

Retraction

Retracted: Identification of Driving Factors of Scientific and Technological Innovation in the New Material Industry Based on the Theory of Complex Adaptive System: Taking the Construction of Green Innovation System as an Example

Complexity

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] T. Ma and C. Liu, "Identification of Driving Factors of Scientific and Technological Innovation in the New Material Industry Based on the Theory of Complex Adaptive System: Taking the Construction of Green Innovation System as an Example," *Complexity*, vol. 2021, Article ID 5537789, 12 pages, 2021.

Research Article

Identification of Driving Factors of Scientific and Technological Innovation in the New Material Industry Based on the Theory of Complex Adaptive System: Taking the Construction of Green Innovation System as an Example

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Complex adaptation systems are the main development direction of China's current green innovation research. New material industry is one of the key entry points to accelerate the construction of modern industrial system and promote innovation, green, and efficient development. Under the requirements of China's current low-carbon development, China's green innovation system is developing rapidly. Green innovation complicates traditional innovation models and their functions and improves economic development. The purpose of this paper is to study the theoretical analysis framework of applying complex adaptive systems and to analyze and calculate the characteristics of the current status of green innovation systems in multiple industries in China's manufacturing industry. Analysis is as follows. The experimental group and the control group are set for comparison, and the data are organized by applying complex adaptive system theory and data analysis methods. Experimental data show that the coordinated development of the green innovation systems in various industries in China is not balanced, with a difference of more than three times; the parameters of the various green innovation systems within the industry are unbalanced, and the difference is more than five times. The experimental results show that the green innovation subject can strategically interact by adjusting the ratio of resource allocation through the constructed green innovation system model. The green innovation system with complex adaptive system theory is conducive to the development of the green system. It can save about 23% of green innovation time and improve efficiency by about 15%, to promote the development of green innovation in China.

1. Introduction

With the rapid development of China's industrial manufacturing industry today, it is particularly important to complete the construction of a green innovation system and apply it to guide the development of China's industrial manufacturing industry. The green innovation system is a complex system involving multiple interacting subsystems, and the mechanism and synergy between the subsystems will affect the healthy operation and coordinated development of the entire innovation system. Facing the current situation of China's industrial development at great cost and serious environmental damage, if we want to become a large

industrial country and a strong country, we must focus on green technology innovation and achieve sustainable development. As for industrial innovation, at present, most experts focus on multiple technical aspects, such as innovation efficiency, capability, and innovation strategy. There is relatively little research literature on the combination of green development and innovation in complex adaptive systems. Therefore, analyzing and exploring the application theory of green innovation system is of great significance to further enhance the innovation ability of China's industrial manufacturing industry and effectively promote the innovation process of various industries. New material industry is an important part of strategic emerging industries and the

industrial foundation for the transformation and upgrading of the whole manufacturing industry. As the leading industry of national economy and the important guarantee of high-end manufacturing and national defense industry, new materials will become the focus of strategic competition in the future, so the manufacturing industry studied in this paper is also based on new materials industry.

Materials are the foundation of national manufacturing industry. The R&D level and industrialization scale of new materials are important symbols to measure a country's science and technology and economic strength. They play an important role in developing high and new technology, transforming and upgrading traditional industries, and enhancing comprehensive national strength and national defense strength. However, due to the late start and weak foundation of China's new material industry, the overall strength is still relatively weak. There is still a big gap between China's new material industry and developed countries in innovation ability and competitive strength and international advanced level. At the same time, under the requirements of low-carbon development at this stage, China's green innovation system is developing rapidly and presents a variety of characteristics. This paper applies the theoretical analysis framework of complex adaptive systems and establishes and analyzes the theoretical model of China's manufacturing green innovation system under the low-carbon background. The green innovation system is a complex system composed of multiple interactive subsystems. The interaction and coordination mechanism between subsystems affects the smooth operation and coordinated development of the entire innovation system [1]. This paper uses the theoretical model of complex flexible systems to calculate the overall coordination degree of China's manufacturing green innovation system and its subsystems. Any model of green innovation can use this model to adjust the allocation of strategic interactive resources and achieve the overall optimization of the green innovation system. The subsectors and subsystems rank lower, and some industrial subsystems are unbalanced; especially the industrial innovation activity subsystem and the ecological environment subsystem have an impact on the overall development of the entire green innovation system; the innovation system in each industry link may be made in China, such as the development paths and models of various industry links in the industry, market demand characteristics, national strategies, and the different degrees of influence of the industry on resources and the environment; each industry sector is more or less different; it seems that, between subsystems of the green innovation system, both are strongly interconnected.

Tang and Lai and others used the theory of complex adaptive systems (CAS) to provide new perspectives and methods for analyzing health systems and policy implementation [2]. They found that wood fuel and solid waste as energy sources increased, while fossil oil decreased. This result is consistent with the Swedish government's industrial and environmental policies, which indicate that these policies are related to "green innovation." Rånge and Sandberg studied the current status and development of climate change and nonfossil energy. They found that during the

period 2003–2010, wood fuel and solid waste as nonfossil energy sources gradually increased, while fossil energy sources decreased significantly, which is closely related to the policies of the local government [3].

