International Journal for Housing Science and Its Applications
Publish August 6, 2025. Volume 46, Issue 3 Pages 8638-8646

https,//doi.org/10.70517/ijhsa463738

Impact of the Concept of Sustainable Development on the Green Innovation Ability of Ecological Environment under the Background of Artificial Intelligence

Yuanke Zhang[1], Guangwei Wang[2,*]
[1] School of Civil Engineering, Architecture and Environment, Hubei University of Technology, Wuhan, Hubei, 430000, China
[2] Aviation Service and Tourism Management College, Guilin University of Aerospace Technology, Guilin, Guangxi, 541004, China
Corresponding authors: (e-mail: wangguangwei198809@guat.edu.cn).

Abstract At this stage, the relationship between the natural ecological environment and economic development has attracted more and more attention, and green innovation has begun to enter people's vision. For companys, green innovation activities can improve their technical level and reduce production costs, which is conducive to improving resource utilization efficiency and ecological and economic benefits, and is conducive to achieving coordination between people and nature, and between the environment and economic development. Based on this, this article examined the green innovation ability of companies and the concept of sustainable development. Under the background of Artificial Intelligence (AI), strategies to enhance the sustainable development ability such as making decisions by using expert systems have been proposed. The strategy to increase the green innovation ability was put forward, and the impact of the concept of sustainable development on the green innovation ability of companys was studied. The following findings were concluded from the experimental study. In terms of green innovation input capacity, both Company S and Company T, which adhered to the concept of sustainable development, have improved their green innovation input capacity year by year. The green innovation input capacity index of Company S was 4.27% higher than that of Company T. In other aspects, Companys S and T, which adhered to the concept of sustainable development, have improved their green innovation and ecological environmental protection capacity index year by year. The concept of sustainable development that companys adhere to is conducive to enhancing their green innovation capabilities.

Index Terms Green Innovation Ability, Ecological Environment, Sustainable Development Concept, Expert System

I. Introduction

The disorder and increasing frequency of human economic activities have caused serious damage to the natural environment, and people are gradually facing up to the contradiction between natural ecological environment protection and economic development. Based on the company perspective, compared with the conventional company economic development model, the green innovation company economic development model belongs to a sustainable and high ecological economic benefit development model. The green innovation capability of companys is an essential part of realizing the economic development model of green innovation companys. The enhancement of the green innovation capability of companys is of great significance for achieving the unity of environmental protection and economic development, and improving the ecological and economic benefits of companys. Therefore, this paper explores the green innovation capability from the perspective of companys, and analyzes the impact of the concept of sustainable development, hoping to provide valuable reference for relevant research.

Many scholars have studied green innovation. Ardyan Elia believed through analysis that green innovation activities were conducive to enhancing the competitive advantage of companies, improving the marketing ability of companys and the ecological and sustainable economic development [1]. Through experiments, Liao Wei-Wan proved that research and development of environment-friendly products and environmental education were significantly positively correlated with green innovation capability [2]. Chang Ching-Hsun believed that manufacturing companys should cultivate the ability of green innovation and green relationship, and enhance the recognition of entrepreneurial opportunities through the intermediary of co innovation behavior [3]. Huang Jing-Wen discussed the mechanisms of influence on green innovation and the contribution of green innovation to performance by analyzing the influence factors that had been derived from the dynamic capability perspective and the integrated insights of social network theory [4]. Song Wenhao argued that green innovation contributed to the competitiveness of firms, and he used organizational identity and organizational creativity theories to build a

theoretical framework for comprehending green innovation strategies [5]. Ren Shenggang believed that CEO's hometown status was beneficial to green innovation of companys, and analyzed the regulatory role of management discretion [6]. Ionescu Luminita investigated green innovation behavior in company environmental performance, climate change mitigation and sustainable finance [7]. Liu Jiamin studied the influence of digital finance on green innovation [8]. Meng Fansheng argued that digital finance achieved the integration of finance and technology, thus making up for the many shortcomings of conventional finance, which brought chances for the development of green innovation. He proved through his research that digital finance could significantly enhance regional green innovation [9]. Ramazanov Sultan studied the development, management and prediction of green innovation economy [10]. Begum Saira analyzed the impact of green transformational leadership on green innovation, and proved through research that green thinking and creative process participation were intermediaries between green transformational leadership and green innovation [11]. Zhai Yuming believed that green innovation was a critical way for companys to build competitive advantages and promote sustainable development, and discussed the role of environment, society and governance in promoting green innovation [12]. Su Huishuang believed that AI could promote companys to carry out green radical innovation and help high-tech companys to improve their green innovation ability [13]. Through experimental research, Meng Fansheng proved that law and green innovation were beneficial to the intelligent upgrading of companys, and that green innovation played a part of the intermediary role in the relationship between environmental protection laws and company intelligence [14]. All the above scholars have conducted research on green innovation and put forward valuable suggestions.

