Research on the Sustainable Development Path of Technology-driven Enterprises: Based on the Case Analysis of Zhong Lun New Materials Co., Ltd.

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Abstract:Under the backdrop of the "dual carbon" goal and the global industrial structure transformation, how technology-driven enterprises can achieve sustainable development has become a core issue of concern for both the academic and practical communities. Based on the dynamic capability theory, this paper constructs an analytical framework of "idea-capability-behavior-performance", and takes Zhong Lun New Materials Co., Ltd. as a case to systematically analyze the mechanism of the three paths of technological innovation, green manufacturing, and industrial chain collaboration on the sustainable development of enterprises. The research findings are as follows: (1) Technological innovation, through resource integration and capability transformation, becomes the core driving force for promoting the sustainable development of enterprises; (2) Green innovation plays a mediating role between technological application and sustainable performance; (3) Industrial chain collaboration enhances the overall system efficiency through information integration and resource allocation; (4) There is a significant synergy among the three paths, jointly promoting the formation of long-term competitive advantages of enterprises. This paper integrates the resource-based view and the dynamic capability theory in theory, and provides an operational sustainable development path for technology-driven enterprises in practice.

Keywords: Technology-Driven Enterprises; Sustainable Development; Dynamic Capabilities; Green Innovation; Industrial Chain Collaboration

1. Introduction

With the intensification of global climate change and the strengthening of resource constraints, sustainable development has gradually become an important component of corporate strategies. Sustainable development emphasizes the coordinated unity of economic growth, environmental protection, and social progress[1], and its core lies in achieving a balance among the three dimensions of economy, environment, and society [2]. From the perspective of enterprises, this concept not only means a transformation of development goals, but also implies that enterprises need to systematically restructure their resource allocation methods, technological path selection, and organizational management models.However, in the energy sector, Chinese enterprises still face significant challenges in achieving sustainable development and clean production. Particularly, the slow progress in the development and application of green energy, as well as the overcapacity of traditional resource-based industries, continue to impede China's environmental governance and ecological protection efforts. These structural issues indicate that the transition to sustainable development remains complex and arduous[3].

In this context, technology-driven enterprises, especially those in the new materials sector, have played a crucial role in technological innovation and industrial upgrading, becoming an important force driving the green transformation. Compared to traditional enterprises, these enterprises have a stronger technological orientation and path dependence characteristics. Their development is highly dependent on the accumulation and transformation of continuous innovation capabilities. However, existing research mostly focuses on traditional manufacturing industries and lacks a systematic explanation of the mechanism by which technology-driven enterprises can transform their technological advantages into sustainable development paths. Therefore, it is necessary to conduct an in-depth

analysis of the internal logic from the perspective of capability evolution and path integration.

2. Literature Review and Theoretical Foundation

2.1 The Theory of Sustainable Development

The concept of sustainable development has become a highly popular topic in recent years. The idea was first proposed by the World Commission on Environment and Development (WCED), and its core lies in meeting current needs without compromising the development capabilities of future generations[4].As research has deepened, its connotation has gradually focused on three dimensions: environmental integrity, economic prosperity, and social equity [4]..

At the enterprise level, sustainable development is not only reflected in environmental management practices, but also includes reducing ecological footprints and optimizing resource allocation[4].. Moreover, enterprise sustainable development is characterized by its long-term nature and uncertainty, and its economic benefits often exhibit lagging and dispersed characteristics[4].

2.2 Resource-Based View and Dynamic Capability Theory

The resource-based view posits that an enterprise's competitive advantage stems from its scarce resources and their integration capabilities[5]. Furthermore, enterprise capabilities arise from the integration and application of resources, and directly influence the level of sustainable development of the enterprise [5]. This indicates that merely possessing resources is not sufficient to create a competitive advantage; the key lies in how the enterprise, through organizational mechanisms, transforms resources into sustainable capabilities.

In a dynamic environment, enterprises need to continuously integrate and restructure resources to cope with changes. This ability is known as dynamic capability. Research shows that in highly uncertain market environments, sustainable development has become an important factor for enterprises to maintain their competitiveness[6]. Therefore, dynamic capability is not only a tool for enterprises to adapt to environmental changes, but also a core mechanism for promoting enterprises to achieve long-term sustainable development.

