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Business and Economic Operation Management of Ecological Enterprises Based on Internet of Things and Low-carbon Economyo

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Abstract: Since the new century, China's economic development model has undergone tremendous changes. While China is developing its economy, there are also environmental problems. Environmental protection issues and low-carbon economy have become common concerns. The innovation of business model is an important way to promote enterprise development and social and economic development. In this regard, through the description of the economic operation management under the new type of enterprise, the paper brought out the problems on the current enterprise management theme and drew out the decision-making model. This paper compared traditional enterprises and new enterprises, mainly in four aspects: management efficiency, product utilization rate, profit improvement, and enterprise competitiveness. The results showed that compared with traditional enterprises, new-type enterprises improved management efficiency by 20.9%, and product utilization rate increased by 38%, as well as profit points also increased by 2 points. The competitiveness of enterprises was also improved, which also showed that the new type of enterprise was more in line with the development of the current era and was feasible in the economic operation of the enterprise.

1. Introduction

Enterprises play a pivotal role in social and economic development. Therefore, in order to develop a low-carbon economy, the traditional business model must be transformed. Under the background of today's social development, the development mode of high pollution and high energy consumption is no longer suitable for the needs of social development. The realization of a harmonious and low-carbon lifestyle is an inevitable trend of today's social and economic development. In the development process in recent years, all countries in the world urgently need to realize economic development in a low-carbon environment. In the process of economic transition and development, China must solve the problems of enterprise operation and management, and

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strengthen the management innovation of low-carbon economy, as well as integrate the low-carbon concept into enterprise operation and management.

In the age of Internet of Things (IoT), governments are increasingly focusing on the environment. Enterprises seek to survive and develop by using various environmental protection facilities and environmental protection information, and they also obtain economic benefits while making full use of resources. That is to say, in order to reduce energy consumption and minimize environmental pollution, enterprises should develop low-carbon and energy-saving products to better adapt to new trends, which is very helpful for the development of the company.

2. Literature review

In the management of enterprises, the economy of the current era tends to be a low-carbon economy and the world has begun to pay attention to the ecological environment, which has had an impact on many enterprises. In this regard, many enterprises have begun to improve their operation management, and related scholars have also conducted research on it. Hema is a new retail brand under Alibaba, which is mainly engaged in fresh food and has developed rapidly in recent years. As of June 2019, it had 152 stores in 21 cities in China. Hema's service concept of fresh items and 30-minute delivery is widely welcomed by consumers. Xie X mainly discussed the operation management of Hema, including site selection strategy and supply chain management, and analyzed its characteristics to find the reasons for its success [1]. Due to the strategic position between manufacturers and end users, the service sector has the potential to play an important role in the transition to a circular economy. However, there is a lack of supporting methodologies and practical applications to demonstrate that service-oriented companies implement circular economy principles in their day-to-day business practices. Heyes G addressed this gap by analyzing the potential of service-oriented companies in the Information and Communication Technology (ICT) sector to build and implement circular economy business models. He showed how ICT companies could identify, evaluate and prioritize circular sustainable business model innovations. Risk shocks played an important role in explaining business cycle fluctuations [2]. Mendicino C studied the impact of risk shocks on small open economies with tradable and non-tradable productive sectors. The findings suggested that a large part of the volatility in output, investment, risk premiums and corporate net assets in the Canadian economy could be explained by sector-level risk shocks. Volatility measures were constructed from stock returns at the Canadian firm level, and the out-of-sample performance of the model was found to be quite good [3]. Chen K J incorporated country's production into a Real Business Cycle (RBC) model of small open economies to explain the different empirical patterns of international business cycles between advanced economies and emerging markets. In order for the RBC model to quantitatively replicate a reasonable moment of experience for a small open economy, the model needed to be characterized by a counterfactual, that is, the effect of income on labor supply was small. The considered household production introduced substitutability between market consumption and household consumption, which made the data generate high volatility of market consumption [4]. In business and economic operation management, scholars conducted research and discussion in many aspects, but they did not conducted research on ecological enterprises in a low-carbon economy. In this regard, relevant scholars have conducted research on ecological enterprises.

In terms of ecological enterprises, scholars have also discussed from many aspects. Jha A K aimed to analyze the socio-ecological policy trade-offs resulting from technological innovation in the post-COVID-19 era. The research results were used to design a comprehensive policy framework to achieve the Sustainable Development Goals (SDG). The results showed that the innovation-CO_2 emission correlation was inverted U-shaped, and the innovation-unemployment

correlation was U-shaped. The findings revealed conflicting policy trade-offs resulting from technological innovation [5]. Barinova S studied the spatial distribution of phytoplankton species richness along the waters of Lake Balkhash. As phytoplankton had weak statistical links to environmental parameters, the 3D maps revealed complex features of their spatial variability across environmental factor gradients [6]. In the process of social development in the new era, the management and development of enterprises need to implement changes and innovations. In the context of ecological civilization construction, the concept of green management has been gradually introduced into the development and operation of enterprises, which has brought great reference to the management of enterprises. To this end, Zhou Y briefly expounded the necessity of implementing green management in enterprises and the problems existing in actual green management, and actively explored specific measures for enterprises to implement green management in the context of ecological civilization construction, so as to promote the healthy development of enterprises [7]. Scholars have discussed various aspects of ecological economy, but not in the context of the Internet of Things and low-carbon economy. In this regard, this paper analyzed the operation and management of ecological enterprises based on the Internet of Things and low-carbon economy.