Based on the current development of China's green innovation system and previous studies, this article is based on the theory of complex adaptive systems, and it analyzes and calculates the status of the coordination of the status of green innovation systems in multiple industries in China's manufacturing industry. The construction of the theoretical system and the analysis of the results were carried out. The experimental data and calculation results show that the current development of green innovation systems in various industries in China is not coordinated, and the parameters of various green innovation systems within the industry are imbalanced, which varies greatly. At the end of the article, this article proposes that various industries can construct the green innovation system theory under the guidance of complex adaptive system theory to improve the economic production and environmental benefits of the industry. The innovation of this paper is to take advantage of a variety of research methods, highlighting the effect of the application of its green innovation system theory, and explain its role in the new materials industry through the test case.

2. Proposed Method

2.1. Connotation of Manufacturing Green Innovation System

2.1.1. Definition and Status of Green Innovation System in Manufacturing Industry. Green innovation system is actually a combination of industrial innovation system and green development theory. As an emerging concept, there are few domestic explanations about it, and its specific connotation is not clearly defined. Sun and Lu constructed a theoretical model of the green innovation system of the manufacturing industry on the basis of the complex system and evaluated the degree of synergy and order of the green innovation system of 31 subsectors of the manufacturing industry in China [4]. Green innovation mainly includes the transformation of production technology, industrial innovation, and the transformation of green supply chain, with the tight integration of complex large-scale systems as the core of the system. In the field of green innovation systems in industrial manufacturing, in addition to some relatively mature emerging green industry innovation systems, such as the wind energy industry innovation system, most of China's green technologies and industries are still in their infancy, and they have not yet formed a benign relationship with green innovation activities in various industries. For interaction, see [5–7].

Combining with the definition of green innovation system by the predecessors, under the theory of complex adaptive system, this paper believes that the green innovation system of the manufacturing industry is based on the innovation of industrial technology, through the use of innovative technologies and innovative means, to achieve a complex theoretical system of green sustainable

development. The theoretical model can be summarized, as shown in Figure 1.

2.1.2. Development Characteristics. The international academic community has been conducting research on green innovation systems and their applications from a variety of microperspectives from about ten years ago. For example, A pak and Atay studied the impact of green innovation theory on the EU. We mostly explore new green innovation systems from specific perspectives and case studies. Others learned about the development process from order to disorder through the coordination and interaction of the self-organizing system and put forward the concept of system coordination and the degree of coordination [8–10].

While Chinese scholars are mainly concentrated in the field of theoretical research, the application of specific theories is relatively rare. Hall, Matos, and others believe that the current understanding of how green technology companies emerge and spread more sustainable innovation is still limited. For this reason, they have established a theoretical framework that combines institutional work, search tools with business organizations and society (TCOS). Frameworks are combined to identify key opportunities, obstacles, and potential unintended consequences in the early stages of technology development [11].

The research on the previous literature shows that China's research on green innovation in the manufacturing industry is still in its infancy, most of which is still at the qualitative level. The research on the synergy effects of industrial innovation systems is mainly focused on high-tech industries and strategic industries, and there is a lack of empirical research on manufacturing green innovation systems from the perspective of interaction between systems. Therefore, this paper studies the green innovation system of China's industrial manufacturing industry, constructs a theoretical model of green innovation system, and conducts an empirical analysis of the synergy effects of green innovation systems in different industries.

2.1.3. Principle Analysis of Limit Analysis. Under the theory of complex adaptive system, there are many ways to analyze the degree of synergy. In this paper, the limit analysis method is used to analyze the data systematically to calculate the degree of synergy of each unit in the green innovation system. In the limit analysis method, there are a static allowable stress field (referred to as a static field) and a mobile allowable displacement velocity field (referred to as a mobile field). These two fields need to satisfy the following basic mechanical relationship in the theoretical calculation process:

$$\begin{aligned} \delta &= w_j, \\ \delta_{i,j} n_j &= T_i, \\ \xi_{i,j} &= \frac{u_{i,j} + u_{j,i}}{2}, \end{aligned} \quad (1)$$

where ξ_{ij} is the strain rate:

$$f(\delta_{i,j}) \leq 0. \quad (2)$$

For the measurement of synergy, Mohr–Coulomb theorem is usually used, and the expression of its function is

$$\begin{aligned} \tau &= c + \tan \phi, \\ V &= CW^3 R, \\ s &= d_c - \sum_{c=1}^i (a_c^* - a_c) b(x_c, x) + \vartheta, \\ s &= d_c - \sum_{c=1}^i (a_c^* - a_c) b(x_c, x) - \vartheta, \end{aligned} \quad (3)$$

where v is the growth rate, q is the investment, r is the proportion of the same period, and c is the coefficient.

$$y(kT + t_i) = \frac{1}{\alpha(z)} \sum_{j=1}^r \beta_{ij}(z) \bar{u}(kT + t_{j-1}) + v(kT + t_i). \quad (4)$$

Formula is as follows:

$$\begin{aligned} \alpha(z) &= 1 + \alpha_1 z^{-1} + \alpha_2 z^{-2} + \dots + \alpha_n z^{-n}, \\ \beta_{ij}(z) &= \beta_{ij}^0 + \beta_{ij}^1 z^{-1} + \beta_{ij}^2 z^{-2} + \dots + \beta_{ij}^n z^{-n}. \end{aligned} \quad (5)$$

