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The Management Model Construction about Green Supply Chain of Chinese Rare Earth Industry Based on Big Data

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Abstract: With the maturity of the application of big data technology in various industries, especially in the fields of atmospheric monitoring and pollution control, we can introduce big data and experience into the green supply chain of China's rare earth industry. Therefore, it provides necessary support for solving the problems of centralized control of the ecological environment of the rare earth industry and poor controllability of rare earth prices. The significance of this research is to comprehensively consider the characteristics of the system industry, and conduct dynamic quantitative analysis of data in various supply chain links such as mining, refining, supply, consumption, and recycling. At the same time, it is also possible to use the constructed model to fully analyze and display the data collected from the environment from multiple dimensions, the progress status of the governance measures, and the governance results, and provide reference for the scientific decision-making and sustainable development of the rare earth industry.

Keywords: rare earth industry; green supply chain; big data; pattern construction

1. INTRODUCTION

Rare earth is an important strategic resource for non-renewable, and it is a key element for the upgrading of China's traditional industries, the vigorous development of emerging industries and the competitiveness of the defense science and technology industry. China is a major producer and exporter of rare earths, with global rare earth reserves accounting for 23% of global rare earth reserves, providing more than 90% of the world's rare earth supply. However, at present, China's rare earth industry is still in the development mode of mining and initial processing, and the top-heavy development of medium and high-end applications. The disorderly exploitation of resources, deterioration of ecological environment, blind expansion of production and export smuggling are still serious. . Compared with the environmental damage and resource waste, the ecological environment cost of the development of the rare earth industry is very heavy, and it does not get the benefits it deserves. The state and society are very concerned about the pollution caused by the rare earth industry. There have been many studies on the emissions and linkages of the rare earth industry and the local environment, and the company has invested a lot of energy and financial resources into environmental governance. In July 2015, the state launched the “Guiding Opinions on Actively Promoting “Internet +” Actions”, pushing emerging concepts such as cloud computing and big data to the front, encouraging traditional enterprises to widely use these new development models to promote enterprise transformation and upgrading. . With the rapid development of information technology, the intersection of modern information technology and economic society and the natural environment has also produced a large amount of environmental data. Big data information technology brings together a large number of environmental data with scattered sources and diverse formats. Through the correlation analysis and deep mining of data, the data presents good economic value and social value, and reveals it and the world in an intuitive form. The linkages and interactions between production, distribution, distribution, consumption activities, and economic operating mechanisms, social lifestyles, and national governance capabilities. This creates the basis for truly finding the connection between the environment and the production and product flow of the rare earth industry, and also provides an information base for the green supply chain management of the rare earth industry. Therefore, this paper is devoted to the use of big data

technology, based on massive environmental monitoring data, with a green supply chain management model as the goal, quantitative analysis and evaluation of dynamic data in various supply chain links such as mining, refining, supply, consumption, and recycling. The eco-efficiency of the rare earth industry can also be fully analyzed from various management links using the constructed model from multiple dimensions of the collected environmental data, the progress status of the environmental remediation measures of the rare earth industry, and the real-time remediation and remediation effects obtained. And presentation, providing a reference for scientific decision-making and sustainable development in the rare earth industry.

2. THE IMPORTANCE AND NECESSITY OF THE CONSTRUCTION OF GREEN SUPPLY CHAIN MANAGEMENT MODE FOR THE DEVELOPMENT OF CHINA'S RARE EARTH INDUSTRY

2.1 Development of green supply chain management and its application in the rare earth industry

The concept of a green supply chain sprouted in the early 1990s. In 1994, Webb L. noticed the impact of products on the environment during product procurement research and proposed the concept of green procurement [1]. Subsequent to 1996, the Institute of Manufacturing Research at Michigan State University first proposed the concept of a green supply chain in a study funded by the National Science Foundation (NSF) [2]. In terms of the definition of green supply chain, Beaumon has expanded the concept of traditional supply chain to incorporate re-manufacturing, recycling and reuse activities into the green supply chain management system [3]. Srivastava believes that environmental management factors should be incorporated into all aspects of supply chain management products [4]. However, Bin et al. refer to the definition of green manufacturing to incorporate environmental impact and resource efficiency into supply chain management objectives. He believes that green supply chain management is a kind of supply, production, sales and user, allowing products to be obtained, processed and packaged. A sustainable management model with the least impact on the environment during transportation, use and end-of-life treatment [5].