3. Materials and methods of basic theory of enterprise ecology

3.1 Definition of Enterprise Ecology

Enterprise ecologicalization is to extend the concept of natural ecology to the production and operation of enterprises, and treat it as a small natural ecological environment, so as to study it and apply it to all levels of the enterprise. As far as ecologicalization is concerned, it is actually the development of the living environment of natural organisms. Only under such a premise can all business operations be done well. To achieve both internal and external economic goals, it is necessary to have an ecological economic behavior of enterprises, that is, the synergistic effect of social responsibility and enterprise interests. The scientificity and rationality of ecological economic behavior depend on the maximum economic, social and ecological benefits of enterprises, while the minimum resources are invested in this process, so that the interests of society and enterprises can be organically unified. In today's market economy, as the main body of the market, on the one hand, enterprises are to maximize their own interests; on the other hand, they are to maintain and strengthen the ecological environment of the market economy. The conflict between the two is essentially a conflict between the interests of the company and society. Therefore, both the interests of the society and the interests of the company must be taken into account. In these aspects, the most fundamental requirement is to realize the preconditions that meet the social interests without affecting the healthy development of the society and the ecological environment, and enable enterprises to fully assume the responsibilities and obligations that the society should undertake. Only under the framework of relevant national policies and laws can enterprises obtain the maximum profit in production and operation. The government should effectively restrict the development and vitality of enterprises to obtain the best social effect.

For enterprises, it is necessary to regulate their own ecological environment by adjusting the investment structure. Enterprises must strengthen their environmental awareness and responsibility under the premise of complying with the environmental protection policies and laws and regulations formulated by the state. Through the external economy of environmental protection, the enterprise realizes the internalization. At the same time, the ecological environment compensation fund is to serve the people, and the adjustment of the ecological environment must be strengthened, as well as enterprises are required to actively pay and use it as a compensation fund for the protection and construction of the ecological environment resources caused by production and life. Only in this

way can enterprises consciously construct and implement an ecological compensation mechanism. The government ensures its implementation by strengthening the ability of policy regulation, and regulates it through laws and regulations. Since the business activities of the enterprise are related to the economic problems both inside and outside the enterprise, it is necessary to formulate and implement various environmental protection regulations to achieve a win-win situation between the enterprise and the society. Through the analysis of the above problems, the concept of enterprise ecologicalization is obtained: Enterprise ecologicalization is to take the enterprise as a living body and form an organic whole with the surrounding environment.

The ecological management concept of an enterprise's operation is ultimately reflected in the ecologicalization of its business performance. The combination of quantum performance and quantum organizational structure makes it no longer a simple matrix model, but a multi-dimensional ecological transformation based on the height of strategic thinking of enterprises. The ecological management of enterprise operation is based on its own industrial chain and its core competitiveness. Enterprise ecological performance takes employee growth as the primary goal, and takes employee growth as the hard indicator, as well as improves the overall performance of the company through the ecological management of the enterprise.

3.2 Difference and Significance of Enterprise Ecological Operation Management and Traditional Enterprise Management

Fundamentally speaking, the difference between traditional management and ecological management concepts lies in the difference between traditional management concepts and ecological management concepts. Especially in the complex environment faced by traditional enterprises, the advantages of ecological management would be highlighted.

First, the focus of human and material resources management is different. Traditional companies pay more attention to the distribution of material resources, while ecological enterprises focus on people's enthusiasm. Second, the formality of management: Traditional companies emphasize "system above everything else", while ecologically operated companies pay more attention to internal needs and whether to work according to the company's agreement. Third, the diversification of operation: The traditional business model was formed under the social background of the past, while the operation of an ecological enterprise must adapt to the reality and future development. Therefore, the traditional operation and the ecological operation are completely different. Fourth, there are differences in product demand between traditional enterprises and ecological enterprises: Traditional enterprises aim at quantity, while ecological management enterprises need technological advantages, such as artificial intelligence. Fifth, there are some differences between traditional management and ecological management. Sixth, the goals of traditional management and enterprise ecological management are different: Traditional management is mainly for small companies, while ecological management is for fast-growing small and medium-sized enterprises.

