Research on Optimization of Enterprise Green Supply Chain Sustainable Development Strategy Based on Big Data Analysis

Abstract: The green supply chain concept plays an important role in realizing the sustainable development of supply chain. This paper improves the FOA algorithm and proposes an adaptive fruit fly optimization algorithm AFOA to optimize the initial weights and thresholds of the BP neural network and proposes the AFOA-BP model to analyze the supply chain data of the enterprise.The AFOA algorithm converges at the 10th generation, which has a faster convergence rate than the traditional FOA algorithm. The RMSE and MAE values of the model are 0.07682 and 6.84381%, respectively, which are smaller than the BP and FOA-BP models, and have stable prediction effects.After applying the model of this paper for the prediction of the importance of green supply chain risk mitigation strategies, the overall management and operation performance and energy consumption and emission performance of enterprise K have been improved.
Keywords: FOA; AFOA-BP model; green supply chain; sustainable development; risk mitigation strategy.

1. Introduction

As the global environmental problems become more and more prominent, green supply chain management as a sustainable development strategy has been emphasized by more and more enterprises [1-2]. Green supply chain management aims to promote the sustainable development of enterprises by integrating the concept of environmental protection and supply chain management practices to realize the efficient use of resources, reduce environmental pollution and energy consumption [3-5]. It includes environmental protection, resource utilization, energy consumption, waste disposal and other aspects, so that enterprises in the production, supply, distribution, recycling and other links to achieve the goal of saving energy, reducing waste, reducing emissions and so on [6-9].

Green supply chain management has important significance. The first is the enhancement of environmental protection awareness. With the aggravation of global climate change, resource shortage and other environmental problems, people's awareness of environmental protection is gradually increasing. As an important part of corporate social responsibility, green supply chain management can effectively reduce the negative impacts of enterprises on the environment, enhance corporate image, and satisfy consumers' demand for sustainable development [10-13]. Second, the requirements of laws and regulations. Governments have introduced relevant laws and regulations, requiring enterprises to strengthen environmental protection, reduce carbon emissions, and promote green development. As an important way for enterprises to fulfill their social responsibility, green supply chain management helps them to comply with laws and regulations and reduce environmental risks [14-17]. Thirdly, it saves cost and improves efficiency. Through green supply chain management, enterprises can optimize resource allocation, reduce energy consumption and waste emissions, lower production costs and improve efficiency. At the same time, green supply chain management also helps to improve the stability and reliability of the supply chain and reduce business risks [18-21].

Aiming at the problems such as insufficient attention of enterprises in the sustainable development of enterprise green supply chain, this paper proposes a prediction model of supply chain risk mitigation strategy based on AFOA-BP neural network based on the historical data of enterprise supply chain management. Based on the evolutionary algebra to adjust the iterative step size, the traditional FOA algorithm is improved, and an adaptive fruit fly optimization algorithm AFOA is proposed.With the improved AFOA algorithm to optimize the initial weights and thresholds of the BP neural network, the prediction model of the importance of sustainable supply chain risk mitigation strategy is constructed, which provides a reference for the enterprises to realize the sustainable development of green supply chain. The specific application effect of the model in this paper is explored through iterative comparison, prediction error comparison, and case study.

2. Problems in the sustainable development of enterprise green supply chain

2.1 Green supply chain

Green supply chain is a management concept that adds the concept of environmental protection and resource conservation to the management concept of traditional supply chain, and uses advanced technology (e.g., big data, artificial intelligence, etc.) to plan, organize, coordinate, and control the resource flow process in all the links of the supply chain to achieve the unity of economic, social, and environmental benefits, which covers the whole process from product design, raw material procurement, production, transportation, Its content covers the whole process from product design, raw material procurement, production, transportation, storage, sales, use to product end-of-life treatment and recycling [22].

2.2 Obstacles for enterprises to realize sustainable development of green supply chain

2.2.1 Excessive costs for enterprises to implement green supply chains

Excessive costs are currently an important factor hindering the implementation of green supply chains by enterprises and promoting the sustainable development of green supply chains. Green supply chain management involves the whole process of supply chain management, including material selection, product design, supplier evaluation and selection, as well as product production, transportation, distribution, packaging, sales and waste recycling, and so on. For each process, green supply chain management should take effective environmental measures and focus on the protection of the environment. As green supply chain involves more processes, and in each process, enterprises need to incur certain additional costs to improve the environment. Therefore, the cost of “green compliance” for enterprises will rise rapidly compared with that before the implementation of green supply chain management. Low cost is a powerful means for enterprises to improve their competitiveness in the market economy, and the increase in the cost of “green compliance” will undoubtedly weaken the market competitiveness that enterprises should have, thus hindering the implementation of the sustainable development of green supply chains by enterprises.