Its role is to make $s(kT + t_{i-1})$, $i = 1, 2, \dots, r - 1$ sampled signal at time $s(kT + t_{i-1})$ shifting back by 1 nonuniform sampling interval, a new transfer function model is proposed:

$$y(kT + t_i) = \frac{B_i(\delta)}{A_i(\delta)} \bar{u}(kT + t_i) + v(kT + t_i), \quad i = 0, 1, \dots, r - 1,$$

$$y = \sqrt{\sum_{m=1}^x w_n * (r_{nm} - uq_m)^2},$$

$$y_n = \frac{1}{1 + d(r_n, uq)}. \quad (6)$$

2.2. Purpose and Structure Function of Green Innovation System. As a complex system closely related to socioeconomic and ecological environment, the development direction and function of green innovation system must be consistent with the goal of sustainable development. We can specifically divide such goals into three areas:

- (1) The goals of the green innovation system should be consistent with the goals of sustainable economic development, promote economic growth and the transformation of economic growth methods and technological progress, and promote technological innovation to promote innovation in the economic system, industrial structure, and market structure.

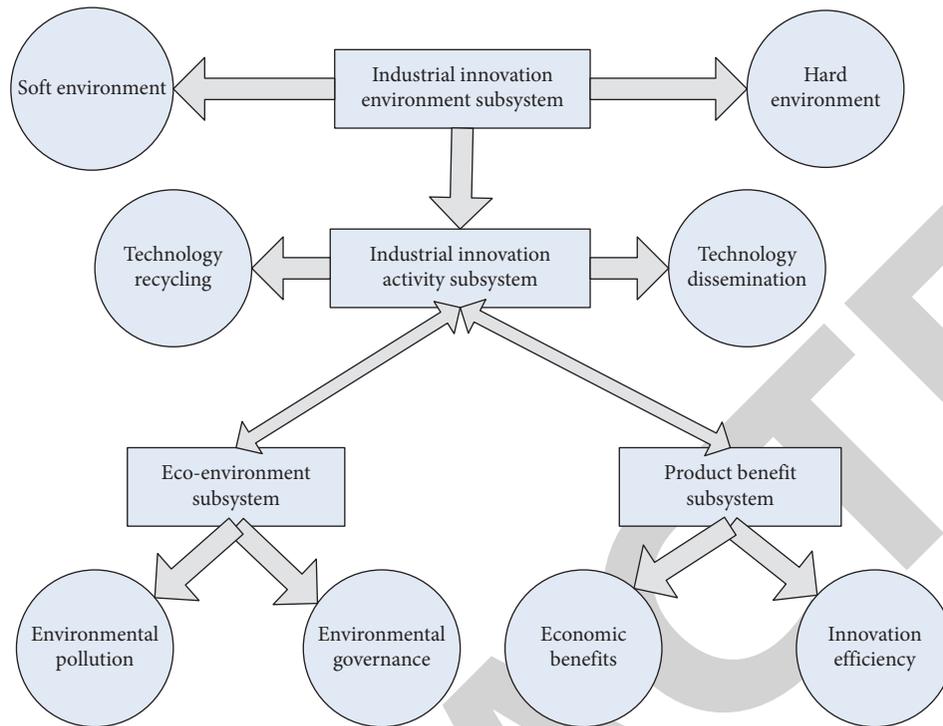


FIGURE 1: Principle of biosensor.

The technological innovation required for sustainable development includes improving economic benefits, product quality, saving resources, and energy and reducing waste emissions to promote the improvement of economic quality [12–14].

- (2) The goals of the green innovation system should be consistent with the goals of ecological security and carry out technical activities to protect life and maintain ecological security, such as protecting biodiversity and preventing and controlling environmental pollution, to improve the quality of human living environment. For sustainable use of resources, see [15–17].
- (3) The goals of the green innovation system must meet the requirements of sustainable social development. By disseminating green knowledge and using green technologies, people’s awareness of environmental protection is promoted, and social harmony is promoted. The innovation system should coordinate the economic development of all levels, societies, and ecosystems to support the sustainable development capabilities of various countries, regions, and social organizations [18–20].

2.3. Calculation Method

2.3.1. Selection of Subsystem Indicators

- (1) Industrial innovation environment subsystem selection index: the industrial innovation environment includes hard internal and external environments

that can encourage innovation activities. This experiment selects government research and development expenditure (X1), tax reduction (X2), industrial research and development institutions (X3), and new fixed assets (X4). Among them, the new fixed assets include the realization of energy conservation and emission reduction and environmental protection. Equipment and projects can help the experimental results more fully reflect the support capabilities of the industry’s green innovation system infrastructure.

- (2) Selection index of industrial innovation activity subsystem: select parameters according to the industrial technology innovation chain, namely, R&D investment intensity (X5), R&D full-time personnel (X6), digestion and absorption of imported technology expenditure (X7), and number of effective invention patents (X8), national or industry patent standard number (X9), and patent ownership transfer income and license income (X10) as indicators of single parameters [21, 22].
- (3) Selection index of ecological environment subsystem: the environment subsystem mainly includes three aspects: environmental pollution, energy consumption, and environmental management. Select chemical oxygen demand (X11), industrial emissions (X12), industrial soot emissions (X13), total energy consumption (X14), number of industrial wastewater treatment plants (X15), and operating costs of industrial waste gas treatment plants this year (X16) as an order parameter index.

