Research Article

Analysis on the Independent Innovation Path and Development Trend of Emerging Marine Industry Based on DEA Model

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The development trend of the emerging marine industry affects the development of the marine economy, to study the independent innovation path of the emerging marine industry and the empirical analysis of its development trend. Based on the independent innovation path of the emerging marine industry, explore the development trend of the emerging marine industry. Select the added value of the emerging marine industry as the dependent variable; R&D personnel and R&D funds as the intermediary variables; innovation efficiency as the explanatory variable; and technical capabilities, technical management capabilities, technical strategies, and network capabilities as control variables, using data packets. The network analysis method establishes a development trend measurement model and analyzes the independent innovation path and development trend of the emerging marine industry through the established model. The four independent innovation paths of technological capability, technological management capability, technological strategy, and network capability have a positive incentive effect on the development of emerging marine industries, and technological capability has a higher incentive for the development of emerging marine industries. Based on the results of empirical analysis, it proposes strategies to promote the development of emerging marine industries, such as enhancing public awareness of emerging marine industries, improving long-term mechanisms for the development of emerging marine industries, and enhancing the independent innovation capabilities of emerging marine industries.

1. Introduction

Emerging industries are an important choice for China to achieve sustainable economic development. Emerging marine industries are of great significance to driving the transformation of the marine economy, enhancing the core competitiveness of the marine economy, and adjusting the structure of the marine economy [1–3]. Independent innovation of emerging marine industries has high urgency and necessity [4]. To study the path of independent innovation of emerging marine industries, it is necessary to clarify the current state of marine economic development, recognize the main characteristics of emerging marine industries, and understand how emerging marine industries influence the marine economy and the important significance of China's economic development. Marine high-tech is an important part of the emerging marine industry. Marine high-tech can speed up the upgrading of

marine economic structure and realize the optimization of marine economic structure. At present, all countries in the world attach great importance to the development of marine high-tech [5, 6].

In 2010, the director of the State Oceanic Administration pointed out that the emerging marine industry is an important part of the marine high-tech industry, and it is of high strategic significance to include the emerging marine industry in the marine high-tech industry. The marine biomedicine industry, marine renewable energy industry, seawater comprehensive utilization industry, marine power industry, seawater desalination industry, deep sea industry, and marine equipment industry are all important parts of the emerging marine industry. Vigorously developing the above-mentioned industries can achieve rapid marine technology development. Emerging marine industries can demonstrate the country's marine strategic intentions [7], using marine high-tech to tap the development

potential of the marine economy, so that it has broader market prospects, and emerging marine industries have long-term, dynamic, and overall and oriented characteristics, and it can lead the rapid development of the marine economy.

Current research on emerging marine industry depth, part of the study was underpowered and in the research process, the paper analyzes the current situation of new ocean industries, only puts forward the strategy but did not predict development trend, for the future development direction of master degree is low, but the results credibility is low, and the imperfection of the resolution strategy.

In view of the above problems, in order to improve the credibility of the independent innovation path and accurately predict the development trend of the marine industry, study the independent innovation path and development trend of the emerging marine industry, fully analyze the independent innovation path of the emerging marine industry, verify its development trend through empirical research, propose development strategies that can promote the independent innovation path of emerging marine industry based on the empirical research results, and promote the continuous development of the marine economy.

2. Literature Review

Emerging marine industries have high environmental friendliness and advanced technology and have huge development potential. Emerging marine industries have become an important decision point to promote marine economic growth. In recent years, the annual output value of emerging marine industries has increased year by year. Many researchers have conducted a lot of research on emerging marine industries. Zaehringer et al. believe that higher technological capabilities can improve the competitiveness of industries and enterprises [8], which can be used as an important indicator to measure the efficiency of enterprise innovation. The results of research scholars such as Bendjama et al. show that corporate sales capabilities can be reflected through the network [9], and network capabilities have a high impact on the success of independent innovation; Wangmo et al. believe that the accumulation of effective technical resources can be achieved through corporate technology strategies [10], and effective technical resources can improve the core technical level of the enterprise. Through the above-given research, the present stage by attention gradually emerging marine industry and obtained the recognition of people, the present study has obtained certain achievements, but the emerging marine industry studies have limitations, its independent innovation path, and the development trend analysis in-depth; by its development trend is not very accurate budget, lead to study the effect not beautiful. Therefore, this paper puts forward an empirical analysis on the independent innovation path and development trend of China's emerging Marine industry.

3. Research Method

Select the relevant data applied by a marine biomedical company in independent innovation in 2019 as the empirical analysis data source, and use the development trend calculation

model to study the independent innovation path and development trend of the emerging marine industry [11, 12].