In 2003, Zhu Qinghua mentioned in the book "Green Supply Chain Management" that green supply chain management is one of the overall benefits of the company, and should improve the environmental performance and economic performance of the company in the whole process of supply chain management. Achieve overall efficiency optimization [6]. With the continuous development of new information technologies, the theory of green supply chains is also constantly improving. In 2016, at the Tsinghua RONG series – Big Data and Sustainable Development Forum, Zhang Jianyu proposed the content of the green supply chain under big data, as shown in the following figure [7]:

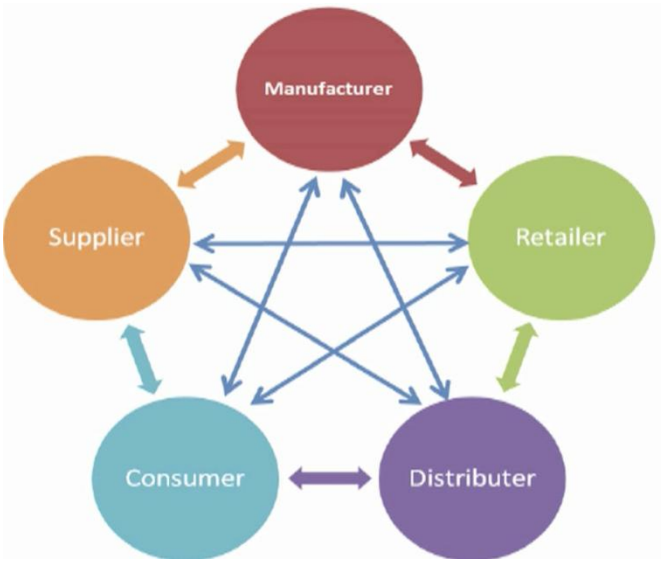

Figure 1. The green supply chain under big data

Gu Zhibin [8] and others conducted a literature review of the green supply chain at home and abroad, and proposed that the current green supply chain research has operational research, influencing factors and dynamic mechanisms, performance evaluation, empirical research and research directions in specific industry supply chain research.

In the evaluation of the green supply chain management model, Sarkis [9] believes that the product life cycle, operational life cycle, performance measures, and environmentally-affected corporate policies are the main factors affecting the green supply chain management model and establish corresponding performance. The evaluation system used the network analysis method to evaluate the management model. Liu Zhifeng et al. established a supplier green evaluation system based on fuzzy comprehensive evaluation method and analytic hierarchy process [10]. Zhou Qiang et al. used the catastrophe progression method to decompose the multi-level contradiction of the overall goal of green supply chain performance evaluation. Finally, it was evaluated as a parameter, which provided a reference for overcoming the subjectivity of the index weight performance evaluation method [11]. Li Jingfang et al. established a green supply chain performance evaluation index system based on the optimization of the green supply chain system environment, and used MGRA (multi-level grey relational analysis) to establish a multi-objective comprehensive evaluation simulation model to evaluate its performance [12].

In the research of supply chain of rare earth industry, Shang Lijuan [13] summarized the research results of domestic and foreign scholars on the supply chain of rare earth industry, introduced the bar model of supply chain network, proposed a reasonable algorithm, and passed the demonstration of Jiangxi rare earth industry. Analysis, the establishment of the rare earth industry supply chain can reduce the procurement cost of raw materials and the retail cost of terminal applications, improve the comprehensive utilization of rare earth resources and the overall competitiveness of the rare earth industry, reduce environmental pollution costs, and achieve low consumption, low pollution High-efficiency growth model of rare earth industry.