- (4) Selection index of industrial efficiency subsystem: industrial production efficiency and profit are the ultimate pursuit of industrial development. This article selects the main business income profit rate (X17), total profit (X18), and new product development income (X19) as indicators of contract parameters, where new product development income refers to the difference between new product income and expenditure.

2.3.2. Selection of Measurement Method

(1) *Index Weighting Method.* At present, the index weighting method is divided into subjective weight method and objective weight method. The subjective weight method refers to the subjective color of experts and individuals who have problems in evaluating the uncertainty of indicators. The calculation methods of system cooperation degree include entropy quality method, factor analysis method, and correlation coefficient matrix method. In order to avoid subjective overlap of indicator quality, reveal these key elements, and reflect innovation, this paper chooses a method of maximizing bias to determine indicator weights. The maximum deviation method is to compare the deviation of the indicator with the total deviation of all indicators and then describe the significance of the indicator; the larger the comparison value, the greater the weight of the indicator [18, 23, 24].

(2) *Green Innovation System Collaboration Measurement Model.* According to the compound system theory, as a complex system, the green innovation system is composed of multiple subsystems. The development process of this subsystem is mainly determined by a set of parameters with different speeds and slowly changing parameters. This paper uses the research methods of previous generations to construct a phase model of synergy of green innovation system in manufacturing industry.

2.4. *Activity Process of Green Innovation System.* The knowledge activity process of the green innovation system includes three subsystems, which are knowledge production, dissemination, and application. Among them, the green knowledge production subsystem includes the green science knowledge production subsystem and the green science knowledge production subsystem transformed into green technology knowledge. The research on nonnuclear energy, new energy, new materials, ecological environment, and other scientific knowledge refers to the production activities of scientific knowledge and green technology knowledge for sustainable development; the green knowledge dissemination subsystem consists of green education subsystem, and the green knowledge occupation training subsystem consists of education, vocational training, and the cultivation of high-knowledgeable talents to achieve the dissemination of green knowledge and the mastery of green technical knowledge and innovation capabilities.

3. Experiments

3.1. Experimental Setup Process

- (1) Preliminary preparation: after reading a lot of relevant literature, sort out relevant theories of China's green innovation system and complex adaptation system at this stage, and determine the basic framework of the experiment. On this basis, the connotation, characteristics, constituent elements, evolutionary conditions of the green innovation system in China, and the driving factors that affect the dynamic evolution of the green innovation system in the shipbuilding industry in China are provided to provide a theoretical basis for exploring the system of green innovation systems in China's industrial manufacturing industry at this stage.
- (2) Data analysis: this paper uses a variety of analysis methods and compound formulas to find relevant report data, analyzes and calculates specific values of related parameters, and conducts empirical analysis of the theoretical model. By analyzing the coordination degree and related data of green innovation systems in various industries, and classifying the provinces across the country, the calculation of the development coordination degree of green innovation systems in specific industries is used to draw the final conclusion.
- (3) Analysis of results: based on the test results and related previous arguments, a comparative demonstration is made from three aspects to draw a conclusion: the overall green innovation system is in a low coordinated development stage, and an efficient application system for green innovation systems needs to be established in the future; according to time analysis of the process shows that the degree of coordination has steadily increased over time, and there is still a lot of room for development. According to the parameter index and coordination, the development of the green innovation system in various industries and provinces across the country is not synchronized, and there is a gap between regions.

3.2. Experimental Steps

- (1) Select the parameter index, construct the theoretical model of the green innovation system, and combine the existing scholars' opinions to complete the theoretical model and the establishment of reference standards for the green innovation system under the application theory of complex adaptive systems.
- (2) Statistics on the current parameters and measurement indicators of the industry in China, and statistics and calculations based on the current development of the industry, are carried out.
- (3) Analyze the results of the experiment, determine the level of coordination of the green innovation system,

and respond accordingly. The analysis and construction of China's green innovation system industry are completed under the theory of complex adaptive systems.

3.3. Experimental Details

3.3.1. Comparison Principle. When setting up an experiment, two experimental groups are usually created. One is an experimental group that uses the green innovation system of the complex adaptive system theory to obtain data, and the other is a control group that uses the green innovation system of the complex adaptive system theory to measure data. After intervening or controlling the green innovation system of complex adaptive system theory to eliminate or reduce data errors, we can more clearly and contrastively see the effect brought by the accuracy of the parameters of the green innovation system of complex adaptive system theory. Among them, many control methods are used, including positive control, standard control, and self-control, but the most commonly used one is the blank control method.

3.3.2. The Principle of Randomness. The principle of randomness of green innovation system experiments of complex adaptive system theory refers to the random and random selection of samples to be studied within the experimental range of green innovation system parameters that monitor complex adaptive system theory. In this way, the significance of the green innovation system experiment of the complex adaptive system theory can be ensured, the unnecessary innovation error caused by the green innovation system experimental system of the complex adaptive system theory can be reduced, and the conditions brought by the various applications can be balanced.