2.2.2 Insufficient attention by enterprises themselves

With the increasing attention paid by the state to environmental protection, green supply chain management will surely become a new trend in enterprise supply chain management. In the process of green supply chain management, the degree of importance attached by enterprise leaders will largely determine whether the green supply chain of enterprises can be implemented and continue to be implemented. At present, the green supply chain of some enterprises is difficult to promote with the insufficient importance attached by the leaders of the enterprises themselves. Green supply chain management, as a major management strategy of enterprises, involves many personnel, which not only needs to prudently digest the “green compliance” costs incurred by its own implementation of green supply chain, but also needs to obtain the close cooperation of all the employees and upstream and downstream units of the enterprise, especially in the process of cooperation with the upstream and downstream enterprises, due to the “green compliance” costs incurred by its own implementation of green supply chain. Especially in the process of cooperation with upstream and downstream enterprises, due to the existence of “green compliance” costs, it is likely to make the cost structure of upstream and downstream enterprises change, thus triggering conflicts of interest between different nodes of the supply chain. In practice, it is precisely because some enterprise leaders do not know enough about the new trend of green supply chain management and do not pay enough attention to the above problems, which makes it difficult to implement the green supply chain or stop moving forward.

3. Green supply chain sustainable development strategy based on big data

From the above, it can be seen that in the process of realizing the sustainable development of green supply chain, it is crucial for enterprises themselves to pay attention to green supply chain management. Sustainable development requires enterprises to fully realize the risks in the green supply chain and control them, so this paper proposes a green supply chain risk mitigation strategy prediction model as a specific green supply chain sustainable development strategy based on supply chain management big data.

Aiming at the problems of BP neural network and the characteristics of the importance prediction of sustainable supply chain risk mitigation strategies, this chapter adopts AFOA to optimize the threshold and weight of BP neural network, mines the relationship between sustainable supply chain risk factors and risk mitigation strategies based on AFOA-BP neural network, and predicts the importance of risk mitigation strategies based on this according to the importance of risk factors. Figure 1 shows the risk mitigation strategy prediction model based on AFOA-BP neural network.