This paper put forward strategies to improve sustainable capability such as building an effective management system, as well as ways to improve green innovation capability such as training green innovation talents of companys and the role of government and consumers. The impact relationship between sustainability concept and green innovation was analyzed and an experimental study was conducted in terms of green innovation input capacity and other aspects.

II. Concept of Sustainability under the Background of Artificial Intelligence

(1) Meaning

Sustainable development includes not only natural ecology, but also social, economic, scientific and technological aspects. From the natural perspective, sustainable development is to maintain a balanced development between the carrying capacity of the natural environment and the development of human activities. From the social perspective, sustainable development is defined as the development of enhancing people's quality of life without exceeding the carrying capacity of the ecosystem. From the economic point of view, sustainable development can be defined as the development that does not adversely affect the economic income and welfare treatment of future generations while ensuring the increase of economic income and welfare treatment of contemporary people. From the perspective of science and technology, sustainable development can be defined as: turning to technologies with higher resource utilization, cleaner and greener.

(2) Principles

The principles of sustainable development include fairness, sustainability, commonality, etc. Fairness can be understood from the perspective of space and time. From the perspective of space, it refers to the need to maintain sustainability between different regions in the same era. It cannot maintain or promote the sustainability of the region by harming other regions, so that people in the same space have a fair right to enjoy resources and wealth. From the perspective of time, it means that people in the same region should ensure sustainability in different times, so that the sustainability of future generations' access to resources and wealth are not damaged. Sustainability means that human development should take into account the constraints existing in development. Resources and environment are the two most important constraints for human development. The commonness means that although the sustainable development models adopted by different regions are different, the principles and goals pursued by sustainable development are common. Different regions have different sustainable development models due to their different natural environment, economic development, social culture and other aspects. However, they all need to work together to achieve the overall goal of sustainable development.

(3) Capacity building

Capacity building for sustainable development includes the following contents: building an effective management system, establishing an effective legal system, using science and technology to promote sustainable development, strengthening education and expanding public participation, as shown in Figure 1.

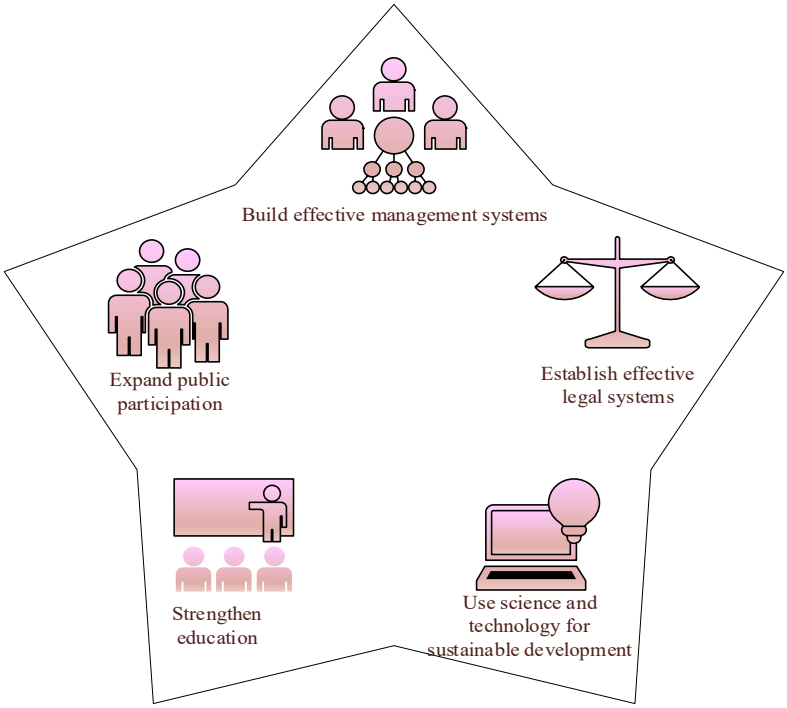

Figure 1: Capacity-building for sustainable development

a) Building an effective management system

The disharmony between ecological environment and development is largely caused by management factors. The improvement of sustainable development capacity can be achieved through the following ways. A number of excellent management talents have been cultivated to play a constructive and guiding role. The integration of laws, policies and economic means is realized to promote the establishment of a mature sustainable development mechanism.