3.1. Development Trend Estimation Model. Data Envelopment Analysis (DEA) is an evaluation method based on relative efficiency using linear planning and convex analysis as tools [13]. When the input and output of the decision-making unit of empirical analysis have not changed, comparing the relative efficiency between decision-making units through mathematical programming models and statistical data can clarify the more effective elements [14] and obtain the relative effects of different variables.

Suppose there are s decision-making units. The output and input quantities contained in each decision-making unit are m and n, respectively. Y_{ij} and X_{ij}, respectively, represent the total output and total input of type j of the i decision-making unit. The output vector of the unit is $Y_{ij} = (y_{1j}, y_{2j}, j_{3j}, \ldots, y_{nj})^T$, and the input vector is $X_{ij} = (x_{1j}, x_{2j}, x_{3j}, \ldots, x_{mj})^T$.

Suppose the constraint of the development trend measurement model is the efficiency index of the decision-making unit, and the available development trend measurement model takes the efficiency index of j_1 decision-making units as the target formula as follows:

$$\begin{cases} s.t. \sum_{j=1}^{n} \lambda_j x_j \leq \theta x_0, \\ \min\theta, \\ \sum_{j=1}^{n} \lambda_j x_j \geq y_0, \\ \lambda_j \geq 0, j = 1, 2, \ldots, n. \end{cases} \quad (1)$$

Here, the decision coefficient θ is unconstrained, and λ_j represents the combined weight of the decision-making unit. The slack variables S^+ and S^+ are introduced into the formula, and the formula is as follows:

$$\begin{cases} \min\theta, \\ s.t. \sum_{j=1}^{n} \lambda_j x_j + S^+ \leq \theta x_0, \\ \sum_{j=1}^{n} \lambda_j x_j - S^- \geq y_0, \\ \lambda_j \geq 0, j = 1, 2, \ldots, n. \end{cases} \quad (2)$$

Here, θ is unconstrained, $S^+ \geq 0$, $S^- \leq 0$.

Analyzing formula (2), let $\min\theta = 1, S^+ = 0$, $S^+ = 0$, $S^- = 0$. The available decision-making unit is DEA valid. At this time, the economic activity scale and technology of the decision-making unit are valid; when $\min\theta = 1, S^+ = 1, S^- = 1$ and at least one of the inputs or outputs is greater than or equal to 0, the decision unit λ_1 can be obtained at this time for weak DEA to be effective, the decision-making unit has only one effective economic activity with effective scale or technically effective and cannot satisfy the two economic activities at the same time; when $\min\theta \leq 1$, the decision-making unit is invalid DEA at this time, and the size of the decision-making unit λ_1 and technology are invalid.

3.2. Variable Definition. Select the added value of the emerging marine industry that can directly reflect the development trend of the emerging marine industry as the dependent variable for the empirical analysis [15, 16], and select the R&D personnel and R&D funds that can affect the results of independent innovation as the intermediary variables of the established development trend measurement model; select the innovation efficiency that can be obtained through different independent innovation paths as the explanatory variable; select technological capabilities, technological management capabilities, technological strategies, and network capabilities in the path of independent innovation as the control variables for the empirical analysis of the development trend measurement model.

3.2.1. Interpreted Variables. Set the added value of the emerging marine industry as the explained variable [17], and reflect the innovation efficiency of independent innovation through the four aspects of the independent innovation path: technical capabilities, technical management capabilities, technical strategies, and network capabilities, and use innovation efficiency to measure the added value of emerging marine industries, and clarify emerging industry development trend of the marine.

3.2.2. Control Variables

(1) *Technical Ability.* Technological capabilities are of great significance to the independent innovation of enterprises in the emerging marine industry [18, 19]. Bao Gongmin and others believe that when an enterprise has a high level of technological capability, its chance of success in innovation is higher than that of a low-level technological capability enterprise. Enterprise independent innovation is an important development stage of enterprise technological innovation, and the improvement of technological capabilities has a positive impact on enterprise independent innovation.

(2) *Network Capability.* The path of independent innovation is the whole process of innovative conception, innovative research and development, innovative product production, and the commercialization of innovative products. Enterprises need a lot of resources to achieve independent innovation. Different enterprises often have limited resources, and all the resources needed for innovation can be obtained through the network of relationships. Network capability is an important indicator for evaluating the access to different resources of enterprises, and enterprises can use different channels to solve resource problems through the network.