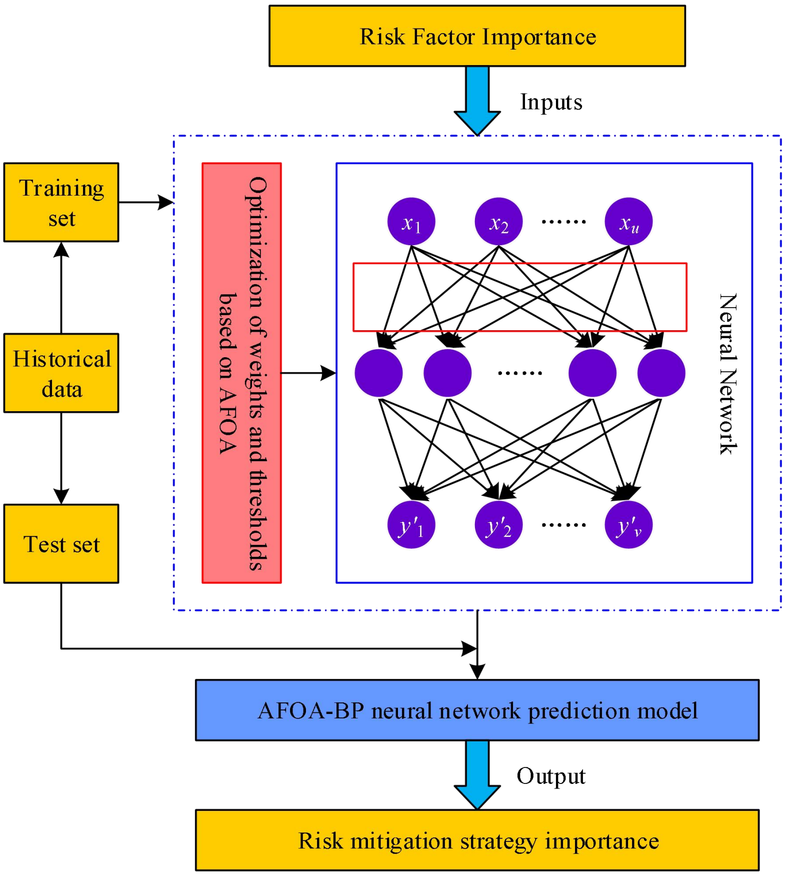

Figure 1 Risk mitigation strategy prediction model

3.1 Adaptive Drosophila Optimization Algorithm AFOA

The traditional FOA algorithm adopts a fixed step size in the optimization search process, which makes it difficult to make a trade-off between the global search capability and the local search capability [23]. For this reason, this paper proposes the adaptive Drosophila optimization algorithm AFOA, which adjusts the iterative step size based on the number of evolutionary generations, and the adjustment trend of the iterative step size is shown in Equation (1).

The adjustment mechanism of the adaptive step size is: in the pre-evolutionary stage, a larger iteration step size is used to avoid falling into the local optimum and increase the global optimization search speed, and with the increase of the number of iterations, the iteration step size is reduced to improve the optimization search accuracy and avoid missing the optimal solution:

$$R_g = \frac{(R_{\max} - R_{\min})}{2} \times \sin\left(\frac{\pi \times g}{G} + \frac{\pi}{2}\right) + \frac{(R_{\max} + R_{\min})}{2} \quad (1)$$

where G is the maximum number of evolutionary generations, g is the current number of evolutionary generations, and $R_{\max}$ and $R_{\min}$ are the maximum and minimum values of the iteration steps, respectively.

3.2 AFOA-BP neural network prediction modeling

The values of BP neural network weights and thresholds play an important role in the training speed and prediction accuracy of the model, while the initial weights and thresholds of the traditional BP neural network model are determined by randomly assigning the values, which may lead to problems such as slower convergence of the model, longer training time, and easy to fall into the local minima [24]. Therefore, it is necessary to optimize the weights and thresholds before determining the initial structure of the BP neural network. In this section, combining the advantages of the Drosophila optimization algorithm, the AFOA algorithm is used to optimize the initial weights and thresholds of the BP neural network, and the prediction model of sustainable supply chain risk mitigation strategy based on AFOA-BP neural network is created.

Step 1: Identify the major risk factors and major risk mitigation strategies in the sustainable supply chain management process through expert research and literature analysis. It is assumed that a total of u risk factors and v risk mitigation strategies are identified, denoted as $\{RF_1, RF_2, \ldots, RF_u\}$ and $\{RM_1, RM_2, \ldots, RM_v\}$ respectively.

Step 2: Collect historical data on the importance of risk factors and risk mitigation strategies in the process of sustainable supply chain management and normalize the data using Equation (2) to form a sample sequence for the prediction model. Assuming that there is N group of sample data, the n group of sample data are $Z_n = (d_{n1}, d_{n2}, \ldots, d_{nu}, m_{n1}, m_{n2}, \ldots, m_{nv})$, $n = 1, 2, \ldots N$. where

$D_n = \left(d_{n1}, d_{n2}, \ldots, d_{nu}\right)$ is the importance of each risk factor in the n th group of samples, which is the input of the prediction model, and $M_n = \left\{m_{n1}, m_{n2}, \ldots, m_{nv}\right\}$ represents the importance of each risk mitigation strategy in the n th group of samples, which is the output of the prediction model:

$$x_i = \frac{x - x_{\min}}{x_{\max} - x_{\min}} \tag{2}$$

Where, x is the original data, $x_{\max}$ is the maximum value in the original data, $x_{\min}$ is the minimum value in the original data and x_i is the normalised data.

Step 3: Initialisation parameters. Based on the identified sustainable supply chain risk factors and risk mitigation strategies, set the number of nodes in the input layer of the BP neural network to u, the number of nodes in the output layer to v, and the number of nodes in the implicit layer to h. Set the maximum number of iterations of the AFOA algorithm to G, the maximum step length to $R_{\max}$, the minimum step length to $R_{\min}$, and the number of populations to S, and the size of the populations to sizepop represent the number of optimisation weights and thresholds required for the BP neural network:

$$sizepop = uh + hv + h + v \tag{3}$$

Step 4: Generate the position of the initial fruit fly population $\left(X, Y\right)$. $X = \left(X_1, X_2, \ldots, X_S\right)$, where $X_i = \left(x_{i1}, x_{i2}, \ldots, x_{isizepop}\right)$ is the horizontal coordinate of the i th population, $Y = \left(Y_1, Y_2, \ldots, Y_S\right)$, where $Y_i = \left(y_{i1}, y_{i2}, \ldots, y_{isizepop}\right)$ is the vertical coordinate of the i th population, $i = 1, 2, \ldots, S$.

