamic Capabilities - niche construction".

In practice, Tesla, as a benchmark enterprise for global digital transformation, its unique practice provides transformation experience for traditional manufacturing enterprises. This study will break down Tesla's specific practices in key areas such as intelligent manufacturing, software defined automobiles, direct marketing mode, and energy ecology in detail, extract the success factors such as the pace of technology investment, organizational culture adaptation, and data governance architecture, and form a systematic transformation roadmap.

At the social level, under the background that the "double carbon" goal has become a global consensus, it is of great practical significance to explore the collaborative path of digitalization and greening. Tesla uses digital technology to carry out precise carbon management and build

ISSN: 2688-9323

a clean energy closed loop, which provides a demonstration for enterprises to achieve the dual improvement of economic and environmental benefits. This study will deeply study this synergy mechanism and provide theoretical support for the green transformation of industry.

1.3. Research Innovation

First of all, in terms of case selection, Tesla is one of the few enterprises worldwide that have achieved digitalization in the whole value chain, including R&D, manufacturing, sales and services. Its unique vertical integration mode, software defined vehicle technology route, and ecological synergy of energy and vehicle constitute a digital closed loop that is difficult to replicate. Unlike most studies that focus on a segment of digital transformation, this paper makes a panoramic analysis of Tesla's transformation, revealing the systemic nature and complexity of digital transformation.

Secondly, from the perspective of research, the existing literature focuses on the impact of digital transformation on financial performance and innovation performance, and pays relatively little attention to ESG performance. This study incorporated the ESG dimension into the analysis framework, and in-depth studied how the digital transformation can enhance the sustainable development ability of enterprises by means of precise carbon management, technology popularization and promotion, data openness and transparency, and made up for the deficiencies of existing research. Combined with Tesla's Localization Practice in China and other emerging markets, this paper puts forward the transformation strategy of technological transition and ecological co construction to make up for the lack of attention to emerging markets in existing research.

Finally, at the theoretical level, this study proposes a "Technology Organization Ecology" Trinity digital transformation analysis framework. The framework not only focuses on the technology application itself, but also emphasizes the collaborative evolution of technology, organizational structure and business ecology, providing a new theoretical tool for understanding the deep mechanism of digital transformation[4] .

2. Literature Review

2.1. Impact Mechanism of Digital Transformation on Enterprise Performance

Academic research on the relationship between digital transformation and enterprise performance has formed a multidimensional exploration pattern. From the perspective of impact path, digital transformation mainly affects enterprise performance through three core mechanisms: efficiency improvement, innovation driven and cost optimization.

In terms of financial performance, Chi Renyong et al. (2022) found that the digitalization of manufacturing process and business model have a positive effect on the financial performance of enterprises, and the synergy effect of dual digitalization is more significant. Their empirical research shows that the return on assets (ROA) of enterprises implementing comprehensive digital transformation is 15-20% higher on average than that of enterprises implementing single dimension digital transformation. This discovery reveals the systematic value of digital transformation - only when technology application and business model innovation form a joint force, can we maximize financial benefits[5] .

In the field of innovation performance, Li Xiaojing and Jiang Lingduo (2023) pointed out that digital transformation can improve innovation performance by promoting the intermediary role of enterprise innovation. Their research shows that for each standard deviation of digital level, the patent output intensity of enterprises increases by about 18%, and the proportion of new product sales revenue increases by 12%[6] . It is particularly noteworthy that there is industry heterogeneity in this promotion effect: Jin Yu et al. (2022) found that in the high-tech

ISSN: 2688-9323

industry, the promotion effect of digital transformation on green innovation is more obvious, while in the traditional manufacturing industry, this effect is relatively weak[7] .

In terms of environmental performance, the existing research shows a significant theoretical gap. Li (2022)'s preliminary exploration shows that the impact of digital transformation on environmental performance presents an inverted U-shaped curve - in the early stage of transformation, digitalization reduces resource consumption through process optimization; However, with the deepening of digitalization, problems such as data center energy consumption and electronic waste may offset some environmental benefits. This finding suggests that we need to analyze the complex relationship between digital transformation and environmental performance more finely[8].