b) Establishing an effective legal system

Legal system is the guarantee for the implementation of sustainable development and continuous optimization. Legislators can formulate and improve laws on the natural ecological environment to provide legal basis for the protection of natural ecology. The law enforcement agencies should strengthen the monitoring of the destruction of the natural ecological environment to discover and deal with the ecological destruction in a timely manner, and control the environmental pollution in a timely manner, so as to ensure the sustainability of resources and ecology.

c) Using science and technology to promote sustainable development

Science and technology is an essential driving force for the improvement of sustainability. It can provide support for the decision-making and management of sustainable development, such as the use of AI Internet of Things for environmental monitoring, the use of big data analysis platform for data collection and analysis, and the use of expert systems for decision-making [15]. By means of science and technology, more people can realize that man and nature should maintain a harmonious relationship. The progress of science and technology can provide further support for the governance and protection of the natural ecological environment, which is beneficial to enhancing the use efficiency of resources and ecological and economic benefits.

d) Strengthening education

Education for sustainable development includes not only school education, but also social education. From the perspective of schools, school administrators should strengthen sustainable development education and cultivate students' awareness of sustainability. They should also impart their knowledge on natural ecological environment sustainability, economic development sustainability, economic ecological environment sustainability, and improve their ability to apply sustainable knowledge. From the social perspective, relevant departments should strengthen the ideological guidance of the public to imperceptibly cultivate the concept of sustainable development of the public.

5) Expanding public participation

Public participation is an important aspect of enhancing the capacity for sustainable development. Therefore, the way of public participation should be guaranteed, and the way of public participation should be constantly

optimized. For the public, they should not only participate in the decision-making process related to the natural ecological environment, but also participate in the implementation process.

III. Relationship between Sustainable Concept and Green Innovation Ability

(1) Characteristics of green innovation of companys

In a narrow sense, green innovation mainly refers to the green innovation activities of companys. In a broad sense, the subjects of green innovation include not only companys, but also multiple subjects such as government, companys, regions and social organizations. This paper studies green innovation with companys as the main body, and green innovation is characterized by complexity, synergy, etc., as shown in Figure 2.

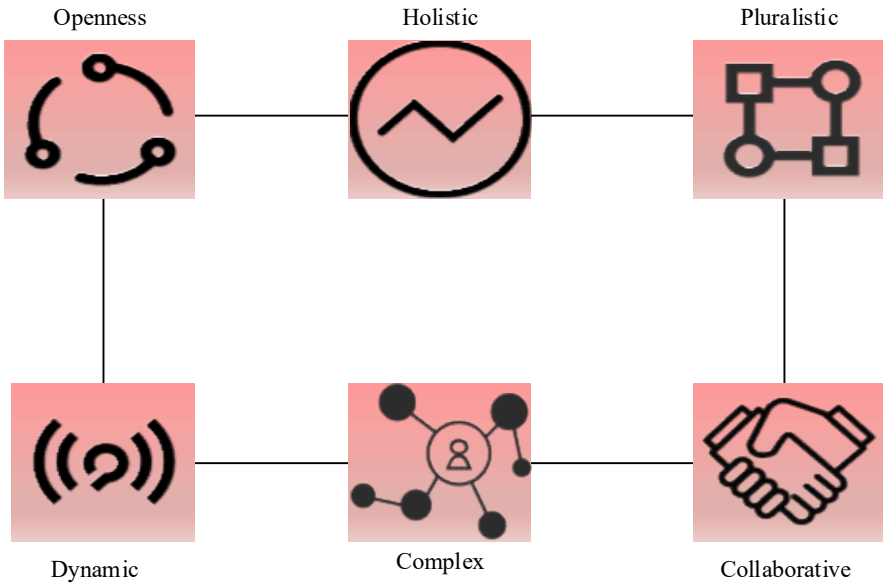

Figure 2: Characteristics of green innovation in companys

Openness: Information and resources exchange is required between internal subsystems of companys, and companys also need to obtain materials and information from the external environment of green innovation. Integrity: Although the internal elements of the company are independent of each other, they can be regarded as a whole in the process of green innovation activities. Diversity: companys need to exchange information and resources with diversified subjects when carrying out green innovation. In addition, the internal elements of companys that exchange materials and information are also multiple subjects. Dynamic: The process of green innovation is not static, but dynamic and adjustable. Complexity: The internal green innovation elements of companys are complex and constantly changing, while the external innovation environment is more complex and changeable. Synergy: Company green innovation requires the coordination among management elements, technology elements, economic elements and company culture elements.