Step 5: Assign flight distances and directions to the other fruit fly population individuals foraging, such that the number of iterations $g = 1$:

$$X_i = X_i + R_g \times \left(2 \times rand\left(1, sizepop\right) - 1\right) \tag{4}$$

$$Y_i = Y_i + R_g \times \left(2 \times rand\left(1, sizepop\right) - 1\right) \tag{5}$$

Step 6: Calculate the distance from the origin of the individual fruit flies of each population and determine the odour concentration decision value:

$$D_i = \sqrt{X_i^2 + Y_i^2} \tag{6}$$

$$S_i = \frac{1}{D_i} \tag{7}$$

Step 7: Use the odour concentration determination value S_i of an individual of the population as the weights and thresholds of the BP neural network and input it into the BP neural network for model training. The prediction error function of the prediction model is used as the odour concentration determination function and the odour concentration value $Smell_i$ of the population is calculated:

$$Smell_i = Function\left(S_i\right) \tag{8}$$

$$Function = \frac{1}{T} \times \frac{1}{v} \times \sum_{t=1}^{T} \sum_{f=1}^{v} \left| \frac{y_{tf} - y'_{tf}}{y_{tf}} \right| \tag{9}$$

Where, y_{tf} denotes the true value of risk mitigation strategy importance for sustainable supply chain, y'_{tf} denotes the risk mitigation strategy importance predicted by BP neural network, v denotes the number of predicted risk mitigation strategies, and T denotes the number of test samples.

Step 8: Identify the population with the smallest fitness value, i.e., the lowest odour concentration, in the fruit fly population and record the odour concentration value and the corresponding location:

$$\left[bestSmell, bestindex\right] = \min\left(Smell\right) \tag{10}$$

Step 9: The optimal odour concentration and position coordinates are retained and the other fruit flies in the colony fly to the optimal position:

$$Smellbest = bestSmell \tag{11}$$

$$S_{best} = S_{bestindex} \tag{12}$$

$$\begin{cases} X_i = X_{bestindex} \\ Y_i = Y_{bestindex} \end{cases} \tag{13}$$

Step 10: Let $g = g + 1$, determine whether the number of iterations g of the algorithm reaches the maximum number of iterations G. If $g < G$, repeat steps 5 to 8, and at the same time determine whether the optimal odour concentration of the current population is lower than the Smellbest, and if it is satisfied, execute step step 10, otherwise execute step 10 only until $g = G$, end the optimization algorithm and output the Smellbest and S_{best}.

Step 11: Substitute the output S_{best} of the AFOA algorithm as the optimal weights and thresholds of the BP neural network, and train based on the sample data. The network is cured after meeting the training requirements, thus forming a prediction model for the importance of sustainable supply chain risk mitigation strategies.

Based on the above steps to construct a sustainable supply chain risk mitigation strategy importance degree prediction model, the risk factor importance degree using the formula (2) normalisation process, as the input of the prediction model $X = (x_1, x_2, \ldots, x_u)^T$, can be predicted risk mitigation strategy importance degree $Y = (y_1, y_2, \ldots, y_v)^T$, the prediction model expression is:

$$Y = F(X) \tag{14}$$

where $F(\cdot)$ represents the mapping relationship between risk factor importance and risk mitigation strategy.

4. Model validation and case studies

4.1 Example Predictions and Model Validation

4.1.1 Example of a forecast

The main green supply chain risk mitigation strategies were identified through questionnaire survey, literature analysis and principal component analysis. Taking

Company F as an example, it was found that there were six major risk factors and five related risk mitigation strategies for its sustainable supply chain, and Table 1 shows Company F's green supply chain risk factors and risk mitigation strategies.

Table 1 Risk factors of green supply chain and mitigation strategies

Risk factors	Symbol	Mitigation strategies	Symbol
Production planning problem	RF1	Product outsourcing	RM1
IT and information sharing risk	RF2	Improve product design and development	RM2
Talent shortage	RF3	Environmental protection measures	RM3
Natural disaster	RF4	Maintain and update equipment	RM4
Non-social and environmental benefits	RF5	Prediction analysis	RM5
Infrastructure problems	RF6		

Based on the big data such as management data, historical development documents and other big data, we extracted the risk factors affecting the sustainable development of green supply chain and the importance of risk mitigation strategy historical data, and obtained 140 groups of sample data by eliminating the fuzzy and distorted data, and randomly selected 100 groups of which were used as the training sample data, and the rest of 40 groups were used as the test sample data. The prediction results of green supply chain risk mitigation strategy based on AFOA-BP neural network are shown in Table 2. It can be seen that for this enterprise to achieve the sustainable development of green supply chain, it is most important to predict and analyse the supply chain, and in addition, it is also vital to take environmental protection measures.