2.2. Research Status of Digital Transformation of Automotive Industry

The research on the digital transformation of the automotive industry mainly focuses on three aspects: technology path, business model and industrial ecology.

On the technical path, software defined vehicle (SDV) has become a consensus direction. Traditional car companies such as Volkswagen Group have invested 27billion euros to build the software department cariad, aiming to increase the proportion of independent software research and development to 60% by 2025. However, this transformation faces great challenges - Volkswagen id.3 model was delayed due to software problems, exposing the weakness of traditional car companies in software development capability. In contrast, Tesla has realized the continuous evolution of vehicles through OTA (air upgrade). Its FSD (fully autonomous driving) system has been iterated to V13 version, and the intervention mileage has been increased by 5 to 6 times.

In the field of business model innovation, subscription service has become a new revenue growth point. BMW's "function on demand subscription" mode allows users to unlock seat heating, adaptive cruise and other functions at a cost, but it has been resisted by consumers. Tesla's FSD subscription service is more successful. By the end of 2024, more than 400000 users had participated in the FSD beta test. This difference stems from their different value proposition - Tesla's FSD is regarded as the core technology experience, while BMW's subscription function is more about the split sales of basic configurations.

Table 2. Comparison of Key Indicators of Digital Transformation of Major Automobile Enterprises in 2024

Index	Tesla	Volkswagen Group	Toyota Motor	BYD
Proportion of software R&D investment	About 15%	About 10%	About 8%	About 12%
OTA update frequency	Multiple times per month	2-3 times a year	1-2 times a year	Once a quarter
Proportion of software revenue	3.37%	<1%	<0.5%	<1%
Number of data acquisition vehicles	About 1.8 million	About 500000 vehicles	About 300000 vehicles	About 1million vehicles
AI computing power input	About 50000 H100 chips	About 5000 GPU	About 3000 GPU	About 10000 GPU

In the construction of industrial ecology, the charging network has become the focus of competition. Tesla has built more than 50000 super charging piles around the world, with more than 10600 new ones in 2024. It has provided 5.2 TWH charging services, which is equivalent to reducing 5.5 billion kg of carbon dioxide emissions. The advantages of this infrastructure not only enhance the user experience, but also build an ecological barrier. If other car companies

ISSN: 2688-9323

want to layout the charging network, they need to invest a lot of money to build their own or access the network system formed by Tesla.

2.3. Research Gap and Theoretical Enlightenment

Although the existing research has achieved fruitful results, there are still three obvious theoretical gaps:

At present, there is a lack of in-depth case study on the digital transformation path of technology intensive enterprises. Most studies use large sample statistical method, which is difficult to capture the dynamic process and context specificity of digital transformation. As a model of technology driven enterprises, Tesla's transformation process completely shows the path from technology breakthrough to business success, and provides a good case for related research.

Secondly, there is insufficient discussion on the correlation mechanism between digital transformation and non-financial performance, especially ESG. At present, most of the existing literatures focus on environmental performance, but pay limited attention to social performance, such as employment structure, technology inclusion and governance performance, such as data security and transparent operation. Tesla has innovative practice in the three dimensions of ESG, which provides material for systematic research[9] .

Finally, there are relatively few studies on the systematic impact of digital transformation from the perspective of value chain integration and ecological synergy. Digital transformation is not a simple technology application. It needs to rebuild the entire value chain of enterprise research and development, production, sales, services and so on. At the same time, it also needs to reshape the relationship between enterprises and suppliers, customers and partners. Tesla's vertical integration mode and ecological construction practice provide a window for understanding this systematic impact[10] .