(2) Impact of the concept of sustainable development

By adhering to the concept of sustainable development for green innovation, companys can enhance their own green innovation input, management, service, marketing, and eco-environmental protection capabilities. Investment ability: Under the influence of the concept of sustainable development, the proportion of professional and technical personnel is increased, and the investment level of intellectual capital is improved. Management ability: Under the guidance of sustainable concept, companys advocate green innovation culture and strengthen the adaptability of organizational structure to green innovation. Service ability: Under the influence of the concept of sustainable development, company managers pay more attention to the improvement of service ability, and the green innovative services of companys are more recognized by consumers. Marketing ability: companys adhering to the concept of sustainable development improve the level of economic market research and prediction, and improve the level of adaptation of their own marketing system. Ability to protect the ecological environment: Company managers adhere to the concept of sustainable development, which promote the enhancement of the ecological and economic benefits of companys.

(3) Influence based on multiple regression

The influencing factor of company green innovation ability is set as dependent variable α_n, and the company green innovation capability is set as independent variable ζ. The linear equation of multiple regression is:

$$\zeta = \omega_0 + \omega_1\alpha_1 + \omega_2\alpha_2 + ... + \omega_{n-1}\alpha_{n-1} + \omega_n\alpha_n + \rho \tag{1}$$

Among them, ρ is the error value and ω_0 is the constant.

Other influencing factors are continuously observed, and the multiple regression equation obtained is:

$$\begin{cases} \zeta_1 = \omega_0 + \omega_1\alpha_{11} + \omega_2\alpha_{12} + ... + \omega_{n-1}\alpha_{1(n-1)} + \omega_n\alpha_{1n} + \rho_1 \\ ... \\ \zeta_n = \omega_0 + \omega_1\alpha_{n1} + \omega_2\alpha_{n2} + ... + \omega_{n-1}\alpha_{n(n-1)} + \omega_n\alpha_{nn} + \rho_n \end{cases} \tag{2}$$

The matrix expression of multiple regression equation is:

$$\zeta = \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ ... \\ \zeta_n \end{bmatrix}, \omega = \begin{bmatrix} \omega_0 \\ \omega_1 \\ ... \\ \omega_n \end{bmatrix}, \alpha = \begin{bmatrix} 1 & \alpha_{11} & ... & \alpha_{1m} \\ 1 & \alpha_{21} & ... & \alpha_{2m} \\ & & ... & \\ 1 & \alpha_{n1} & ... & \alpha_{nm} \end{bmatrix}, \quad \rho = \begin{bmatrix} \rho_1 \\ \rho_2 \\ ... \\ \rho_n \end{bmatrix} \tag{3}$$

Then the multiple regression equation can be converted into:

$$\zeta = \alpha\omega + \rho \tag{4}$$

The least squares method is used to evaluate and estimate the unknown parameters to minimize the sum of squares of the residuals. The equation is as follows:

$$L(\sigma) = \sum_{p=1}^{n}\left(\beta_p - \omega_0 - \omega_1\alpha_{p1} - ... - \omega_m\alpha_{pm}\right)^2 = (\beta - a\sigma)'((\beta - a\sigma)) \tag{5}$$

IV. Strategies to Enhance the Green Innovation Capability of companys

Green innovation can coordinate the relationship between economic growth and environmental protection to ensure the friendly relationship between people and the natural environment, so as to achieve the sustainability and high-quality quantification of ecological protection and improve the utilization rate of natural resources. From the perspective of the company, the green innovation behavior of the company is beneficial to improving the ecological and economic benefits and enhancing the competitiveness. It is also conducive to improving their own technical level, thereby enhancing the economic efficiency and competitiveness of companys. The path to enhance the green innovation capability of companys' ecological environment can be realized from the following aspects: formulation of innovation strategic planning, increase of capital investment, training of talents, and joint role of government and consumers, as shown in Figure 3.