(3) *Technology Strategy.* The technological choice of an enterprise is the focus of the technological strategy of an enterprise. A reasonable technological choice can determine the major decisions of enterprise technology acquisition, maintenance, and utilization. The technological decision of the enterprise affects product and process innovation. The advanced development stages and goals of enterprise technological innovation are determined by independent innovation [20]. The independent innovation of enterprises is directly related to the technological strategy of enterprises. Enterprises use technological strategic planning to determine the training mode and accumulation of technological resources, which affect the technological level of the enterprise. When an enterprise formulates a reasonable technological strategy, it will form a large number of R&D resources and train many high-level R&D personnel. High-level R&D personnel can effectively enhance the company's corporate culture of learning technology and enhance the company's technical level.

(4) *Technical Management Ability.* There is a close theoretical relationship between independent innovation of enterprises and technological management capabilities. The technological strength of enterprises determines the level of technological innovation of enterprises [21]. The implementation of technological management of enterprises can improve the success rate of enterprise innovation. After investigating and studying the results of many companies, Cooper came to the conclusion: high-quality management is an important factor for the success of independent innovation of an enterprise, and the performance of an enterprise's technological innovation can promote its technological management ability. The advanced development stage and goal of enterprise technological innovation is independent innovation, and independent innovation of enterprises can bring positive guidance through technological management capabilities.

The management of technological resources of an enterprise can enhance the competitive advantage of an enterprise. The adjustment of an enterprise's organizational structure, the quality of management models, and the level of technical resource management are important manifestations of the level of technical management. The formulation of corporate technology strategy determines the level of corporate technology management. The emerging marine industry is a new industry. With the improvement of marine industry competitiveness and the emergence of many high-tech levels, the network environment determines the technological acquisition of enterprises, and the enterprise network environment affects the external management methods of enterprises and determines the network status of enterprises. The network status of an enterprise determines the network capability of the enterprise in the process of independent innovation [22, 23]. When the enterprise is at the center of the network, the enterprise has a higher ability to control network resources. The planning of enterprise technology resources and the created corporate culture are also important factors that determine network capabilities.

4. Results Analysis

The development trend calculation model established was used to analyze the independent innovation path and development trend of the emerging marine industry. The experimental computer was configured with 2.0 GHz Core Pentium, DDRI memory of 2 GB, and notebook hard disk of 7500 speed of 300 GB. The operating system is WindowsXP, the database is SQL, the development tool is C++, the development environment is VC, and the data isolation tool is v0.8.3. libpcap. Use the libpcap tool to collect about 500 MB of data packets from the network. The analysis results are shown in Table 1.

Analyzing the results of the empirical analysis in Table 1, it can be seen that with the increase of the set variables, the significance of each variable has improved, which verifies that the set development trend measurement model has high feasibility. The regression coefficient of each variable passed the t-test at the 10% significance level, indicating that the results of studying the development trend of emerging marine industries through independent innovation paths are credible.

In order to further determine the effectiveness of the proposed design method, improve the credibility, and verify the design method of forecast accuracy, in the form of contrast analysis of the experimental verification, contrast method for literature [21], the method using the panel vector autoregressive model (PVAR) analysis of marine science and technology innovation, marine dynamic relationship between total factor productivity and the development of the marine economy. The specific experimental results are shown in Table 2.

According to Table 2, the prediction accuracy of the design method reaches more than 99.0%, and that of the PVAR method is about 90.0%, and the maximum value is only 90.5%. Compared with the two methods, the accuracy of the design method is improved by more than 8.5%. Therefore, the prediction accuracy of the design method is high, and it is effective and feasible.

Analyzing the experimental results in Table 1, technical capabilities have significantly stimulated the innovation efficiency of emerging marine industries, improved technological capabilities, and obtained higher added value of emerging marine industries, effectively promoting the development of enterprises in emerging marine industries. The efficiency of independent innovation of enterprises has been improved, the cost of independent research and development of independent innovation activities of enterprises and the risk of independent research and development have been reduced, and the safety guarantee of enterprises in the emerging marine industry has been improved.

The network capabilities in the independent innovation path of enterprises have a higher incentive effect on the development of enterprises in the emerging marine industry. That is, the enterprises in the emerging marine industry have higher network capabilities in the process of independent innovation, and the stronger the independent innovation capabilities of enterprises. The network is the main channel for the dissemination of many high-tech technologies. The

enhancement of corporate network capabilities will provide enterprises with more materials for independent innovation, improve the efficiency of independent innovation, and promote the further development of emerging marine industries.