3.3.3. The Principle of Parallel Repetition. That is to say, the range of application data of the green innovation system showing complex adaptive system theory is shown. For scientific rigor, this experiment must be repeated many times. In order to reduce the data errors caused by unnecessary factors as much as possible, it is necessary to randomly sample samples. Of course, this cannot guarantee that the full impact of unnecessary factors can be completely eliminated. The principle of parallel repetition is the answer to this confusion.

3.3.4. Single Factor Variable Principle. These are control variables, highlighting the application data of a green innovation system with complex adaptive system theory, while the other variables remain unchanged. Observe the impact of this data on the experimental results of the green innovation system of complex adaptive system theory; that is, other variables that have constant control must be consistent. It is precise because we usually forget some basic principles when doing experiments in ordinary times, which leads to errors in solving or designing experiments.

4. Discussion

4.1. Data Analysis of the Whole. The manufacturing industry is the main body of the application of China's green innovation system. It carries out innovation activities to achieve a win-win effect of environmental benefits and product benefits. Based on the sequence parameters and measurement indexes selected above, further visualization is shown in Figure 2. From the results, we can see that the indicators of the obtained results are basically positive.

- (1) From the change data in Figure 2 and Table 1, it can be seen that the gradual decrease of the green innovation system diagram of complex adaptive system theory indicates that the development of electronic information is conducive to green development. From the perspective of the industrial innovation environment subsystem, the tobacco industry has the lowest level of innovation environment and the highest level of production of electronic equipment such as computers and communications. The environmental subsystem of industrial innovation includes the general and specific production of equipment, the production of automobiles, motors and equipment, and computers, the production of communication and other electronic equipment, the production of nonmetallic mineral products, and the production of chemical raw materials and chemical products, with a relatively high level average of 0.64. The development of these high-tech industries is conducive to the development of green industries; specific data such as this are shown in Figure 2 and Table 1.

It can be seen from the decline of the histogram that the gradually decreasing possible value can be seen and that the tobacco industry has the lowest level of industrial innovation (0.0191), and the productivity of electronic equipment such as computers and communications is the highest (0.7425). Computers, communications, and other electronic equipment manufacturing, electrical machinery equipment manufacturing, and other applications are conducive to the improvement of green industries. Due to the lack of high-quality technology and equipment, the pharmaceutical industry is generally different from specific industries, equipment production, and the automotive industry. It belongs to the end of the low-value chain of most other industries. The low added value of production technology leads to a low level of activity in its innovative subsystems. All this will lead to the speed of implementation of green innovation ideas. The specific data is shown in Table 2 and Figure 3

4.2. Analysis of Data for Specific Industries

- (1) After subdividing the data, the green innovation system with complex adaptive system theory was found. The results of specific analysis of data in some industries are shown in Figure 4 and Table 3. According to the proportion of the graph in the

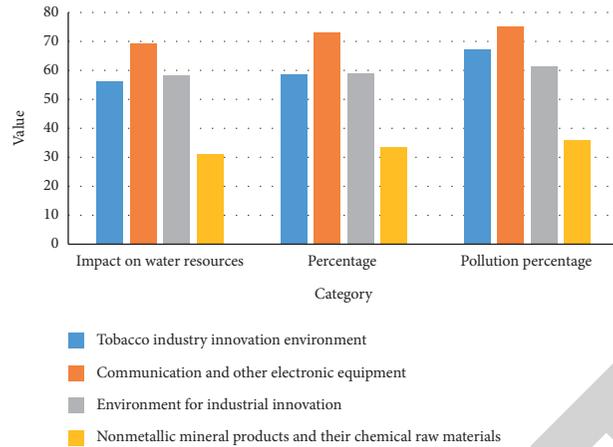


FIGURE 2: Indicator system for measuring synergy of green innovation system in manufacturing industry.

TABLE 1: Indicator system for measuring synergy of green innovation system in manufacturing industry.

	Impact on water resources	Percentage of impact on surrounding plants	Pollution percentage impact on air
Tobacco industry innovation environment	56.3	58.5	67.3
Communication and other electronic equipment	69.2	73.1	75.2
The environment for industrial innovation	58.3	59.1	61.4
Nonmetallic mineral products and their chemical raw materials	31.2	33.4	35.8

figure, the complex adaptive system theory can be seen, in which different industries have different contributions to the concept of green development. Because of these differences, it can be seen that high-end industries are a firm direction to lead the concept of green development. It is clear from the figure that the related coefficient of the ecological environment is obviously low, and the development of green innovation systems in individual industries still does not pay enough attention to the ecological environment.

- (2) The application of the green innovation system of complex adaptive system theory to the ecological environment subsystem can develop innovative green industries. In all industries, the parameters of the organic environment subsystem of the paper and paper products industry are the lowest (0.0013), and the organic environment subsystems of culture, education, industry, beauty, and other have the highest priority, while the production order of sports and entertainment products is the highest, as well as the organic environment subsystem. The average ranking of the system is papermaking, petroleum processing, coking and nuclear fuel production, chemical raw materials and chemical products industry, chemical fiber manufacturing, nonmetallic mineral products, ironmaking, and steel rolling, while the nonferrous metal smelting processing industry is only 0.0125. The nature of high energy consumption, high

emissions, and high pollution is closely related, and the result is shown in Figure 5.