2.2 The current development of big data in China and its application in the rare earth industry

2011 is the first year of China's big data market. From 2012 to 2016, the big data market is developing rapidly. As of 2016, the entire market is approaching 10 billion yuan. The traditional industry has become the main force for big data analysis. From the perspective of development model, from 2011 to 2012, big data is still in its infancy, and analysis is still limited to traditional IT thinking. It is based on traditional data analysis mode. Conceptualization and patterning are more serious. It is based on machines. Development model. From 2013 to 2014, during the exploration period, visualization and forecasting applications have become the main direction of big data development. The direction of big data analysis has turned to satisfying and guiding human information needs. It is based on human development model. After 2014, the focus of big data applications has shifted to data mining, the value innovation of enterprise big data. Big data's scalable, high-performance data warehouse enables centralized and integrated business data to support diverse and complex data analysis. It can cope with the challenges of massive data, realize efficient logic operation, real-time and fast data presentation, solve the problem of data sharing and integration of cross-platform heterogeneous application systems, effectively eliminate information islands between business systems and organizational structures, and realize data Unified management.

The application of big data in the rare earth industry is still in the exploration and initial stage. In December 2015, the State Council issued the “Opinions of the General Office of the State Council on Accelerating the Construction of Traceability System for Important Products”, which number is” Guo Ban Fa [2015] No. 95”proposed to actively promote the application of modern information technology such as Internet of Things and cloud computing to trace the rare earth products. . Since 2016, the Ministry of Industry and Information Technology and other relevant government departments have intensively issued documents to encourage and support the deep processing technology upgrade and recycling comprehensive utilization of domestic rare earth enterprises. In the wave of information technology development, the government encourages rare earth enterprises to actively participate in the "Internet +" development, widely use cloud computing big data,

promote the rare earth industry to achieve industrial intensification and high-end through the development of information industry, green and intelligent transformation and innovation. At present, the combination of rare earth industry and big data application is mainly concentrated in the rare earth market. Through the big data of the trading platform, the rare earth is transformed from pure industrial products into investment products like stocks and gold. In August 2016, Baotou Rare Earth High-tech Zone jointly began to build a cloud computing big data center to provide infrastructure, enterprise services, industrial index, and file management system service solutions based on big data information technology for Baotou Rare Earth High-tech Zone to achieve flexibility. Resource invocation capabilities and efficient use of IT resources.

Therefore, for the rare earth industry, with the maturity of big data technology in various industries, especially in the fields of atmospheric monitoring, pollution control and other fields, we have accumulated big data and experience, using big data to build a green supply chain management model and improve rare earth. The production efficiency of resources and the overall competitiveness of the rare earth industry, reducing the negative effects of the environment, is a good solution to promote the healthy development of the rare earth industry under the ecological civilization.

3 BIG DATA COLLECTION METHODS

According to the supply chain management process, the enterprises in the supply chain of the rare earth industry can be divided into six types: 1. the rare earth mining enterprises belonging to the six major groups. 2. Rare earth smelting and extracting enterprises 3. Rare earth primary product application enterprises with overcapacity 4. Rare earth high-end product application enterprises 5. Environmental protection industry 6. Rare earth trade industry. Data collection mainly comes from three aspects:

3.1 Collection of production data for different types of enterprises

This part of the data mainly comes from the corporate and corporate management departments, as well as various annual reports and related reports of the industrial and commercial departments.

3.2 Environmental monitoring information published by relevant departments of environmental protection and environmental monitoring

According to the emission standards of rare earth pollutants, the environmental protection department and other environmental monitoring departments regularly carry out environmental monitoring information for enterprises in the rare earth industry, such as the baseline unit emission concentration of atmospheric pollutants monitored by rare earth industrial enterprises, and the discharge concentration of water pollutants.

3.3 Space environment data collection

Collect environmental big data, and collect environmental data that has not been covered by the environmental monitoring department of the rare earth industry in the rare earth industry supply chain, but has significant impact on the ecological environment. For example, real-time air quality monitoring data, real-time monitoring data of surface water and groundwater in areas where rare earth production enterprises are located. In addition, the rare earth pollutant discharge standard is applicable to rare earth industrial enterprises. For the water quality monitoring data of the region where the rare earth material processing enterprise is located, air quality monitoring data and aeronautical data can also be obtained through environmental big data.

