Status Analysis, Path Exploration and Policy Enlightenment of Zhejiang Province's Manufacturing Green Technology Innovation

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Abstract. Manufacturing industry is an important economic force in China's industrialization process, but the rapid and extensive development model has caused great damage to the ecological environment and has become a major shortcoming in China's current economic transition to high-quality development. The analysis of the problems of green technology innovation in the manufacturing industry in Zhejiang province mainly includes: insufficient green innovation mechanism, insufficient maturity of green innovation organization, insufficient support for green innovation, and breakthroughs in green innovation technology. Then we select typical enterprises to explore and draw conclusions: Green innovation strategy includes forward-looking green innovation strategy and reactive green innovation strategy, which promotes green innovation behaviors such as products, technology, and equipment through value guidance and strategic guidance, and then creates and realizes corporate performance. Finally, targeted policy suggestions are given according to the empirical results.

1. Introduction
The manufacturing industry is the main body of China's real economy and an important force to promote the country's industrialization process. However, the rapid and extensive development model of China's manufacturing industry has caused great damage to the ecological environment, and the fragile ecological environment has gradually become a major shortcoming of development [1]. In order to make up for the shortcomings of the ecological environment, we must realize the innovation drive and green leadership of the development path, and use green innovation to inject new momentum into the development of manufacturing [2]. But there is not much analysis and research on the internal factors of the enterprise and the internal relationship between the innovation strategy of the manufacturing
enterprise and the performance of the enterprise. Therefore, the research and exploration of the formation, evolution mechanism, path exploration and model innovation of the green innovation of Zhejiang manufacturing enterprises has become more important.

2. Research Methods and Sample Characteristics

2.1. Research Methods
This article adopts an exploratory case study method, and selects Hangzhou Iron and Steel Group, Zhejiang Energy Group and Juhua Group as typical cases to summarize the green innovation path. Secondly, the questionnaire survey method is used to rationally design the questionnaire. The method is issued. Finally, the mathematical statistical analysis method is adopted, and the statistical analysis software spss24.0 is planned to be used to sort out the questionnaire data and relevant tests.

The survey adopted a multi-stage sampling method, and a total of 350 manufacturing companies were selected. Considering the cost constraints of the survey, 258 companies were finally screened for questionnaires. Finally, 852 questionnaires were distributed to employees of 258 manufacturing companies in Zhejiang province. 796 questionnaires were actually recovered, and 557 valid questionnaires were obtained, with an effective recovery rate of 65.37%.

2.2. Sample Features
In the sample, the ratio of men and women in the survey population is close to 2: 1, the age is mainly concentrated in the age of 21-40, the education level is mainly below the tertiary level, and the rank is mainly the general staff of the department. Among the survey objects, the proportion of private enterprises is the largest, 90.8%; Companies with annual sales of "more than 40 million yuan" accounted for the largest proportion, 47.4%.

Among the survey objects, private enterprises accounted for the largest proportion, 90.8%; according to the industry of the enterprise, the proportion of "equipment-based operations" was relatively large, at 40.2%; the proportion of enterprises with more than 1001 employees is the largest at 43.4%; the distribution of the company's annual sales and the number of employees is similar, and to a certain extent relevant. The company with annual sales of "more than 40 million yuan" accounts for the largest proportion, 47.4%; the years of the establishment of the enterprise are more evenly distributed in "3-10 years", "11-15 years", "16-20 years", and "more than 20 years", respectively 22.8%, 26.2%, 25.3%, and 25.3%.

3. Status of Green Innovation in Zhejiang Manufacturing
As a new measure to solve environmental protection problems, green system innovation has been widely recognized by Zhejiang manufacturing enterprises. Green innovation has brought high-quality green production efficiency to Zhejiang enterprises and improved their competitiveness [3]. However, there are still many problems in the development of green innovation in Zhejiang manufacturing enterprises.

3.1. Insufficient Green Innovation Mechanism
The biggest challenge of Zhejiang's green technology innovation is the institutional obstacles. Insufficient green technology innovation, a large international gap, and limited industrialization are very prominent.