3. Tesla Digital Transformation Path Analysis

3.1. Case Background

Founded in 2003, Tesla is a global leader in the field of electric vehicles and clean energy. With the mission of "accelerating the transformation of the world to sustainable energy", the enterprise has built a digital ecosystem covering the whole process of energy production, storage and consumption through vertically integrated R&D system, highly automated manufacturing plants, direct sales network and software driven service mode. Tesla's digital transformation is not a simple technology application, but a comprehensive and systematic reconstruction of strategy, organization and operation, so that it can continue to maintain its technological leadership and market appeal in the highly competitive automotive industry.

3.2. Technology Driven Reconstruction of the Whole Value Chain

Tesla's digital transformation begins with the fundamental reconstruction of the underlying technology. In the manufacturing process, through self-developed production lines, large-scale application of industrial robots, and the construction of "super factories", it has realized the automation and intelligence of the production process, significantly reduced the unit cost and improved the productivity elasticity. In R&D, Tesla adheres to the concept of software defined vehicle (SDV), continuously optimizes vehicle performance and user experience through OTA (air upgrade), and constructs a sustainable revenue model of "hardware embedding + software unlocking". In the supply chain, Tesla realized end-to-end visualization through the digital platform. The supply chain level of traditional automobile enterprises is up to 4-5 levels, and the information transmission lags behind and is prone to distortion. Tesla uses a flat supply chain to establish a direct relationship with its core suppliers, reducing the payment cycle to 90 days, far below the industry average of 120-150 days. More importantly, Tesla tracks the full

ISSN: 2688-9323

life cycle carbon footprint of key components (such as battery raw materials) through blockchain technology, providing a reliable data base for carbon credits trading. In the third quarter of 2024, Tesla's carbon credit revenue reached $739million, the second highest in history.

3.3. Digital Subversion of Business Model

The digital subversion of Tesla's business model is not a simple channel change, but a reshaping of the value creation logic of the automotive industry.

The direct selling model has completely changed the relationship between car companies and users. In the traditional dealer model, there is an information gap between car companies and end users. It is difficult for car companies to grasp the real needs of users, and users also lack channels to directly feedback the use experience to car companies. Tesla uses the combination of the official website and experience store to directly establish contact with consumers, eliminating the middleman link and realizing the flattening of the sales channel. This model brings three values: first, it is to convert dealer price increases into enterprise profits or user preferences; The second is to establish a closed loop of user data, and the whole process data from test drive, purchase to after-sales service can be traced and analyzed; Third, it is to enhance brand consistency. The globally unified price and service standards have avoided confusion at the dealer level.

Software servitization is the core of Tesla's business model innovation. FSD (fully automatic driving) system adopts the "hardware embedding + software unlocking" mode, and users have two payment options: one is to pay 15000 dollars directly at one time; The second is monthly subscription, which costs 199 dollars per month. This model will transform the car from a one-time sale of goods to a continuous service platform. More importantly, software revenue has the characteristics of high gross profit rate - the marginal cost of FSD is almost zero, and the gross profit rate is more than 80%, much higher than 20-25% of car sales.

Energy and ecological synergy are the third pillar of Tesla's business model. With the help of Powerwall household energy storage equipment, Megapack grid energy storage system and solar roof, Tesla has built a clean energy cycle system covering the whole process of "power generation, energy storage and power consumption". In 2024, Tesla's energy business revenue reached US $10.086 billion, a year-on-year increase of 67%, accounting for more than 10% of the total revenue for the first time. This synergy not only creates a new source of income, but also enhances user stickiness - users who use Tesla solar energy and energy storage systems choose Tesla when replacing their vehicles, up to 85%, much higher than the industry average of 40%.

4. Impact Mechanism of Digital Transformation on Enterprise Performance

4.1. Financial Performance Improvement Path

The impact of digital transformation on Tesla's financial performance is multidimensional and dynamic, which is reflected in the optimization of income structure, the strengthening of cost control and the improvement of capital efficiency.