- (3) The green innovation system of complex adaptive system theory has the lowest parameters in the industrial efficiency subsystem of ferrous metal smelting and processing (0.0951), and the highest order parameters can be found in the industrial efficiency subsystem of the automotive industry (0.7947). The production of communication and other electronic equipment, electrical equipment, chemical raw materials, and chemical products is much higher than 0.5. It can be seen from the figure that the development of the electronic equipment industry corresponds to the application of complex adaptive system theory.

4.3. Changes in Green Innovation in Various Industries in Recent Years.

We have analyzed and counted the changes of green innovation in various industries in recent years and digitized them through models for easy comparison. The specific data are shown in Table 4.

From Figure 6, we can see that, in recent years, the green innovation value of various industries has been fluctuating, but overall, it has shown an upward trend, but the change trend is not particularly obvious. We introduced a complex adaptive system through the model, simulated the data, and obtained new data, as shown in Table 5.

From Figure 7 we can see that, after the introduction of the complex adaptive system theory, the simulated innovation value of each industry has increased to a certain extent, about

TABLE 2: Code and its weight of every part.

	Percent improvement in the pharmaceutical industry	Percent increase after improvement in the automotive industry	Increase in added value of production technology
Tobacco industry innovation environment	65.3	67.1	64.1
Communication and other electronic equipment	71.3	75.1	76.5
The environment for industrial innovation	89.1	84.1	80.1
Nonmetallic mineral products and their chemical raw materials	54.2	55.1	49.2

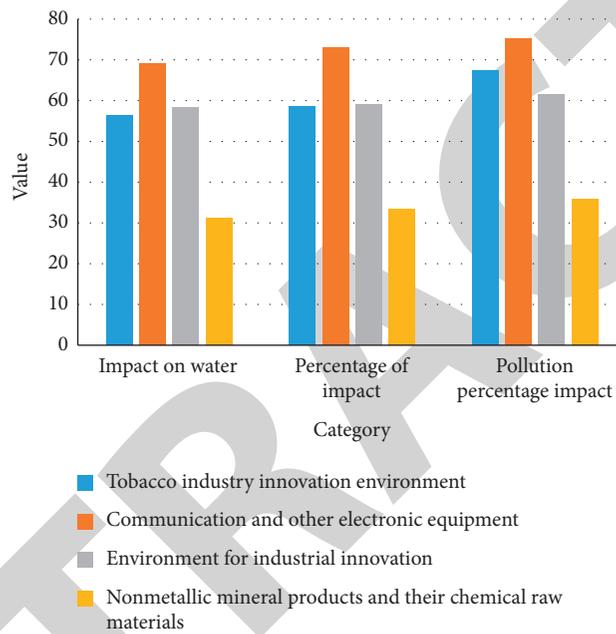


FIGURE 3: Code and its weight of every part.

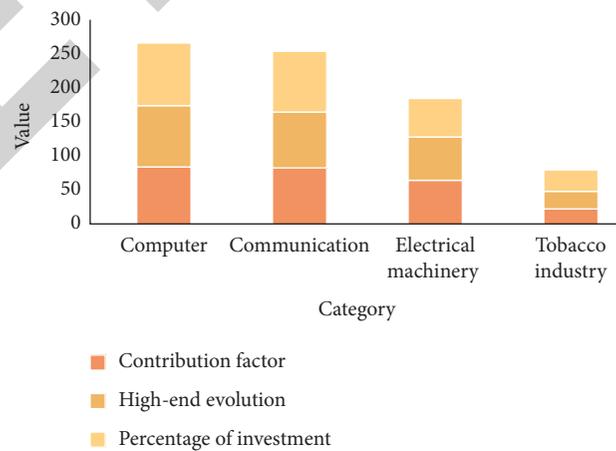


FIGURE 4: Results of some code of some industries.

20%. This shows that, to increase the industrial innovation value, the complex adaptive system theory is a good choice. Of course, this is the result of the simulation of the knowledge

program, so we choose a representative for each of these industries and verify the validity of the experiment by comparing the changes before and after the parameters.

TABLE 3: Results of some code of some industries.

	Contribution factor increase	High-end evolution level factor increase percentage	The percentage of investment in scientific research in the past 5 years
Computer	84.5	89.4	91.2
Communication and other electronic equipment manufacturing	83.2	81.4	88.3
Electrical machinery and equipment manufacturing	65.1	63.1	56.1
Tobacco industry	23.4	25.6	31.2

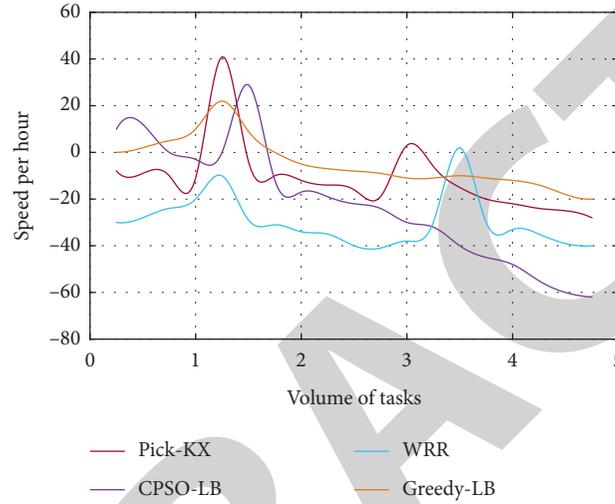


FIGURE 5: Refined results.