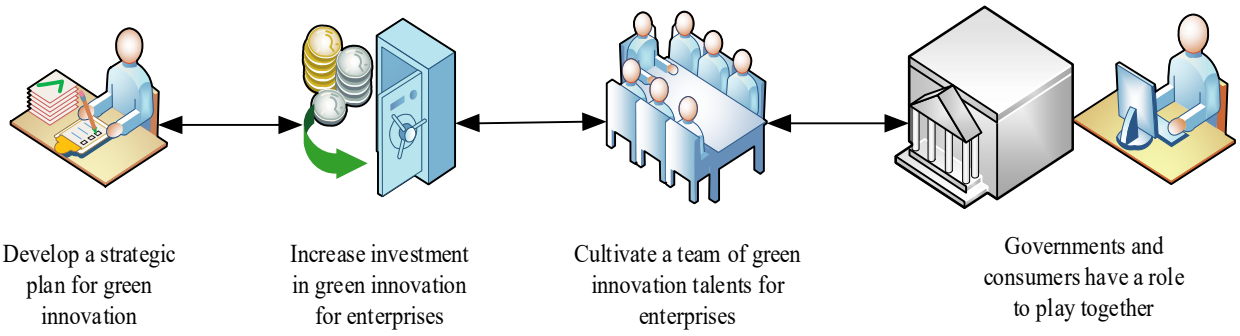

Figure 3: Strategies to enhance the green innovation capabilities of companys

(1) Formulating green innovation strategic plan

Company managers should formulate reasonable and sustainable strategic plans, including the formulation of green innovation goals, ways to achieve goals, specific implementation plans, etc. When making strategic plans,

company managers should master as much information as possible to enhance the scientificity and comprehensiveness of planning. Company managers should deeply understand the limitations of their own companys in green innovation, and understand the gap between the status quo of green innovation and the goal of green innovation, so as to formulate a scientific strategic plan.

(2) Increasing the stable and sustainable investment of companys' green innovation funds

Companys should increase the funding for green innovation investments to ensure the sustainability of economic development and the stability of economic and ecological environment. From the external green innovation environment of companys, the government and financial institutions should provide support for company innovation in terms of tax and interest, and create a better policy environment and economic environment for company innovation activities.

(3) Cultivating green and innovative talents

The cultivation of green innovative talents in companys can be started from three aspects. First, company management should recognize the importance of talents, and should have and cultivate the awareness and environment of respecting talents and knowledge. Second, company managers can actively attract foreign talents and make full use of the role of foreign talents in green innovation and experience transfer. Thirdly, company managers should establish a reliable mechanism for training green and innovative talents.

(4) Playing a role between government and consumers

The government should play a guiding and promoting role to determine and continuously improve the rules of market transactions. The government should expand the scope of green product procurement for companys to provide support for the protection of company surplus, which is also conducive to ensuring that more companys participate in innovation activities. Consumers should cultivate green consumption values to realize green and ecological consumption life.

V. Experiment on Green Innovation Ability of companys

This paper analyzes the green innovation capability of two logistics companys, and calls them Company S and Company T. Both companys have implemented the concept of sustainability. Company S has deeply implemented the concept of sustainability. In this paper, the green innovation ability of companys S and T in 2019-2021 has been specifically analyzed from the aspects of green innovation and ecological environment protection ability.

(1) Green innovation input capacity

The input capacity of green innovation is measured from two aspects: the level of scientific and technological investment of companys and the level of intellectual capital investment of companys. The value range of green innovation input capacity index is 1-100, as shown in Figure 4.