The optimization of income structure is the most direct financial embodiment of digital transformation. In 2024, Tesla's total revenue reached US $97.69 billion, a slight increase of 1% year on year. On the surface, the growth rate of business has slowed down, but the internal structure has changed significantly. Specifically, the revenue from the automotive business was US $77.07 billion, a year-on-year decrease of 6%; While the energy business income was US $10.086 billion, a significant increase of 67%; Revenue from services and other businesses was

ISSN: 2688-9323

$10.534 billion, an increase of 27%. This shows that the revenue from non-automotive business accounts for 21% of the total revenue, while in 2020, this proportion is only 8%.

More importantly, the proportion of high gross margin businesses continued to increase. The gross profit margin of automobile sales is affected by the price reduction, from 29% in 2022 to about 18% in 2024. However, the gross profit margin of software services remained above 80%, and the gross profit margin of energy business also exceeded 25%. This change in revenue structure has improved the overall quality of earnings - although the net profit fell from $15billion in 2023 to $7.1 billion in 2024, the sustainability of earnings has been significantly enhanced.

The strengthening of cost control benefits from intelligent manufacturing and digitalization of supply chain. Shanghai Super factory adopted the local procurement strategy, making the localization proportion of parts and components reach 95%, while the logistics cost decreased by 60%. The integrated die casting technology reduces the manufacturing cost of the model y rear base plate by 40%, and the production time is shortened from 1-2 hours of the traditional process to 3-5 minutes. The digital supply chain has reduced the inventory turnover days from 68 days in 2018 to 45 days in 2024, freeing a large amount of working capital.

These cost advantages are directly reflected in the financial indicators. In the fourth quarter of 2024, Tesla controlled the cost of a single vehicle within $35000, while the industry average cost of a single vehicle in the same period was about $42000.Although the average selling price of automobiles (ASP) fell from $52000 in 2022 to $43000 in 2024, the cost fell faster and maintained a positive margin.

The improvement of capital efficiency is mainly due to the asset light operation mode and the effective management of cash flow. Tesla's direct selling model avoids heavy asset investment in the dealer network and concentrates capital on R&D and manufacturing. In 2024, Tesla's R&D investment reached $4.54 billion, accounting for 4.6% of revenue. Although the absolute value is lower than BYD's $5.32 billion, the investment efficiency is higher - Tesla generates $21.50 revenue per dollar of R&D investment, compared with BYD's $18.30.

Cash flow management can show the advantages of digitalization. Tesla uses the dynamic pricing algorithm to adjust the vehicle price and FSD subscription fee in real time according to the actual situation, so as to optimize the cash flow situation. In 2024, the company's operating cash flow reached US $6.255 billion, and its free cash flow was US $2.74 billion, an increase of 223% year on year. The enterprise has sufficient cash flow and can continue to carry out investment activities. In 2024, the capital expenditure exceeded 10billion dollars, and the funds were mainly invested in AI training and computing and plant expansion.

4.2. Non-Financial Performance Improvement Mechanism

Digital transformation not only improves Tesla's financial performance, but also brings many non-financial advantages, which together lay the foundation for Tesla's long-term competitiveness.

The jump in brand value is an important achievement of digital transformation. The global brand value list for 2024 released by Interbrand shows that Tesla's brand value reached US $66.2 billion, ranking first in the automotive industry and 12th in the world. This brand premium stems from multiple factors: first, the image of technology leader. Tesla is regarded as the technical benchmark of autonomous driving and electric vehicles; Second, the advantage of user experience. The update of Ota makes the vehicle "more and more new", which subverts the traditional value decline curve of cars; Third, environmental protection pioneer positioning, Tesla car owners jointly reduced nearly 32million tons of carbon dioxide equivalent emissions.

The accumulation of data assets constitutes the core competitiveness in the digital era. By the end of 2024, Tesla's fleet had driven more than 30billion miles, including more than 5billion miles in automatic driving mode. These data have three values: the first is the training value,

ISSN: 2688-9323

which can be used to optimize the automatic driving algorithm, so as to improve the safety and comfort of vehicle driving; The second is commercial value. After anonymizing the data, it can be sold to map companies, insurance companies and research institutions; Finally, the strategic value. A large amount of real-world data is an important basis for the development of new businesses such as robotaxi and humanoid robots.