TABLE 4: Green innovation in various industries.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Tobacco	0.372	0.395	0.398	0.389	0.418	0.379	0.437	0.421	0.432	0.481
Computer	0.451	0.462	0.479	0.458	0.436	0.476	0.463	0.447	0.478	0.489
Telecommunication	0.527	0.491	0.482	0.481	0.475	0.508	0.517	0.524	0.541	0.557
Mineral	0.568	0.572	0.553	0.557	0.528	0.517	0.567	0.572	0.569	0.592
Aerospace	0.635	0.598	0.583	0.613	0.624	0.628	0.606	0.629	0.639	0.657

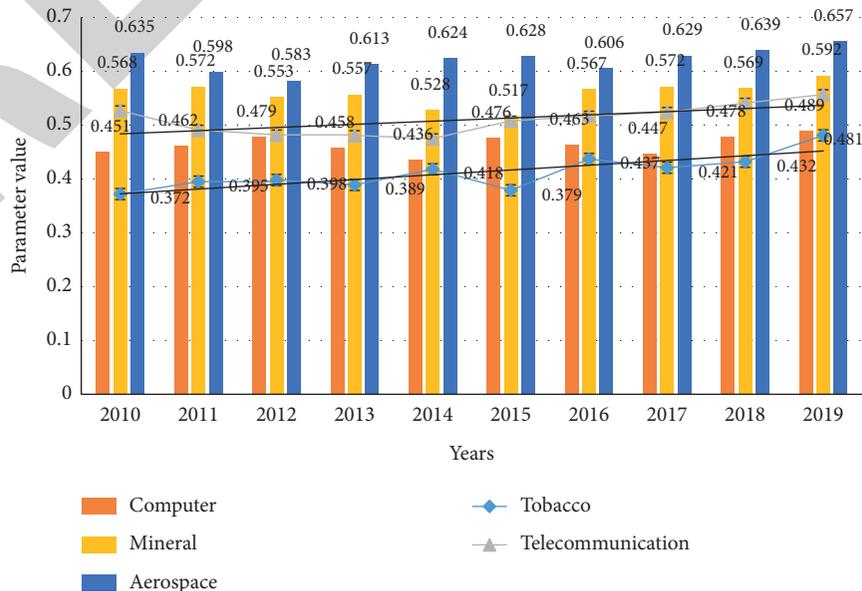


FIGURE 6: Green innovation value changes.

TABLE 5: Innovative changes under a complex adaptive system.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Tobacco	0.441	0.429	0.427	0.388	0.399	0.408	0.426	0.468	0.517	0.526
Computer	0.442	0.467	0.427	0.474	0.446	0.481	0.469	0.485	0.493	0.524
Telecommunication	0.586	0.572	0.588	0.608	0.603	0.615	0.626	0.637	0.662	0.671
Mineral	0.616	0.624	0.617	0.619	0.632	0.665	0.639	0.651	0.658	0.679
Aerospace	0.729	0.724	0.782	0.776	0.785	0.752	0.735	0.765	0.762	0.767

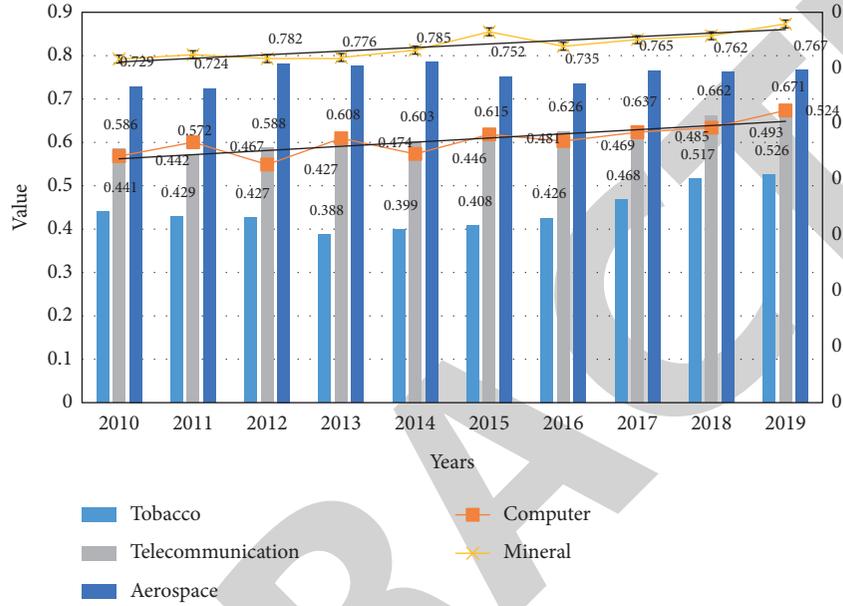


FIGURE 7: Simulated innovative green industry value.