The ecological environment big data is mainly used for stereo measurement by four means [14].

- Ground measurement: The use of monitoring points to obtain massive data. Including surface water and groundwater monitoring data, soil erosion data and land desertification monitoring data, soil pollution

monitoring data, etc.

- Flux tower: used to obtain environmental monitoring data related to air pollution.
- Aerial survey: used for remote sensing detection of forests, vegetation, water and atmosphere, and using remote sensing analysis methods to obtain data.
- Satellite remote sensing: A wide range of environmental monitoring data is obtained through satellite data.

Figure 2. Space environment data collection

The characteristics of the ground and flux towers are: small scale and large quantity. Used for iterative training of models.

Aerial surveys and satellite remote sensing are used to provide macro data. Used for correction of model data, correlation analysis, and comprehensive performance evaluation.

Specific data sources for various data collection methods:

Ground station and flux tower data can be obtained through public channels or through cooperation with relevant associations. Relatively difficult to acquire, it can be used as the main data for model construction.

Aerial survey and satellite remote sensing data acquisition is difficult. It can be used as a supplementary data by collaborating with universities or aeronautical centers, surveying and mapping bureaus, research institutes, with reference to publicly available literature data or by means of purchase cooperation.

4. CONSTRUCTION OF GREEN SUPPLY CHAIN MODEL FOR RARE EARTH INDUSTRY BASED ON BIG DATA

4.1 Data preprocessing and data cleaning

The first step is to process the acquired data, mainly based on the characteristics of the acquired data, eliminating redundant attributes and irrelevant attributes, and compressing the data.

- Attribute specification processing. The original data is simplified or "compressed", the original data is discretized and conceptually layered, redundant attributes and irrelevant attributes are eliminated, and the concepts of normalization and standardization are transformed.

- Data compression processing. The Apriority algorithm is used to perform frequent item compression processing. For example, in the analysis of different pollutant emissions in the production enterprises of the rare earth industry, it can quickly find out the relationship between the various pollutant emissions of the production enterprises and the impact between them.

4.2 Model construction

4.2.1 Distribution pattern and correlation model of supply chain in rare earth industry

The concise workflow of different types of companies in the supply chain of the rare earth industry is as follows:

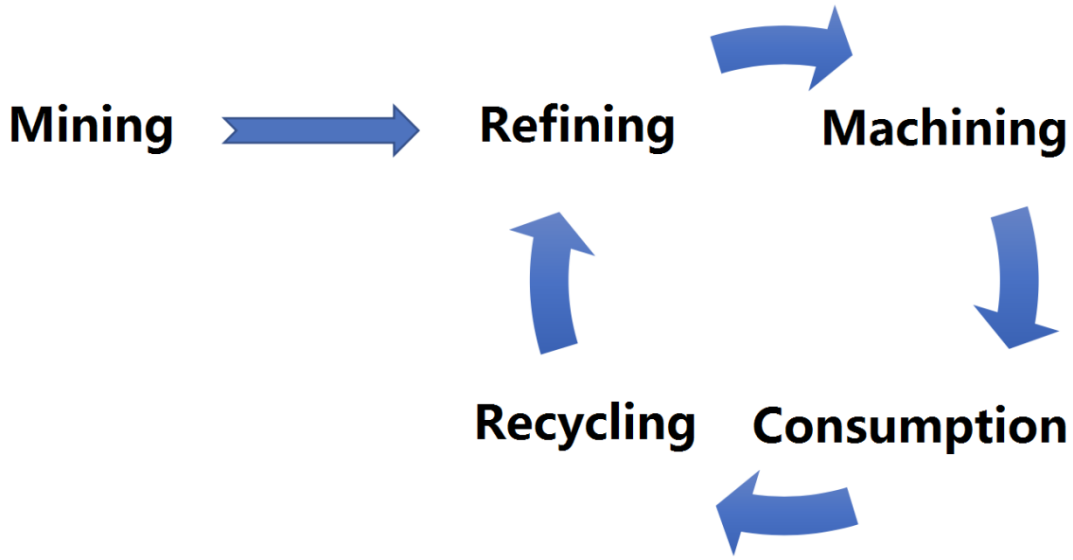

Figure 3. The concise workflow of companies in the supply chain of the rare earth industry