Ecological synergy magnifies the value of digital transformation. The "car pile network storage" ecosystem created by Tesla has realized cross business collaboration: the sales of electric vehicles have promoted the construction of the charging network, and the improvement of the charging network has improved the user experience, thereby attracting more people to buy electric vehicles; The energy storage system can balance the grid load and effectively reduce the charging cost; Solar roofs can provide clean electricity. The financial performance of this synergy effect is the phenomenon of cross selling: among the users who purchased Tesla solar system, 65% also purchased Powerwall energy storage equipment; Among Powerwall users, 80% chose Tesla for the next car.

Ecological synergy can produce network effect. For example, Tesla's super charging network has more than 50000 charging piles, covering 99% of the world's densely populated areas. The huge charging network built by Tesla showed strong attraction, prompting many car companies to choose to access. In 2024, Ford, General Motors, Rivian and other auto brands announced that they would adopt Tesla's charging standard. This network effect makes Tesla not only sit firmly in the position of industry standard setter, but also obtain continuous income through charging service fees.

4.3. Construction of Sustainable Development Capacity -- Based on ESG Perspective

Digital transformation provides Tesla with technical support and management means to improve ESG performance, and promotes the integration of business value and social value[11] .

In the environmental dimension (E), Tesla has achieved full life cycle carbon management through digital means. In the manufacturing sector, the Shanghai Super factory will reduce carbon emissions by more than 50000 tons in 2024, equivalent to the emissions of more than 10000 fuel vehicles a year. This achievement benefits from a number of innovative technologies: the wet touch wet process in the coating workshop reduces the baking link and saves 6.68 million kwh of electricity annually; The waste heat recovery system saves 2.7 million cubic meters of natural gas annually; Integrated die casting optimization reduces 3000 tons of carbon annually.

The emission reduction effect of product use is more significant. In 2024, Tesla customers reduced emissions by nearly 32 million tons of carbon dioxide equivalent. This figure is based on accurate calculation: each Tesla electric vehicle can reduce about 35 tons of carbon dioxide equivalent in its life cycle. The 5.2 TWH clean power provided by the super charging network will emit 5.5 billion kg of carbon dioxide if the same mileage is completed by the fuel vehicle[12] .

In the social dimension (S), Tesla's digital transformation has promoted technology inclusion and employment structure optimization. The continuous improvement of FSD system makes the automatic driving technology penetrate from high-end models to the mass market. Model 3 and model y are also equipped with complete automatic driving hardware. By the end of 2024, more than 400000 users had participated in the FSD beta test, of which about 30% came from families with an annual income of less than 100000 US dollars, reflecting the democratization effect of technology popularization.

In terms of employment, the digital transformation has changed the structure of talent demand. From 2018 to 2024, the composition of Tesla's global employees has changed. The proportion of software engineers in the total number of employees has increased from 15% to 25%, while

ISSN: 2688-9323

the proportion of traditional manufacturing jobs has decreased from 50% to 35%. After the implementation of automation transformation in Shanghai Super factory, it not only increased the production capacity, but also reduced the proportion of direct labor cost in the total cost from 12% to 7%.The transformation of employment structure may reduce the number of traditional jobs in the short term, but at the same time, it has also spawned more valuable knowledge-based jobs, and the average salary of employees has increased by 40%.

In the governance dimension (G), data security and transparent operation have become the focus of attention. Tesla has established a multi-layer protection data security system: vehicle data is encrypted and stored locally, TLS 1.3 encryption protocol is used for transmission, and cloud data storage conforms to ISO 27001 standard. In 2024, Tesla released its first data security transparency report, disclosing the number and compliance of government data requests.