Table 2 Forecast results of green supply chain risk mitigation strategies

Symbol	The importance of risk mitigation strategies	Ranking
RM1	0.2427	5
RM2	0.6287	3
RM3	0.6677	2
RM4	0.5451	4
RM5	0.7324	1

4.1.2 Model validation

According to the AFOA-BP prediction model construction process, set the initialisation parameters of the algorithm. Where the number of nodes in the input layer of the BP neural network μ = 10, the number of nodes in the output layer v = 7, the number of nodes in the hidden layer h = 8, the learning rate γ = 0.01, and the number of training times m = 500. The maximum number of iterative steps in the AFOA algorithm is G = 250, the size of the population is p = 187, the maximum search step length $R\max$ = 5, and the minimum search step length $R\min$ = 0.1.

Firstly, the AFOA algorithm is applied to optimise the weights and thresholds of the BP neural network, and at the same time, the AFOA algorithm is compared with the traditional FOA algorithm, and the iteration comparison is shown in Figure 2. It can be seen that the AFOA algorithm converges at the 10th generation with the best fitness value of 0.06884. Compared with the traditional FOA algorithm, the AFOA algorithm converges faster and the optimisation search accuracy is also improved.

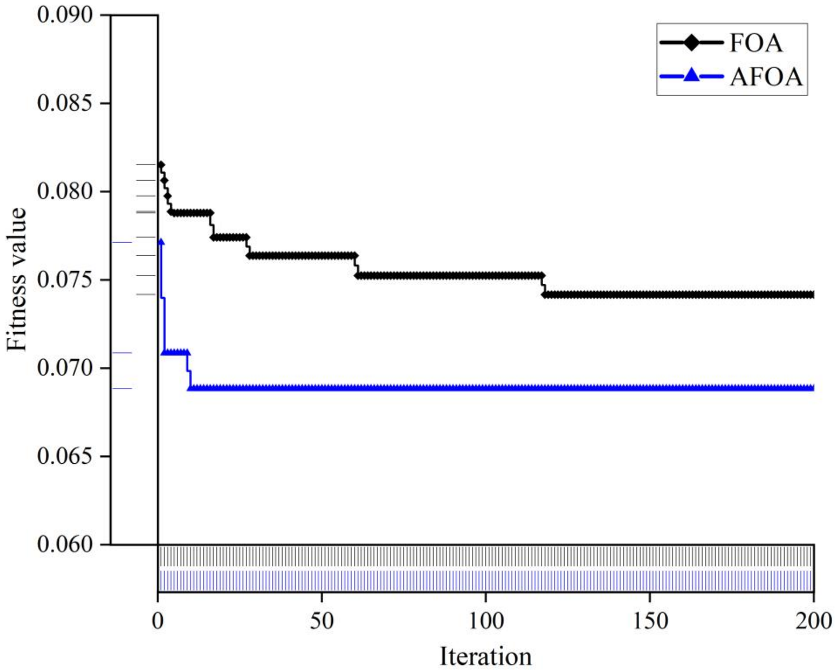

Figure 2 Iterative comparison

The optimal weights and thresholds obtained from the AFOA algorithm are substituted into the BP neural network model, the model is trained by training samples, and then test samples are applied to check the prediction accuracy of the constructed prediction model. In order to verify the accuracy of the model constructed by AFOA-BP neural network, it is compared with the BP neural network prediction model and AFOA-BP neural network prediction model. The initial weights and thresholds of the BP neural network prediction model are randomly generated, the step size of the traditional FOA algorithm is 5, and other parameters are kept consistent. The relative prediction error comparison of the three prediction models is shown in Figure 3. It can be seen that the prediction error of the AFOA - BP neural network prediction model is relatively small and stable in fluctuation.