From the perspective of external factors, the lack of green innovation service platforms, local government lack of relevant innovation policy support, the lack of relevant national direction guidance, insufficient intellectual property protection, and low market demand are not conducive to green innovation of enterprises. Among them, lack of green innovation services platforms and local governments lack the support of relevant innovation policies is the most common. It is obvious that when a company's green innovation has policy support, its innovation strength and investment will increase to a certain extent [4]. In addition, the country's guidance in related directions, intellectual property protection, and the market demand is also an important external factor affecting corporate green innovation.
From the perspective of internal factors, the lack of high-level technical talents, insufficient funds for enterprises, excessive innovation costs, weak independent R & D capabilities, insufficient R & D investment, inadequate cooperation between industry, universities, and research institutes, and low returns are not conducive to green innovation. Among them, enterprise autonomy weak research and development capabilities, the lack of continuous innovation is the most serious, and the company's independent research and development capabilities determine to a certain extent whether the company can have effective green innovation results. Secondly, insufficient research and development investment, excessive innovation costs, and too much risk also affect the company. The important factors of whether to carry out innovation, research cost and risk issues are another key factor for whether the company implements an innovation strategy. In addition, the status of corporate funds, high-tech talents, production-university-research cooperation, and revenue are also important internal factors that affect corporate green innovation.

3.2. Green Innovation Organization Is Not Mature Enough
The organization method of enterprise green innovation refers to the new enterprise organization form that comes with the continuous development of the enterprise itself. To solve the problem of the organization method of enterprise green innovation, we start from the environmental protection product design organization form, environmental technology research and development organization form, and introduce environmental protection technology. There are three main ways to conduct research and analysis.

The data of the organization method of the company were tested for significance respectively. The calculation found that the environmental protection product design organization form, environmental technology research and development organization form, and the main method of introducing environmental protection technology had P values of 0.000, P = 0.000 <0.05, indicating that in the total n groups there are significant differences between at least two groups in each group, that is, the organization of environmental protection product design, the organization of environmental protection technology research and development, and the main ways of introducing environmental protection technology have an impact on the level of green innovation of enterprises.

3.3. Insufficient Support for Green Innovation
The greater the degree of support for green innovation, the greater the effect, ability and potential of green innovation in the company [5]. It mainly includes two aspects: the source of research and development funds and employees' understanding of preferential support policies.

**Table 1. Support for green innovation of enterprises**

| Support for green innovation | n   | percentage | F    | P     |
|-----------------------------|-----|------------|------|-------|
| R & D funding sources       |     |            |      |       |
| Self-raised                 | 317 | 56.9       |      |       |
| Government funding          | 29  | 5.2        |      |       |
| Bank loan                   | 10  | 1.8        |      |       |
| Cooperative investment      | 167 | 30.0       |      |       |
| National Scientific Research Project | 13  | 2.3        |      |       |
| other                       | 13  | 2.3        |      |       |
| Employees' understanding of preferential support policies |     |            |      |       |
| very familiar               | 43  | 7.7        |      |       |
| To understanding            | 94  | 16.9       |      |       |
| do not know much            | 273 | 49.0       |      |       |
| Don’t understand            | 132 | 23.7       |      |       |

The data of the organization of the company were tested for significance, and the P values of the source of research and development funds and employees' understanding of preferential support policies were found to be 0.000, P = 0.000 <0.05, indicating that there are significant differences between the at
least two in the n groups, that is, the source of R & D funding and employees' preferential support policies have an impact on the level of green innovation of the enterprise.

3.4. Green Innovation Technology Needs Breakthrough
Green innovation technology is the main method to solve resource input, environmental pollution and corporate economic development, and is the key to building a green enterprise [6]. Measuring a company's green innovation research and development technology can be based on the company's "energy saving and environmental protection technology", "polluting reduction technology" and whether the relevant R & D institutions and the establishment level of R & D institutions have been set up in "waste recycling technology" and so on.

The data set by the institutions were tested for significance respectively. The P values of the three types of institutions were 0.000 and P = 0.000 <0.05, indicating that there are significant differences between at least two of the n groups, that is, the level of energy conservation and environmental protection technology, pollution reduction technology, and waste recycling technology research and development institutions have an impact on the level of green innovation of enterprises.

4. Exploration of Green Innovation Path of Zhejiang Manufacturing
The analysis of representative and typical cases is helpful to analyze the formation mechanism of green innovation behavior of enterprises. Therefore, this article selects these three companies as typical cases for path exploration, namely Juhua Group, Zhejiang Energy Group, and Hangzhou Iron and Steel Group.

4.1. Case Study
Juhua Group has adopted a reactive strategy (responding to changes in the external environment) to the "three wastes" problem in its production, and has continued to innovate its production technology. It uses the coal chemical industry's energy-saving emission reduction technology transformation as a circular economy practice. Importantly, while enhancing the competitiveness of the coal chemical industry, it has ensured its supporting role in supporting core industries.