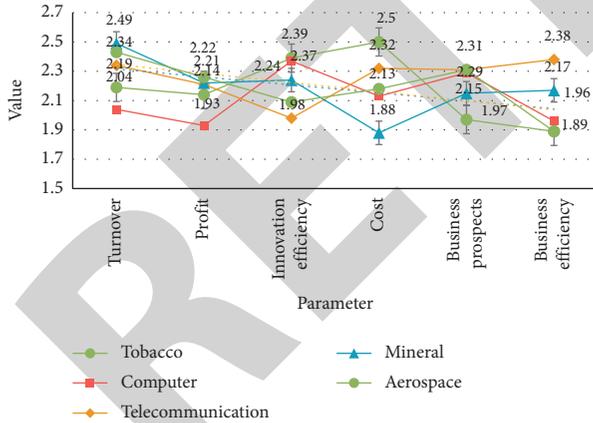


FIGURE 8: The parameters before the change.

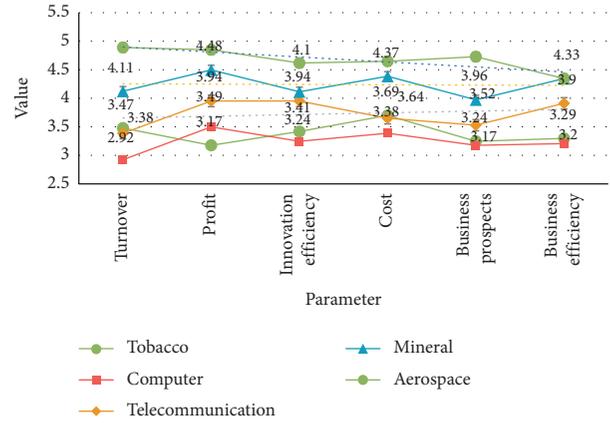


FIGURE 9: The parameters after the change.

From Figures 8 and 9, we can see that, in the selected examples, various parameters have been improved to varying degrees with the introduction of complex adaptive systems. This shows that complex adaptive systems have indeed improved green innovation.

5. Conclusion

In this paper, the maximum degree of deviation method and the coordination degree model of the composite system are used to analyze and calculate the coordination

degree of the green innovation system of the industrial manufacturing industry and the order degree parameters of each subsystem. The conclusions of this paper are as follows: the degree of coordination of the green innovation system of the complex adaptive system theory is extremely low, and the green innovation systems of various industries are in the “noncoordination” stage; the degree of order of the subsystems of each subsector is low, and the subsystems of the industry are not balanced; especially the industrial innovation activity subsystem and the ecological environment subsystem affect the coordinated development of the entire green innovation system; there is a significant gap in the orderliness of the same subsystem of the green innovation system in each subsector. This may be related to factors such as the development path and model of China’s manufacturing industries, the characteristics of market demand, the national strategy, and the degree of influence of the industry on the resource and environment. It shows that there is a strong mutual constraint relationship among the subsystems in the green innovation system. The innovation of this article is to make full use of a variety of methods for research, highlight the application effect of its green innovation system theory, and illustrate its role in the new material industry from experimental cases.

In view of the current development status of China’s green innovation production system, this article believes that, to improve the level of common development of green innovation production system, we must first improve the technological innovation capability of our manufacturing industry. However, the green innovation system of the complex adaptive system theory is only one-third of the level of scientific and technological achievements in general developed industrial countries. It integrates existing innovation and resource providers and improves the conditions for innovation according to industry needs: insufficient innovation chain, the establishment of a new production innovation platform, the establishment of an open production innovation platform, and industrial innovation cooperation network. This shows that, in the process of the common development of the green innovation system of the manufacturing industry, the green innovation systems of the complex adaptive system theory interact, restrict, and cooperate with each other, improve relevant policies and regulations, increase corporate green innovation awareness, and promote sustainable environmental improvement through technological innovation.

In summary, material innovation has always been an important driving force to promote the progress of human civilization. In the industrial era, new materials are an important basic and leading industry of the national economy, and a key field to promote high-quality economic development. Through the research on the manufacturing industry based on and dominated by the new material industry, according to the experimental data and results, we can know that China’s current green innovation system is currently booming, but there is still much room for development. The purpose of this paper is to study the theoretical analysis framework of applying complex adaptive

systems, and to analyze and calculate the characteristics of the current status of green innovation systems in multiple industries in China’s manufacturing industry. Analysis is as follows. The experimental group and the control group were set for comparison, and the data were sorted by applying genetic algorithms and data analysis methods. Experimental data show that the coordinated development of the green innovation systems in various industries in China is not balanced, with a difference of more than three times; the parameters of the various green innovation systems within the industry are unbalanced, and the difference is more than five times. The experimental results show that the green innovation subject can strategically interact by adjusting the ratio of resource allocation through the constructed green innovation system model. The green innovation system with complex adaptive system theory is conducive to the development of the green system. It can save about 23% of green innovation time and improve efficiency by about 15%, to promote the development of green innovation in China. This study is also of great guiding significance to local industrial layout; at present, all kinds of urban agglomerations are building modern industrial system. Yunnan Province, as a frontier ethnic region in China, also has eight industrial development strategies, among which new material industry is one. As the economic growth pole of Yunnan Province, Central Yunnan urban agglomeration can also use this research as a reference to better promote the innovation and development of new material industry driven by scientific and technological innovation.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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