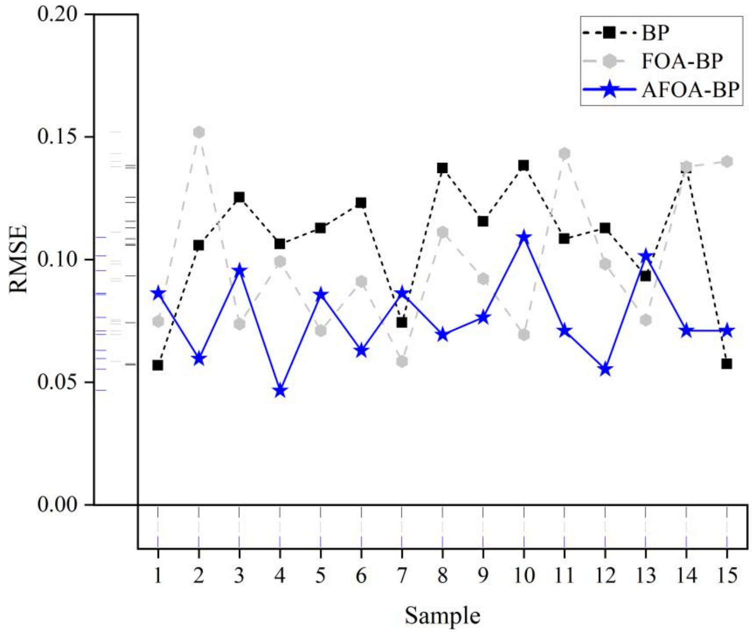

Figure 3 The comparison of prediction error

The mean relative error (MAE) and root mean square error (RMSE) of the three prediction models are calculated separately. Figure 4 shows the comparison of the prediction accuracy of the three models. Compared with other models, the AFOA-BP model has lower RMSE and MAE, which are 0.07682 and 6.84381%, respectively, indicating that the green supply chain risk prediction model based on AFOA - BP has higher prediction accuracy, and it can more accurately predict potential risks in the enterprise's green supply chain based on the big data, so as to provide a guarantee for the sustainable development of the supply chain.

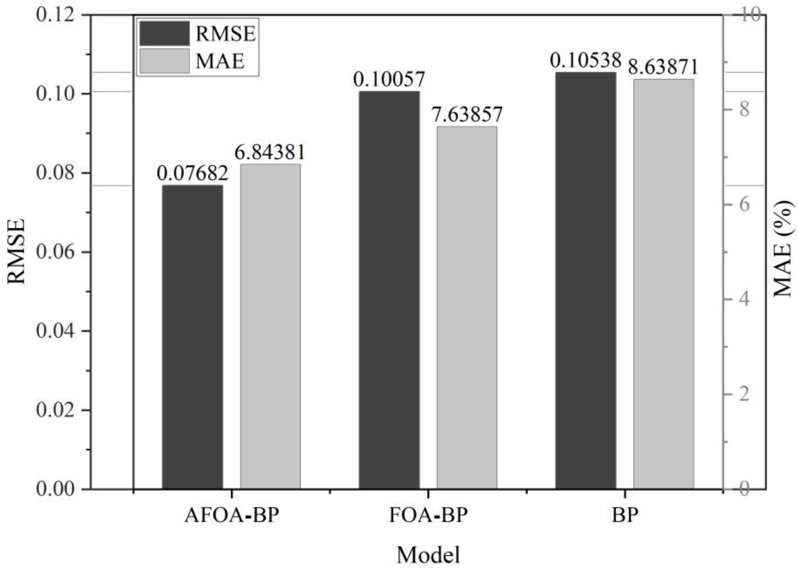

Figure 4 The prediction accuracy pf the three model

4.2 Case studies

A steel company K is used as an example to test the supply chain performance of this company after using this paper's model as an aid to management. The enterprise started to use this paper's prediction model as an aid in April 2024 to optimise its green supply chain management. This paper selects five months' data between April and August, and takes the three directions of management and operation performance, supply chain green performance, and energy consumption and emission performance as the first-level indexes of the index system in the green supply chain performance evaluation method of Enterprise K. It constructs a green supply chain performance evaluation index system based on the method of mutation level.

4.2.1 Managing Operational Performance Analysis

Table 3 shows the results of Enterprise K's management and operation performance evaluation. During the five-month period from April to August, the overall management and operation performance of Enterprise K showed an upward trend, with the top-level design being built and improved from zero, and the growth rate of the financial position slowing down and going downward. China's domestic steel market as a whole suffered severe losses, and the development of K

Enterprises‘ steel industry was also severely constrained, but thanks to the synergies of K Enterprises’ other segments, economic growth was still secured to a certain extent. At the same time, the management of Company K started to use forecasting models to implement green supply chain risk management and integrated some of the ideas of green supply chain management into the strategic documents. Although the development of the steel industry of Enterprise K has slowed down or even regressed due to the severe market environment, the overall management and operation performance still tends to be on the upward trend due to the firm implementation of the top-level design of the green supply chain management system by the decision-makers.