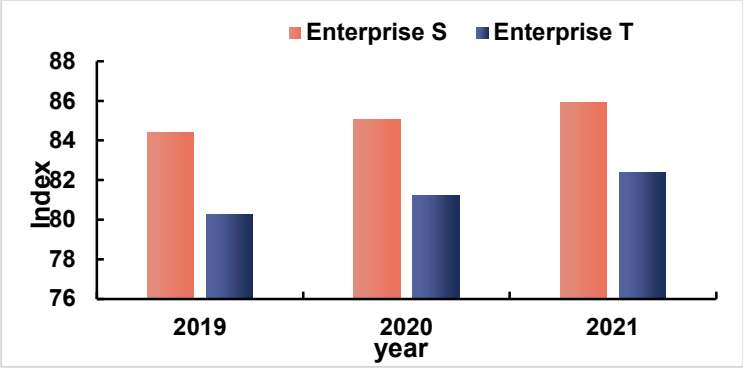

Figure 4: Green innovation investment capacity

As shown in Figure 4, in 2019, the input capacity index of Company S is 84.42 and that of Company T is 80.26. In 2020, the input capacity index of Company S is 85.06 and that of Company T is 81.25. In 2021, the input capacity index of Company S is 85.91, and that of Company T is 82.39. The green innovation input capacity index of Company S is 3.52 higher than that of Company T, with 4.27% higher. From the perspective of Company S, the annual green innovation input capacity index of Company S has increased compared with previous years, indicating that the company's adherence to the concept of sustainable development can effectively promote the increase of its green innovation input capacity. From the perspective of Company T, the annual green innovation input capacity index of Company T has also increased compared with the previous year, which once again proves

the positive correlation between the concept of sustainable development and the green innovation input capacity. In addition, the green innovation input capacity index of Company S is higher.

(2) Green innovation management capability

The green innovation management capability is measured in the following aspects, namely, the adaptability of company management culture and organizational structure to innovation. The value range of the index is 1-100, as shown in Figure 5.

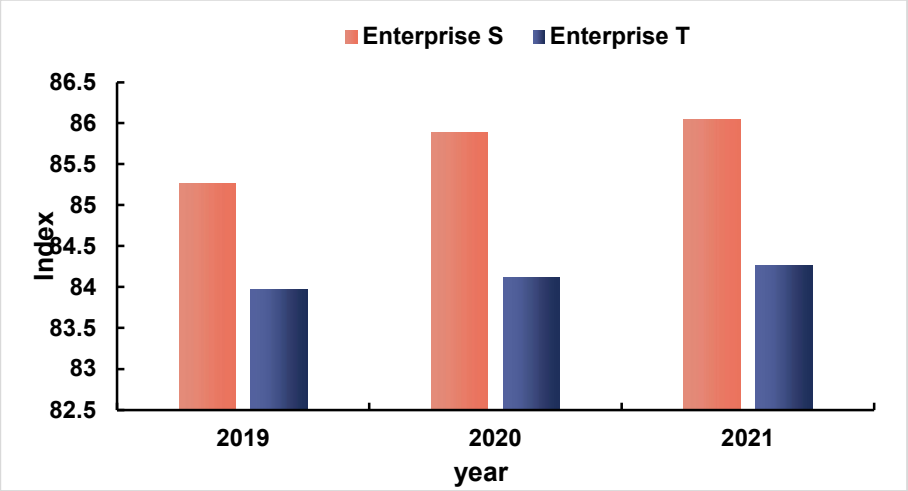

Figure 5: Green innovation management capabilities

As shown in Figure 5, in terms of development trend, the innovation management capability indexes of Companys S and T are in a rising trend. From the specific data, in 2019, the innovation management ability index of Company S is 85.26, and the green innovation management ability index of Company T is 83.97. In 2020, the green innovation management ability index of Company S is 85.89, and that of Company T is 84.12. In 2021, the green innovation management ability index of Company S is 86.04, and that of Company T is 84.27. It can be learned from the above data that the green innovation management ability of the two companys adhering to the concept of sustainable development is gradually increasing, and the innovation management ability of Company S is stronger than that of Company T. It shows that there is a positive relationship between adhering to the sustainable concept and the improvement of innovation management ability, and the degree of implementation of the sustainable concept affects the effect of ability improvement.

(3) Green innovation service ability

The green innovation service ability is measured from the following aspects: customer recognition of green logistics services, service suitability. The green innovation service capability index takes values in the range of 1-100, as shown in Figure 6.