Corporate governance is also more transparent due to digitalization. Tesla updates production data, delivery data and charging network expansion in real time through the investor relations website. The Q3 financial report teleconference in 2024 used AI to automatically generate summaries for the first time, condensed the contents of the 3-hour meeting into 5-minute key points, and improved the efficiency of information disclosure. This transparent operation has enhanced the trust of investors. Tesla's institutional shareholding ratio has stabilized at more than 60%, higher than the industry average of 45%.

5. Theoretical Contribution and Practical Enlightenment

5.1. Theoretical Framework Expansion

First, it expands the explanatory power of the resource-based view in the digital era. The traditional resource-based view emphasizes the value of tangible and intangible resources. Tesla's practice shows that in the era of digital economy, data resources and algorithm technology have gradually become key strategic resources. Data resources have the characteristics of non-competitiveness and network effect, which is quite different from the scarcity assumption of traditional resources. The algorithm ability reflects the dynamic adaptability - Tesla's autonomous driving algorithm evolves continuously through continuous learning, and this evolution ability itself becomes the core competitiveness.

Secondly, it enriches the connotation of dynamic capability theory. Dynamic capability emphasizes the ability of enterprises to integrate, construct and reorganize internal and external resources to adapt to the rapidly changing environment. Tesla has shown a new form of dynamic capabilities in the digital era, including the ability to make decisions based on data, the ability to realize reconstruction through software definition, and the ability to carry out collaborative innovation based on ecosystem. These capabilities are not fixed, but with the help of digital platforms and AI systems, the continuous upgrading of automation and intelligence has been realized[13] .

Finally, the research constructs a comprehensive analysis framework of digital transformation covering three dimensions of technology, organization and ecology. The framework emphasizes that digital transformation requires both systemic and synergistic approaches: technological innovation depends on organizational change, organizational change depends on ecological construction to achieve value creation, and ecological construction will further promote the updating and iteration of technology. Tesla's success is due to the benign interaction between technological innovation, cost control, pricing strategy, market share, data accumulation and algorithm improvement. Specifically, technological innovation reduces Tesla's manufacturing costs, and the lower costs enable it to adopt aggressive pricing strategies to expand its market share. With the increase of market share, Tesla has obtained more user

ISSN: 2688-9323

data, which is used to train the algorithm, improve the algorithm ability, and ultimately enhance the competitiveness of the product.

5.2. Key Success Factors for Transformation

Based on the case of Tesla, this study extracted three successful elements of digital transformation: first, the combination of technology self-development and open collaboration. Adhere to self-control in core technology and actively open cooperation in ecological construction; Secondly, organizational agility and culture fit. Establish a flat, cross functional team structure and cultivate a culture of trial and error and rapid iteration; Finally, data governance and value mining. Build a unified data platform to promote the whole process application of data in R&D, production, service and other links.

5.3. Industry Transformation Path Recommendations

When traditional automobile enterprises carry out digital transformation, they can gradually push forward according to the three stages of "digital efficiency improvement - platform improvement experience - ecological value creation". Attention should be paid to not only blindly investing in technology, but also ignoring the importance of collaborative transformation of organization and business model. Emerging market enterprises can take advantage of the technology spillover and open ecosystem of Tesla and other leading enterprises to achieve local leadership by focusing on innovation in specific scenarios.

For emerging market enterprises, it is suggested to adopt the differentiation strategy of "focusing on scene innovation - leveraging technology spillovers - achieving local transcendence". In the field of automatic driving, priority should be given to tackling the complex road conditions in China, and algorithms for mixed driving of electric vehicles and bicycles, frequent congestion and special weather conditions should be developed. Take advantage of local data to achieve technology leadership in specific scenarios. In terms of battery technology, focus on low-cost and high safety routes. In terms of business model, we can explore innovative models such as vehicle electricity separation and battery leasing, so as to reduce the cost of consumers' car purchase and promote the rapid popularization of electric vehicles.