Table 3 Management performance evaluation

Index / Month	Top-level design	Financial situation	Management performance
April	0	0.19662	0.30253
May	0	0.61721	0.43152
June	0.6	0.76502	0.80995
July	0.6	0.79345	0.80988
August	0.8	0.71391	0.88698

4.2.2 Supply chain green performance analysis

Table 4 shows the trend of supply chain green performance. From the table, it can be seen that the overall development of the supply chain green performance of Enterprise K was slow during the five-month period and the change in the performance level was not significant. Green operations started to recover after bottoming out in May. Green Procurement shows an overall fluctuating trend, reaching a peak in June after a small downward trend in May, and then finally going down to the level of April. Green Production generally rose and then fell, with a more pronounced decline after peaking in July. The trend in green logistics reached its lowest value in July, but rebounded quickly in August.

The overall weakness of the macro-economy in May dragged down the overall performance of the steel market, and K Enterprises, as a large steel company in the region, was also more seriously affected at the manufacturing end. In addition to green production performance, the data on supply chain green performance as a whole declined significantly during this period. As can be seen from the indicators, the rise in green production performance in May is mainly due to the share of environmental research and development, as Enterprise K has invested in a higher level of environmental protection.

It can be seen that the market environment has a great impact on the green supply chain construction of Enterprise K. Under the overall weak market situation, the progress of the green supply chain construction of Enterprise K is slow and tends to stagnate, which may be due to the weak ability of private enterprises to resist market risks, and when encountering a downturn in the market the pressure of survival of the enterprise will lead to the limited resources tilted in other directions.

Table 4 Green supply chain performance trends

Index / Month	Green marketing	Green purchase	Green production	Green logistics	Green supply chain performance
April	0.66374	0.51226	0.2496	0.39017	0.78883
May	0	0.43803	0.64128	0.42365	0.63007
June	0.55725	0.63845	0.68692	0.61267	0.85913
July	0.62232	0.51864	0.71935	0.23778	0.82669
August	0.67842	0.48864	0.49193	0.71766	0.84041

4.2.3 Performance analysis of energy consumption and emissions

Table 5 shows the trend of energy consumption emission performance. In terms of energy consumption and emission performance, the overall trend of energy consumption and emission performance of Enterprise K is upward. The performance of the two indicators, energy consumption and waste emissions, has always maintained a positive growth. Recycling disposal decreased in July but rebounded rapidly in August. The steel industry's environmental monitoring mechanism is nearly perfect, with all metrics filed online in real time, and the almost draconian sanctions force companies to prioritise environmental issues no matter what the circumstances. In addition, the use of predictive modelling to manage risks in the green supply chain has allowed the company to move more smoothly into environmental upgrading. In summary, while the overall development of Firm K's steel industry has been hampered, the company has maintained a high level of investment in energy consumption and emissions.

Table 5 Energy consumption emission performance

Index / Month	Energy consumption	Waste emission	Circulating disposal	Energy consumption emission performance
April	0	0	0.24639	0.23641
May	0.51129	0.14511	0.57297	0.71382
June	0.81349	0.25324	0.66213	0.82058
July	0.86721	0.40609	0.60332	0.84611
August	0.9974	0.49144	0.98024	0.93145

5. Conclusion

This paper proposes an AFOA-BP model for predicting the development strategy of green supply chain, which provides an important degree of reference for enterprises to cope with the existing risks in green supply chain through historical data. The improved AFOA algorithm converges at the 10th generation with the best fitness value of 0.06884, which has better convergence speed and optimisation accuracy compared with FOA. In the test, the RMSE and MAE values of the AFOA-BP model in this paper are smaller, 0.07682 and 6.84381% respectively, and the prediction results are more stable. A steel industry K enterprise, for example, found that after applying this paper's model as an auxiliary means for green supply chain optimisation and management, although the green performance of the supply chain fluctuates greatly under the influence of the market environment, the overall management and operation performance and energy consumption and emission performance of the enterprise were improved, which side by side illustrates that this paper's model has a certain role in the sustainable development of the enterprise's green supply chain.

References

[1] Khan, S. A. R., Dong, Q., Zhang, Y., & Khan, S. S. (2017). The impact of green supply chain on enterprise performance: In the perspective of China. Journal of Advanced Manufacturing Systems, 16(03), 263-273.