The technological strategy in the independent innovation path of enterprises has a high incentive effect on the development trend of emerging marine industries. Emerging marine industries mainly include the marine power industry, seawater utilization industry, and marine biomedicine industry. Enterprises have good technological strategic planning for the industries involved, which will promote the further development of enterprises' independent innovation, enhance the level of independent innovation of enterprises, and promote further development of emerging marine industries.

The technological management ability in the independent innovation path of enterprises has a significant incentive effect on the development trend of the emerging marine industry. Enterprise technology management capabilities are mainly reflected in three aspects: personnel management capabilities, information management capabilities, and equipment management capabilities. Enterprises have high technical management capabilities and can provide hardware and software support for independent innovation of enterprises and use superior technical management capabilities to promote independent innovation of emerging marine industries and promote the development of emerging marine industries. If there are problems of low management efficiency and redundant personnel within the enterprise, it will affect the independent innovation ability of the enterprise. Relevant studies have shown that compared with other types of enterprises, state-owned enterprises have lower innovation capabilities. The main reason is that state-owned enterprises usually have lower management efficiency, which reduces the independent innovation ability and vitality of state-owned enterprises, and to promote the development of emerging marine industries, the enterprise should start from the improvement of enterprise technology management capabilities.

The independent research and development funds of enterprises have a significant positive effect on the development trend of the emerging marine industry. The increase in independent research and development funds of enterprises can encourage enterprises to actively carry out independent innovation. The increase in R&D funds of enterprises and the support of R&D funds for independent innovation of enterprises effectively promote enterprise development and innovation. The larger the scale of the enterprise, the more R&D funds the enterprise can invest in, and the more R&D personnel the enterprise has, which can further promote the development of emerging marine industries.

Enterprise R&D personnel have a significant positive effect on the development trend of the emerging marine industry. The independent R&D funds of enterprises are increased. Enterprises can use R&D funds to hire more R&D personnel with professional and technical level. Enterprise R&D personnel have an incentive effect on independent

TABLE 1: The incentive effect of independent innovation paths on the development trend of emerging marine industries.

Variable name	Technical skills	Network capability	Technology strategy	Technical management ability
Technical skills	0.095*	0.452*	0.387**	0.652*
Network capability	0.852*	0.765**	0.523*	0.782***
Technology strategy	0.462*	0.858*	0.654**	0.184**
Technical management ability	0.658*	0.474*	0.384**	0.964***

Note: ∗, ∗∗, and ∗∗∗ represent the significance of 10%, 5%, and 1%, respectively.

TABLE 2: Prediction accuracy analysis of different methods.

Number of experiments (times)	Accuracy (%)	
	PVAR method	This paper method
1	90.2	99.0
2	89.7	99.3
3	88.6	99.7
4	90.5	99.4
5	90.3	99.1

innovation of enterprises and can promote the development of emerging marine industries.

5. Discussion

Through an empirical analysis of the independent innovation of the emerging marine industry and discussing the incentive effect of the independent innovation path on the development of the emerging marine industry, the following conclusions can be drawn.

Different independent innovation paths have different incentive effects on the development trend of the emerging marine industry, and technological capabilities have a more significant role in promoting the development trend of the emerging marine industry. The path of independent innovation can promote the development of emerging marine industries. The higher the R&D investment of enterprises in the emerging marine industry, the stronger their independent innovation capabilities. The independent innovation path of the emerging marine industry, namely, technological capability, technological management capability, technological strategy, and network capability, has a positive incentive effect on the development of the emerging marine industry. Compared with network capabilities, technical management capabilities, and technological strategies, technological capabilities have a higher incentive for the development of emerging marine industries.

In view of the empirical analysis results of the independent innovation path and development trend of the emerging marine industry, the following measures are proposed to promote the development of the emerging marine industry.

5.1. Raise Public Awareness of Emerging Marine Industries.
A good combination of companies, media, government, and the public, vigorously promote the emerging marine industry and raise public awareness of the emerging marine industry. Promoting knowledge about emerging marine industries through the Internet, TV stations, newspapers, etc., to enhance public awareness of emerging marine industries. Seawater desalination and comprehensive utilization industry, marine equipment industry, marine biomedicine industry, deep sea industry, etc., are all emerging marine industries. The public should understand the development trends of many emerging marine industries and clarify that the development of emerging marine industries has implications for the marine economy and the development of my country's national economy. To clarify the significance of developing emerging marine industries for the marine economy and the development of China's national economy [24], marine administrative departments should provide an economic foundation and reliable guarantee for the development of emerging marine industries and always pay attention to the independent innovation achievements of emerging marine industries, professionalism, and incubation mechanisms of the industry to create better social, environmental, and economic benefits of the emerging marine industry.