6. Conclusion and Prospect

6.1. Research Conclusion

Through the case study of Tesla, this paper systematically reveals the multi-dimensional impact of digital transformation on enterprise performance. Research shows that digital transformation can not only directly improve financial performance through intelligent manufacturing, software services and other paths, but also enhance the long-term competitiveness of enterprises by building data assets, enhancing ecological synergy, and enabling ESG performance. Tesla's practice shows that digital transformation is a systematic project covering technology, organization and ecology. The key to success lies in strategic foresight, executive coherence and resource integration ability.

6.2. Research Deficiencies and Future Prospects

Taking Tesla's digital transformation as an example, its successful experience may not be directly replicated to other enterprises, and the transformation paths of different enterprises are different. The follow-up research can use the multi case comparison method to select the successful and failed enterprises of digital transformation for comparative research, so as to find out the boundary conditions of digital transformation and the possible failure risk.

Secondly, the section observation of dynamic process. This study is based on the historical data from 2003 to 2024, but the digital transformation is a process of continuous evolution. Tesla

ISSN: 2688-9323

officially launched the robotaxi service in June 2025, and the humanoid robot Optimus may be released in 2026. These new developments may further change the picture of digital transformation. Longitudinal tracking method can be used in future research to continuously observe the digital transformation process of Tesla and other car companies and capture the dynamic evolution law.

Finally, the depth of quantitative analysis is insufficient. No econometric model has been established to quantify the contribution of various dimensions of digital transformation to enterprise performance. Future research can build a structural equation model to measure the path coefficient and regulatory effect of variables such as technology investment, organizational change and ecological construction on financial performance, innovation performance and ESG performance.

Digital transformation is a profound industrial revolution, and its impact is far from fully apparent. As the forerunner of this revolution, Tesla's experience and lessons provide a valuable reference for the latecomers. Every enterprise should explore its own transformation mode in line with its actual situation, innovate in reference and move forward in exploration. This study hopes to contribute to theoretical development and practical exploration through in-depth analysis of Tesla case.

References

[1] Li, J., Qiu W. (2022) Research on business model innovation of logistics enterprises under the background of digital infrastructure. Journal of Xi'an University of Petroleum (SOCIAL SCIENCE EDITION), 31 (02): 55-61

[2] Huang J. (2023) Research on the impact of digital transformation of manufacturing enterprises on innovation performance. Harbin University of technology, 4.

[3] Lu S. (2022) Research on the path of enterprise digital transformation. modern business, (08): 10-13.

[4] Zhang J, Long J. (2022) Digital transformation, dynamic capabilities and enterprise innovation performance -- Empirical Evidence from high tech listed enterprises. economics and management, 36 (03): 74-83.

[5] Guo Y, Wu L, Chi R. (2023) Digital focus of ordinary investors and digital transformation of enterprises. soft science, 37 (11): 42-47+64.

[6] Li X, Jiang L, Luo C. (2023) Digital technology and the embedding position of global value chain -- An Empirical Study Based on manufacturing enterprises. academic research, (05): 108-116.

[7] Jin Y, Wen W., He Y. (2022) The impact of digital transformation on enterprises' Green Innovation -- Based on the empirical evidence of Listed Companies in China's manufacturing industry. finance and trade research, 33 (07): 69-83.

[8] Li L. (2022). Digital transformation and sustainable performance: The moderating role of market turbulence. Industrial Marketing Management, 104, 28-37.

[9] Ma Z. (2023) The impact of digital transformation on the performance of automotive enterprises and its mechanism analysis. Inner Mongolia University of Finance and economics, 10.

[10] Wang Q. (2022) Research on the evaluation of innovation and development partners of traditional automobile manufacturing enterprises under the background of digital transformation. Chongqing University of technology and industry, 1.

[11] Jiang R, Zhang L. (2022) Digitalization boosts enterprise green technology innovation. China collective economy, (02): 162-163.

[12] Wan J. (2023) Digital transformation and enterprise market value. Jiangxi University of Finance and economics, 3.

[13] Ji B. (2022) Research on the impact path of digital transformation on the performance of manufacturing enterprises. Shandong University of Finance and economics, 11.