[2] Li, J., & Yan, D. (2021). Exploration on the mechanism of the impact of green supply chain management on enterprise sustainable development performance. Sustainability, 13(17), 9906.

[3] Bose, I., & Pal, R. (2012). Do green supply chain management initiatives impact stock prices of firms?. Decision support systems, 52(3), 624-634.

[4] Acquah, I. S. K., Agyabeng-Mensah, Y., & Afum, E. (2020). Examining the link among green human resource management practices, green supply chain management practices and performance. Benchmarking: An International Journal, 28(1), 267-290.

[5] Sarkis, J., Zhu, Q., & Lai, K. H. (2011). An organizational theoretic review of green supply chain management literature. International journal of production economics, 130(1), 1-15.

[6] Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. International journal of production economics, 162, 101-114.

[7] Zhu, Q., Tian, Y., & Sarkis, J. (2012). Diffusion of selected green supply chain management practices: an assessment of Chinese enterprises. Production Planning & Control, 23(10-11), 837-850.

[8] Hong, J., Zhang, Y., & Ding, M. (2018). Sustainable supply chain management practices, supply chain dynamic capabilities, and enterprise performance. Journal of cleaner production, 172, 3508-3519.

[9] Tarigan, Z. J. H., Siagian, H., & Jie, F. (2021). Impact of enhanced Enterprise Resource Planning (ERP) on firm performance through green supply chain management. Sustainability, 13(8), 4358.

[10] Ying, J., & Li-jun, Z. (2012). Study on green supply chain management based on circular economy. Physics Procedia, 25, 1682-1688.

[11] Kumar, R., & Chandrakar, R. (2012). Overview of green supply chain management: operation and environmental impact at different stages of the supply chain. International Journal of Engineering and Advanced Technology, 1(3), 1-6.
[12] Jaggernath, R., & Khan, Z. (2015). Green supply chain management. World Journal of Entrepreneurship, Management and Sustainable Development, 11(1), 37-47.
[13] Chin, T. A., Tat, H. H., & Sulaiman, Z. (2015). Green supply chain management, environmental collaboration and sustainability performance. Procedia Cirp, 26, 695-699.
[14] Zhu, Q., Geng, Y., Fujita, T., & Hashimoto, S. (2010). Green supply chain management in leading manufacturers: Case studies in Japanese large companies. Management Research Review, 33(4), 380-392.
[15] Bhool, R., & Narwal, M. S. (2013). An analysis of drivers affecting the implementation of green supply chain management for the Indian manufacturing industries. International Journal of Research in Engineering and Technology, 2(11), 2319-1163.
[16] Yang, C. L., & Sheu, C. (2011). The effects of environmental regulations on green supply chains. African journal of business management, 5(26), 10601.
[17] Sheng, X., Chen, L., Yuan, X., Tang, Y., Yuan, Q., Chen, R., ... & Liu, H. (2023). Green supply chain management for a more sustainable manufacturing industry in China: a critical review. Environment, Development and Sustainability, 25(2), 1151-1183.
[18] Green Jr, K. W., Zelbst, P. J., Meacham, J., & Bhadauria, V. S. (2012). Green supply chain management practices: impact on performance. Supply chain management: an international journal, 17(3), 290-305.
[19] Ali, A., Bentley, Y., Cao, G., & Habib, F. (2017). Green supply chain management–food for thought?. International Journal of Logistics Research and Applications, 20(1), 22-38.

[20] Tseng, M. L., Islam, M. S., Karia, N., Fauzi, F. A., & Afrin, S. (2019). A literature review on green supply chain management: Trends and future challenges. Resources, Conservation and Recycling, 141, 145-162.

[21] Yildiz Çankaya, S., & Sezen, B. (2019). Effects of green supply chain management practices on sustainability performance. Journal of Manufacturing Technology Management, 30(1), 98-121.

[22] Ghosh Soumita,Chakraborty Abhishek & Raj Alok. (2024). Analysis of green supply chains under fairness concern and differential power structure. Journal of Business & Industrial Marketing(10),2088-2103.

[23] Bai Yonghua,Luo Minzhou & Pang Fenglin. (2021). An Algorithm for Solving Robot Inverse Kinematics Based on FOA Optimized BP Neural Network. Applied Sciences(15),7129-7129.

[24] Yannan Zhao,Wenfeng Du,Hui Wang & Yingqi Wang. (2024). New shape optimization method for tree structures based on BP neural network. Journal of Constructional Steel Research109059-109059.