2.3 Digital Technology and Green Innovation

Digital technology can enhance the efficiency of information flow and resource utilization within enterprises by integrating multi-source heterogeneous data and reducing information barriers, thereby improving the operational efficiency and economic performance of enterprises[5]. From a fundamental perspective, digital technology has transformed the way enterprises allocate resources, shifting from "dispersed and inefficient" to "integrated and efficient".

Green innovation refers to technological innovation activities centered around energy conservation and emission reduction, pollution prevention and control, and efficient utilization of resources. Its core objective is to achieve environmentally friendly development[5]. Furthermore, many manufacturing enterprises have adopted visualization management platforms and digital tools to enhance the transparency and operational efficiency of their supply chains. These technologies have strengthened enterprises' ability to respond to market changes and have solidified their competitive position in an increasingly dynamic environment[3].In the current context of "dual carbon" goals, green innovation has shifted from an "additive strategy" to a "core competitive strategy".

Further research indicates that green innovation plays a mediating role between the application of digital technologies and the performance of enterprises' sustainable development [5]. This means that digital technologies themselves do not directly bring about sustainable performance; their effect needs to be realized through the transformation mechanism of green innovation. Through green innovation, enterprises can not only reduce environmental costs but also enhance market competitiveness, achieving dual benefits of economy and environment[5].

2.4 Industry Chain Collaboration and Information Mechanism

In a complex industrial system, information systems play a fundamental role in the sustainable development of enterprises. The continuous processing and analysis of information is the key for enterprises to make decisions and achieve sustainable

development[6].

Meanwhile, a well-implemented information support mechanism can help enhance the flexibility and adaptability of the enterprise management system, thereby improving the enterprise's ability to cope with environmental changes [6].

3. Theoretical Framework and Analytical Propositions

Based on the aforementioned literature, this paper constructs an "idea-ability-behavior-performance" analytical framework:

Idea layer: Sustainable development strategy orientation

Ability layer: Technological innovation ability, green innovation ability, collaborative ability

Behavior layer: Green manufacturing practice, industrial chain collaboration practice

Performance layer: Economic performance, environmental performance and social performance

On this basis, the following analytical propositions are proposed:

Proposition 1: Technological innovation ability is transformed into the enterprise's sustainable development ability through resource integration.

Proposition 2: Green innovation plays a mediating role between technological application and sustainable performance.

Proposition 3: Industrial chain collaboration enhances the enterprise's sustainable development performance through information integration.

Proposition 4: There is a synergy effect among the three paths, jointly promoting the formation of the enterprise's long-term competitive advantage.

4. Research Methods

4.1 Research Design

This paper adopts a single-case study method to conduct an in-depth analysis of Zhong Lun New Materials. Case studies are suitable for exploring complex mechanisms and can reveal the inherent logical relationships between variables.

4.2 Data Sources

The data mainly come from enterprise annual reports, social responsibility reports, industry reports, and public materials. At the same time, theoretical verification is carried out through literature analysis.

4.3 Analytical Methods

Thematic analysis methods are employed to divide the enterprise development process into stages and extract key paths and mechanisms of action.

5. Case Analysis

5.1 Technological Innovation Path

Zhong Lun New Materials has built a strong innovation capability through continuous investment in research and technological accumulation. According to the resource-based view, technological resources are an important foundation for the formation of an enterprise's capabilities [5]. However, what is even more crucial is that the enterprise, through an institutionalized research and development system and a continuous investment mechanism, continuously converts technological resources into reusable organizational capabilities.

Through the application of digital technologies, enterprises achieve data integration and information sharing, thereby enhancing their R&D efficiency and product performance[5]. This process not only strengthens the competitiveness of products but also provides technical support for green innovation. It can be seen that technological innovation has formed a "capability amplification effect" within enterprises, that is, through continuous accumulation and application, it strengthens the long-term competitive advantages of enterprises.