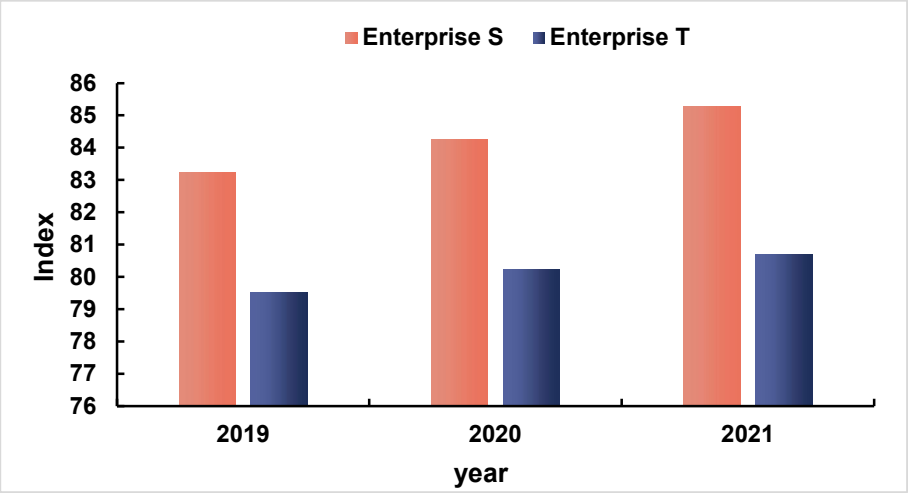

Figure 6: Green innovation service capabilities

As shown in Figure 6, in 2019, the green innovation service capacity index of Company S is 83.24, and that of Company T is 79.51. The green innovation service capability index of Company S is higher than that of Company T. In 2020, the green innovation service capacity index of Company S is 84.26, and that of Company T is 80.23. There is a gap between the two. In 2021, the green innovation service capacity index of Company S is 85.27, and that of Company T is 80.7. The green innovation service capability index of Company S is still higher than that of Company T. The above data indicate that the green innovation service capacity of the two companies that adhere to the concept of sustainable development is rising annually, and the innovation service capacity of Company S is higher.

(4) Green innovative marketing capability

The green innovation marketing capability is measured from the following aspects: the understanding and prediction level of the market, and the adaptability of the marketing system. The green innovation marketing capability index takes values ranging from 1-100, as shown in Figure 7.

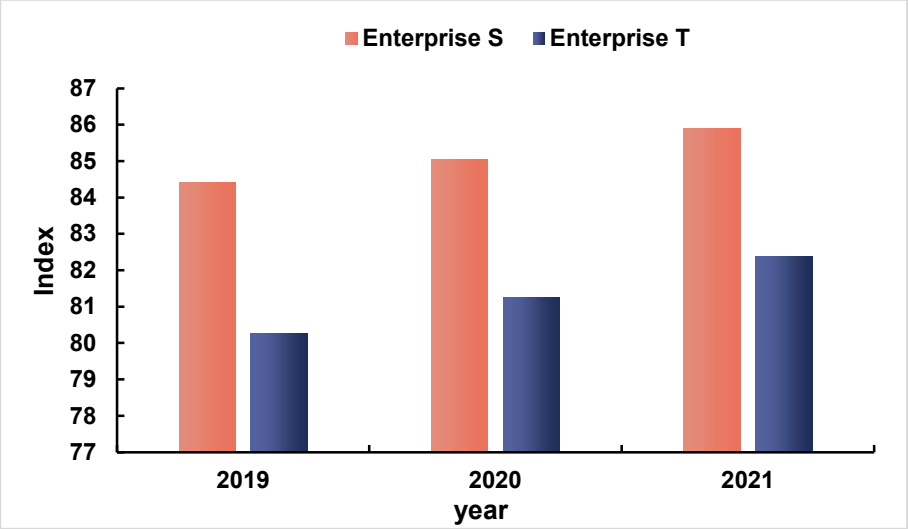

Figure 7: Green innovative marketing capabilities

In Figure 7, from the perspective of the change trend, the green innovation marketing capability indexes of Company S and Company T are growing gradually. On the whole, the innovative marketing capability index of Company S is higher than that of Company T. From the specific data, in 2019, the innovative marketing capability index of Company S is 84.42, and that of Company T is 80.26. In 2020, the innovative marketing capability index of Company S is 85.06, and that of Company T is 81.25. In 2021, the innovative marketing capability index of Company S is 85.91, and that of Company T is 82.39.

(5) Green innovation and ecological environment protection capability

The ecological environment protection capability of green innovation is measured from the energy consumption per unit output value. The value range of the ecological environment protection capability index of green innovation is 1-100, as shown in Table 1.