According to different types of enterprises, statistical analysis was carried out on the emission concentration of the reference units of major pollutants, and correlation analysis was carried out. Expect quantitative statistics:

- Base unit emission concentration of each pollutant
- Distribution of comprehensive emissions by region of each pollutant
- Correlation between pollutants
- Correlation of pollutant emissions between enterprises in the supply chain

The main methods used: cluster analysis, partial least squares correlation analysis. The clustering analysis measures the similarity between different data sources, and classifies the pollutant emission data sources of different types of enterprises. Typical partial correlations between different types of firms and different pollutant emissions data were sought by partial least squares.

4.2.2 Ecological Environment Dynamic Monitoring Model

According to the characteristics of various enterprises in the supply chain of the rare earth industry, and the results of correlation analysis of pollutants, select highly relevant monitoring indicators, use real-time collection of environmental monitoring big data (ground monitoring, flux tower, etc.), and combine the production supply of enterprises Data, using BP neural network sensitivity analysis method, build a dynamic monitoring model, real-time monitoring and adjustment of the entire production behavior of the enterprise. By learning and storing a large number of input-output mode mapping relationships, the error is reduced, the link full value is adjusted, and a grading result is generated. According to the weight of the eigenvalues trained, the influencing factors for

the sensitivity of the ecological environment change in the production of this type of enterprise are found. For example, combined with the real-time atmospheric pollutant content data of the environmental department, the influencing factors and types of enterprises with high sensitivity to smog in the rare earth industry emissions are found, which is beneficial to prevent the prediction of smog and other indexes, and can also be based on the prediction data of the ecological environment. Arrange specific production reduction targets and adjust the industrial structure.

4.2.3 Eco-environmental improvement measures tracking and performance evaluation model

To evaluate the ecological environment to improve performance, on the one hand, we must find a scientific method to improve the difference between before and after the implementation of environmental remediation measures. In combination with the uneven distribution of enterprises in the supply chain of the rare earth industry and the large number of pollutant discharge types, the "distance method" can be used to evaluate the difference before and after implementation. Using the Euclidean distance method (ie, euclidean metric), the difference between the indicators is measured to measure the difference between the indicators before and after the improvement measures; on the other hand, the latest artificial neural network research results can be used to adopt multiple The feedback method is used to study and predict, to evaluate the performance of ecological environment improvement, and to predict the impact of relevant measures on the ecological environment.

5 MODEL DATA ANALYSIS AND EXPECTED RESULTS

An empirical analysis of the data was performed according to the three models mentioned in 3. And modify the model based on the results. According to the data, the model is trained, the typical enterprise is selected, the model is applied, and the model is modified according to the application effect. The mature model is applied to the supply chain management and management effect evaluation of the rare earth industry.

6 LIMITATION ANALYSIS AND IMPROVEMENT SUGGESTIONS

6.1 Limitations of data acquisition.

Since the environmental monitoring data belongs to different departments, the data acquisition depends to a large extent on the related business development of the counterpart department, and the quality of data obtained in different regions is different. The integrity and accuracy of the statistics will have an impact on the data analysis and evaluation model.

6.2 Limitations of the analysis object.

At present, the classification of the supply chain of rare earth industry is still relatively extensive; the geographical distribution of rare earth industry distribution, the flow of rare earth products in different regions and the ecological environment of different regions has certain differences in the decomposition ability of pollutant emissions in the rare earth industry. Assessing the location of the analysis object will have an impact on the accuracy and sensitivity of the evaluation model.

6.3 Suggestions for improvement.

The first is to fully understand the data situation before setting up indicators and collecting data, set the indicators reasonably, and try to minimize the impact of the indicators on the evaluation. In addition, in the different regions to achieve the refined management of the green supply chain of the rare earth industry, it should also through specific research, according to the characteristics of rare earth production and sales and application in the north and south regions of China, and the environmental impact of the local environment on

the manufacture of rare earth products. Segment enterprise type and supply chain management model to improve management accuracy and sensitivity.

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