5.2 Green Manufacturing Path

In the field of green manufacturing, Zhong Lun New Materials has achieved a low-carbon transformation in its production process by introducing environmentally friendly processes and energy-saving technologies. Green innovation not only reduces pollution but also enhances resource utilization efficiency[5]. From the perspective of traditional energy enterprises, improving energy efficiency is not only a key way to reduce environmental impact, but also aligns with the overall trend of the industrial sector's transition towards sustainability and high-quality development[3].This process essentially involves the reconfiguration of the enterprise's production function, that is, achieving higher efficiency and lower

environmental costs under the given resource constraints.

Furthermore, green innovation can also help enterprises establish a favorable environmental image, enhance market recognition, and ultimately achieve a dual improvement in economic performance and environmental performance [5] In the long run, this "green premium effect" helps enterprises establish a differentiated competitive advantage in the market.

5.3 Collaborative Path of the Industrial Chain

Zhong Lun New Materials has enhanced its collaboration with upstream and downstream enterprises to achieve resource sharing and information integration, thereby improving overall operational efficiency. Research indicates that the improvement of the information mechanism can help enhance the decision-making efficiency and management level of enterprises [6]. At the industrial chain level, this information integration can significantly reduce systemic uncertainty.

Meanwhile, the coordination of the industrial chain helps to reduce information asymmetry and transaction costs, thereby enhancing the competitiveness of enterprises in complex market environments[6]. Further analysis shows that the coordination mechanism not only improves the performance of individual enterprises, but also optimizes the resource allocation efficiency of the entire value chain.

6. Mechanism Analysis

6.1 Driving Mechanism of Technological Innovation

Technological innovation forms an enterprise's core capabilities through resource integration, and further transforms into sustainable development advantages. This process embodies the basic logic of the resource-based view [5]. From a dynamic perspective, this process is continuously evolving, where enterprises achieve capability upgrading through continuous innovation.

6.2 The Mediating Mechanism of Green Innovation

Green innovation acts as a bridge between technological application and performance. It not only enhances environmental performance but also improves the economic performance of enterprises[5]. Therefore, green innovation is not merely an environmental tool but also a mechanism for creating economic value.

6.3 Collaborative Mechanism

There is a significant interactive relationship among technological innovation, green manufacturing, and industrial chain collaboration: Technological innovation provides support for green manufacturing, green manufacturing enhances the competitiveness of enterprises, and industrial chain collaboration amplifies the overall effect. The combined action of these three factors forms a systematic path for the sustainable development of enterprises. This multi-path collaborative mechanism indicates that the sustainable development of enterprises is not driven by a single factor, but is the result of the coordinated evolution of multiple capabilities.

Furthermore, the collaborative operation of the industrial chain, through information integration and optimization of resource allocation, enhances the overall system efficiency of enterprises and serves as an important supporting mechanism for achieving sustainable development [6]. This mechanism further indicates that the enterprise boundary is transforming from a "single organization" to a "collaborative network".

7. Conclusion

7.1 Research Conclusion

(1) Based on this case, the following conclusions are drawn:

Technological innovation serves as the primary driving force for the sustainable development of this technology-driven enterprise;

(2) Green innovation plays a crucial mediating role between technological development and enterprise performance within this specific context;

(3) Industrial chain collaboration contributes to improving resource allocation efficiency in this case;

(4)Multi-path collaboration demonstrates potential as a key approach to achieving long-term competitive advantages for similar enterprises.

7.2 Theoretical Contributions

This paper integrates the resource-based view and the dynamic capability theory, and

constructs a systematic analysis framework for sustainable development, addressing the fragmentation issue of existing research.

7.3 Practical Implications

Enterprises should:

Increase investment in technological innovation

Promote the transformation to green manufacturing

Build a collaborative industrial chain system

To achieve sustainable development goals.

7.4 Research Limitations and Future Directions

This paper is a single-case study. Future research can further validate the conclusions through multiple-case or quantitative studies.

Overall, the sustainable development of enterprises is a dynamic evolutionary process, whose essence lies in the combined effect of capacity accumulation, path selection, and collaborative mechanisms.

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