Zheneng Group put forward the idea of "energy technology innovation, fostering the development of new kinetic energy", and it is a forward-looking guiding ideology that traces the current strategic model to the future. After more than 10 years of research and development of 200 million yuan, Zheneng new technological breakthroughs have been achieved in coal combustion, which have largely solved the air pollution problems of coal-fired power plants. In terms of wastewater treatment, we have independently developed zero-discharge technology for desulfurized wastewater, which fully recycles wastewater with low recovery costs.

Hangzhou Iron and Steel Group has formed a number of strategic partners to establish Zhejiang Environmental Protection Group Co., Ltd. The Group will focus on high-quality and high-end lines in its development. It will vigorously develop the metal trading industry and is committed to the optimization and management of management models on model innovation, industrial chain integration, integrating online and offline, international and domestic business.

4.2. Summary of Green Innovation Strategy and Green Innovation Behavior Model
From these three cases, it can be seen that these three enterprises can effectively and autonomously improve the pollution caused by production to the environment, and through the transformation of products, technologies, and equipment, implement green innovative behaviors, reduce environmental pollution, and improve financial performance. Based on the above analysis, the relationship model between green innovation strategy and green innovation behavior is summarized.
Figure 1. Relationship between green innovation strategy, green innovation behavior and corporate performance

Based on related assumptions, we build the following structural equation model, as shown in Figure 2.

Figure 2. Structural model setting diagram

The empirical results show that there is a significant positive correlation between green innovation strategy and corporate performance. Green innovation strategy has a significant positive impact on green innovation behavior. Green innovation behavior has a mediating role between green innovation strategy and enterprise performance. As shown in Figure 3.
From this we finally concluded that the green innovation strategy includes a forward-looking green innovation strategy and a reactive green innovation strategy. It promotes green innovation behaviors such as products, technologies, and equipment through value guidance and strategic guidance, thereby creating and achieving corporate performance.

5. Policy Implications

5.1. Implement Corporate Green Innovation Strategy and Establish Green Corporate Culture
The production costs of green products include environmental costs, so they are usually relatively expensive. Compared with traditional enterprise products, they are inferior in cost competition. In addition to excess capacity, industry and fierce competition, whether companies can maintain their own green needs corporate leaders' firmness to green innovation strategy [7]. Enterprises should put green culture at the height of corporate strategy, guide the value of green innovation, play the intermediary role of green innovation behavior, and improve corporate performance. Second, the dissemination of green corporate culture must surround employees. It should be constructed from the aspects of education and training, corporate green behavior, management institutions, and the external environment. At the same time, enterprises should use various forms to publicize corporate social responsibility, the importance of ecological environmental protection, and promote cleaner production, green manufacturing, the importance of green packaging and recycling makes environmental awareness deeply in the minds of every employee, and it is agreed by all employees.

5.2. Increase Investment in R & D Capital and Set Up Targeted R & D Institutions
Affected by financial pressure and the R & D environment, many companies lack the long-term commitment to green innovation. In the development process, they follow innovation, imitate innovation, mostly introduce innovative technologies, and have fewer independent innovations. Some companies have gradually become independent in the process of independent innovation. On the one hand, enterprises must establish a good cooperative relationship with the government, led by the government, integrate the "industry-industry-research" advantages of enterprises and universities with scientific research resources, and raise funds to establish "energy-saving and environmental-friendly technologies" at the provincial level research institutes, "reduction technology" research institutes, "waste reuse technology" research institutes, and even the establishment of national-level enterprise technology centers to form a good research and development atmosphere of green independent innovation [8]. On the other hand, enterprises should increase the proportion of investment in products green environmental protection design, designing green products with low energy consumption.
Through the analysis of the green attributes of the product's entire life cycle, while satisfying customers' needs for traditional products, the design is based on detachability, recyclability, degradability, and reusability. The goal is to reduce the resource consumption and environmental load of the product as much as possible. Therefore, the green design concept runs through the procurement of raw materials, process innovation, manufacturing and production. The entire process from green packaging transportation to waste recycling and disposal. This process can focus on the development of the network and attract talented and interested independent individuals to conduct product design and production behaviors and methods through competitive bidding.

5.3. Increase Support for Green Innovation and Positively Encourage Green Behavior
The government should introduce and improve national policies and incentive mechanisms for enterprise green technology innovation, coordinate and unify fiscal, tax, and financial policy systems and regulatory systems, improve the backward production capacity elimination compensation and ecological compensation mechanisms, and give enterprises and institutions adopting new green technologies incentives or preferential policies to stimulate the enthusiasm of enterprises for green technology innovation [9]. Second, promote green financial product and service innovation, and guide capital "live water" to flow to green industries.