5.2. Improving the Long-Term Mechanism for the Development of Emerging Marine Industries.
The emerging marine industry takes the State Oceanic Administration as the development benchmark, has a higher standard and a higher starting point, and a relevant emerging marine industry development system should be formulated. The State Oceanic Administration should promote the development of emerging marine industries in terms of projects, finances, taxation, and investment promotion, establish a sound mechanism with independent innovation, sound infrastructure, and ecological environment protection, actively assist emerging marine industry-related companies to go public, and promote the development of emerging marine industries. At present, the level of marine development in my country is relatively low [18, 25, 26], and it is very difficult to promote the development of emerging marine industries. The coordination of industrial policies can effectively promote the development of emerging marine industries.

The government should establish relevant management agencies to coordinate the development of marine science and technology, coordinate and coordinate policies related to emerging marine industries, realize the macromanagement of emerging marine industries, promote the industrialization and applicability of many high-tech applications in emerging marine industries, strictly control the development trend of emerging marine industries, establish a long-term mechanism that can maintain the sustainable

development of emerging marine industries, and maintain the growth of emerging marine industries.

5.3. Improving the Independent Innovation Capability of Emerging Marine Industries. Marine technological innovation and the development of independent intellectual property rights can effectively enhance the development potential and competitiveness of emerging marine industries. Deeply develop the key technological achievements of the emerging marine industry and apply the developed achievements to more fields. The government and marine management departments should encourage the development of marine biotechnology, marine equipment technology, and marine renewable energy power generation technology and promote the marine economy from a resources-dependent type develops to a technology-driven type. For the comprehensive utilization of seawater and marine biological engineering, enterprises, universities, scientific research institutions, and intermediary organizations promote marine scientific and technological innovations [27] and use training institutions, intermediary institutions, and technology promotion stations to promote marine scientific and technological achievements obtained through independent innovation technology. Through the development of national high-tech industrial development zones, promote the development of emerging marine industries, establish important carriers that can cultivate emerging marine industries, and create emerging marine industrial bases with international competitiveness.

5.4. Increasing R&D Funds for Emerging Marine Industries. In the process of independent innovation of emerging marine industries, relevant national policies should be fully utilized to guide the development of emerging marine industries, create an innovative emerging marine industry system, promote the development of emerging marine industries through a good investment and financing environment, and mobilize large amounts of funds to develop emerging marine industries. Industry [28], to promote the sound development of emerging marine industries. By improving the investment environment, relaxing investment fields, increasing policy input, many enterprises, credit funds, and foreign capital are attracted to actively develop emerging marine industries.

5.5. Training Highly Innovative Talents. The cultivation and use of independent innovative talents determines the development opportunities of emerging marine industries. In the development of the emerging marine industry, it is necessary to focus on cultivating independent innovative talents, attach importance to entrepreneurial management talents, and create a development environment for talents with independent innovation capabilities. It is necessary to strengthen the training of technological leaders and high-level innovative and entrepreneurial talents and develop a platform that can cultivate talents with independent innovation ability [29]. Through the talent incentive mechanism,

cultivate new energy technology talents in emerging marine industries, enhance the enthusiasm of independent innovation talents, and enable more independent innovation talents to vigorously develop emerging marine industries and achieve sustainable development of the marine economy.

6. Conclusion

The development of emerging marine industries should aim at building an environment-friendly and resource-saving society, and the emerging marine industries should be taken as a major strategic measure to achieve sustainable development of the marine economy. Aiming at the problems emerging marine industry development at the present stage, puts forward China's emerging marine industry independent innovation path and trend of development of the empirical analysis, the research study emerging from the depth of the independent innovation path of marine industry development fishery trend, using data envelopment analysis, marine industries, as well as the development trend of measuring model construction by predicting marine development trend. It is clear that the five independent innovation paths of technological capability, technological management capability, technological strategy, network capability, and R&D fund have a positive guiding effect on the development of the emerging marine industry. Test analysis to develop new marine industry should promote technology ability, technology, management capacity, level of technology strategy, and the network capacity and increase the research and development; the research according to the results of the analysis put forward the development strategy, can effectively maintain the emerging marine economy sustainable development of the marine industry, to build a world leading level of the marine technology innovation system.

Due to the limitation of the research time, the research method did not analyze the operation time of the ocean development trend calculation model. Therefore, the subsequent research and analysis of the prediction time were conducted in order to reduce the development trend calculation time and improve the operation efficiency of the research method.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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