Table 1: Green innovation ecological environmental protection capabilities

	Company S	Company T
2019	85.07	83.26
2020	86.24	84.68
2021	87.19	85.04

As shown in Table 1, in 2019, the green innovation ecological environment protection capacity index of Company S is 85.07, and that of Company T is 83.26. In 2020, the green innovation ecological environment protection capacity index of Company S is 86.24, and the innovation ecological environment protection capacity index of Company T is 84.68. In 2021, the innovation ecological environment protection ability index of Company S is 87.19, and the green innovation ecological environment protection ability index of Company T is 85.04. It can be learned

from the specific data that there is a positive correlation between the behavior of companys following the concept of sustainable development and the promotion of green innovative marketing capabilities of companys.

VI. Conclusion

This paper outlined the concept of sustainable development, fairness and other principles, as well as capacity building. After describing the characteristics of green innovation with companys as the main body, such as openness, integrity and diversity, the relationship between the concept of sustainable development and green innovation ability was explored. After analyzing the benefits of companys' green innovation, the countermeasures to improve green innovation ability, such as strategic planning and training innovative talents, were proposed, and the experimental research on companys' green innovation ability was carried out. Research showed that companys adhering to the concept of sustainable development could improve their green innovation ability. This paper has reached the conclusion that companys' adherence to the concept of sustainable development could improve their green innovation ability, which provided a reference path for the research of green innovation ability. However, there is not enough sample data for experimental research in this paper. It is hoped that there would be an opportunity to add sample data in future studies to make the article more persuasive.

Reference

[1] Ardyan, Elia. "Green innovation capability as driver of sustainable competitive advantages and smes marketing performance." Technology 8.8 (2017): 1114-1122.
[2] Liao, Wei-Wan. "A study on the correlations among environmental education, environment-friendly product development, and green innovation capability in an enterprise." Eurasia Journal of Mathematics, Science and Technology Education 13.8 (2017): 5435-5444.
[3] Chang, Ching-Hsun, Meng-Yi Shih, and Hsin-Ju Peng. "Enhancing entrepreneurial opportunity recognition: Relationships among green innovative capability, green relational capability, and co-innovation behavior." Business Strategy and the Environment 31.4 (2022): 1358-1368.
[4] Huang, Jing-Wen, and Yong-Hui Li. "Green innovation and performance: The view of organizational capability and social reciprocity." Journal of Business Ethics 145.2 (2017): 309-324.
[5] Song, Wenhao, and Hongyan Yu. "Green innovation strategy and green innovation: The roles of green creativity and green organizational identity." Corporate Social Responsibility and Environmental Management 25.2 (2018): 135-150.
[6] Ren, Shenggang. "CEO hometown identity and firm green innovation." Business Strategy and the Environment 30.2 (2021): 756-774.
[7] Ionescu, Luminita. "Corporate environmental performance, climate change mitigation, and green innovation behavior in sustainable finance." Economics, Management and Financial Markets 16.3 (2021): 94-106.
[8] Liu, Jiamin. "Can digital finance promote corporate green innovation?." Environmental Science and Pollution Research 29.24 (2022): 35828-35840.
[9] Meng, Fansheng, and Wanyu Zhang. "Digital finance and regional green innovation: evidence from Chinese cities." Environmental Science and Pollution Research 29.59 (2022): 89498-89521.
[10] Ramazanov, Sultan. "Development, Management and Forecasting in a Green Innovative Economy, Based on the Integral Dynamics Model in the Conditions of 'Industry–4.0'." ACCESS Journal: Access to science-business-innovation in digital economy 1.1 (2020): 9-29.
[11] Begum, Saira. "Does green transformational leadership lead to green innovation? The role of green thinking and creative process engagement." Business Strategy and the Environment 31.1 (2022): 580-597.
[12] Zhai, Yuming. "Does better environmental, social, and governance induce better corporate green innovation: The mediating role of financing constraints." Corporate Social Responsibility and Environmental Management 29.5 (2022): 1513-1526.
[13] Su, Huishuang. "Artificial intelligence empowerment: The impact of research and development investment on green radical innovation in high-tech enterprises." Systems Research and Behavioral Science 39.3 (2022): 489-502.
[14] Meng, Fansheng, Ye Xu, and Gang Zhao. "Environmental regulations, green innovation and intelligent upgrading of manufacturing enterprises: evidence from China." Scientific reports 10.1 (2020): 1-17.
[15] Rizzo, Cristian. "A fuzzy expert system for sustainable local development." Regional Studies 56.5 (2022): 808-817.