Improve and optimize production equipment, and research and develop green technologies for clean treatment. Enterprises need to reduce the consumption of natural resources and energy, and at the same time recycle, treat or reuse the generated waste, waste liquid, and waste gas. Use ecological technology and purification technology to produce green products, develop products that can save raw materials and energy, use less expensive or scarce raw materials, and do not endanger human health and the ecological environment during and after use, and are easy to recycle. At the same time, pay attention to reducing pollution during production. The resulting clean process technology innovations and end-of-line treatment technologies that reduce the emissions of pollutants that have been generated. The technical attributes of green products must not only meet the requirements of the functions, quality, convenient maintenance and service life of traditional products, but also fully consider the product's ease of use, disassembly, easy recycling and reusability. In the specific design, the assembly structure of the product must be considered to make the product easy to disassemble.

5.4. Strengthen Communication between Industries and Promote Social and Government Collaboration
First of all, encourage enterprises to establish green technology innovation business alliances and green supply chains, and establish broad and solid green strategic alliances with stakeholders. Through complementary resources, benefit sharing, and risk sharing, realize green innovation and inspire enterprises. The enthusiasm of manufacturing companies as the main body of innovation. For example, the development of cross-hybrid electric engines in transportation equipment manufacturing and electrical machinery manufacturing, and strengthening communication between industries can effectively promote the integration and development of green process innovation. Establish an ecological network relationship between each other, and use each other's waste, by-products and output products to reduce resource and energy consumption, reduce environmental pollution, and achieve efficient maintenance of material circulation, reasonable energy flow, and value proliferation throughout the production process. At the same time, for the public and enterprises, as the direct victims of environmental pollution and the beneficiaries of environmental protection, the public has a natural driving force to report corporate pollution behaviors; the government must also establish relevant systems to public participation which is protected and motivated to better restrict corporate emissions. This will lead to the formation of mutual supervision, interdependence and the same synergy through the macro-control of the central government and the active supervision of local governments, the voluntary implementation and cooperation of enterprises, and the active participation and supervision of the public. In order to achieve the incentive compatibility between decision-making subjects and the Pareto optimality of the system, the greening process can be better promoted.
6. Conclusion
The green development strategy is added to its own development strategy system, and the strategy guides
the company's green innovation behavior model. It is not only a model of green innovation and sustainable
development for manufacturing enterprises in Zhejiang province, but also has a strong
foresight. Such a concept and model is applicable to manufacturing enterprises across the country and
has significant reference value for manufacturing enterprises across the country. Explore the green
innovation strategy and management strategy model in green innovation of manufacturing enterprises
in Zhejiang province, drawing on the experience of green innovation development of manufacturing
enterprises in Zhejiang province, has universal significance for the overall development of China's
manufacturing industry under a green economy.

References
[1] Bai Mingguo, Li Zhongjuan. Research on the driving mechanism of green innovation in
traditional manufacturing enterprises [J]. Journal of Southwest Petroleum University (Social
Science Edition), 2018, 20 (3): 13-20.
[2] Liu Zhangsheng, Song Deyong, Gong Yuanyuan, Luo Chuanjian. Analysis on industry
differences and influencing factors of China's manufacturing green technology innovation
capabilities [J]. Information Magazine, 2017, 36 (1): 194-200.
[3] Zhuang Yougang. Accurately grasp the scientific regulations of the concept of green development
[J]. Studies on Socialism with Chinese Characteristics, 2016 (01): 89-94.
[4] Wang Fei, Lu Shasha. A Review of the relationship between green strategy and enterprise
performance [J]. Environment and Sustainable Development, 2015, 40 (4): 138-139.
[5] Zhang Sixue, Lin Hanchuan, Xing Xiaqiang. Green management actions: concepts, methods and
evaluation methods [J]. Science of Science and Technology Management, 2015, 36 (5): 3-12.
[6] Sui Jun, Bi Kexin, Yang Chaojun, Liu Gang. Factors influencing innovation performance of
manufacturing green innovation system——a study based on the perspective of technology
transfer of multinational corporations [J]. Scientific Research, 2015, 33 (3): 440-448.
[7] Yu Hai, Ren Ziping, Zhang Yongliang, Gao Guowei. China's green growth in the new normal:
concepts, actions and paths [J]. Environment and Sustainable Development, 2015, 40 (1): 7-
10.
[8] Jiao Jun, Li Yuan. Alliance-based enterprise green strategy orientation and green innovation [J].
Research and Development Management, 2011, 23 (01): 84-89.
[9] Tariq A, Badir Y F, Tariq W, et al. Drivers and consequences of green product and process
innovation: A systematic review, conceptual framework and future outlook [J]. Technology in
Society, 2017, 51 (6): 8-23