The importance of implementing ecologicalization in the operation and management system of enterprises: Under the current development situation, the ecological operation and management of enterprises have achieved initial results. First, the market value of the company can be increased. To a certain extent, the realization of the value of an enterprise depends on whether it can seize the development opportunities in time and recognize the needs of the market, so that it can truly meet the needs of the market. The adoption of ecological management is to meet the needs of consumers. Only by meeting specific market needs can the company's operating efficiency and operating capabilities be improved. In the current and future development, it is very important whether the enterprise can have super competitive ability, and so is the ecological management. Secondly, sustainable development: New energy vehicles are green, which is to protect the environment and

allow consumers to live a better life. Fourth, improve the brand awareness of the company: The ecological management of the enterprise would improve the brand image of the overall enterprise under the influence of the whole society.

3.3 Enterprises in a Low-carbon Economy

The connotation of low carbon refers to waste gas with less energy consumption, and energy conservation and emission reduction are the key to a low-carbon economy. When developing the real economy, management innovation must be strengthened. Through innovative management methods, the dependence on fossil energy is reduced, and the control of high-energy-consuming gas emissions is realized, as well as the development of a low-carbon economy is promoted. In the context of China's low-carbon economic development, Chinese enterprises must optimize and improve their existing business models in a beneficial and sustainable manner. However, some enterprises still have many problems in the implementation process. As China's low-carbon economy develops and gradually enters the market, the traditional business philosophy must also be changed. In this field, professional and technical personnel in China lack sufficient experience. Therefore, the cultivation of such talents has not been paid enough attention, and the application of low-carbon economy in enterprises is not very good. In addition, in terms of funding, it has not been fully recognized, and most banks have refused to provide funds for a low-carbon economy. With the gradual combination of low-carbon economy and enterprise development, the external development environment of enterprise operation has undergone tremendous changes. China's current enterprise development model is in line with the needs of low-carbon economic development, and innovation in strategic management must be carried out. The Chinese government actively promotes the development of the low-carbon economy, and formulates a large number of development policies, as well as promulgates a large number of programmatic documents.

According to the company's development strategy, the government combines it with management innovation and determines the development path, thereby determining the direction of technology and research. Corresponding management and execution mechanisms have been established to provide sufficient financial support for the research on low-carbon technologies. At present, China's low-carbon technology research has formed a multi-level system, and national policies and institutions keep pace with enterprises. When risks are identified, methods such as risk enumeration, risk identification, and risk prevention can be adopted.

The hazard factors of low-carbon economy are estimated and judged, and the scope of its hazard is clarified, as well as appropriate insurance is adopted to reduce the risk according to the actual situation of the company. In the field of risk management, various channels such as transfer and sales can be used to realize the innovation of management methods, and enhance the awareness of management concepts, as well as reduce the impact of low-carbon management on the company, so that risk management policies can be implemented.

The low-carbon economy has great potential for development. However, at present, many enterprises lack the enthusiasm to develop the low-carbon economy. From the perspective of senior managers, the low-carbon economy faces the disadvantage of high investment and high risk, which makes them question its future development prospects, thus missing the opportunity to transform and develop a low-carbon economy. Some companies blindly develop low-carbon economy and pursue high-tech, and they compare China's low-carbon economy with other countries' low-carbon economic systems. Due to the lack of experience in combination with reality, it deviates from the original intention of developing a low-carbon economy, which has a certain negative effect on its healthy development.

A low-carbon economy can certainly bring business opportunities, but it also has certain risks.

For example, in the early stage of technology research and development, a lot of money should be invested and talents should be cultivated. These are all problems that need to be solved urgently. Once the research and development fails, it would cause huge losses.

Enterprise management concept based on the development of low-carbon economy: The production process of enterprises is relatively complex, which does not allow any mistakes. Innovative management would continue to promote the development of a low-carbon economy, and innovative approaches and strategies would play an important role. In the all-round innovation from design to development, the business objectives of enterprises should be adapted to the development trend of low-carbon economy. Whether from the perspective of investment or project implementation, it is necessary to master the correct management ideas, and get rid of the traditional management model, as well as focus on innovation to improve the efficiency of enterprises. New ideas are passed on to every manager and employee of the enterprise to promote the development of a low-carbon economy. After years of experience and practice, it can expand the scope of risk warning, and improve management and technical levels. In order for enterprises to gain multiple advantages in the process of development, they must promptly reflect and adjust the problems they face, and also need to reposition and innovate.

3.4 Ecological Problem of the Main Body of Enterprise Management

In the field of investment, there is an adage: "The company would rather have second-class products produced and have a good team". The main body of all social activities is developed by people. Similarly, companies also need excellent managers and technical talents to apply advanced management ideas to the extreme and form perfect products. The problems existing in enterprise management are mainly in the following aspects.

The problem of senior managers: At present, there is a certain difficulty in the demand for senior managers in Chinese enterprises. There is a shortage of senior executives across the industry, and industry leaders are even rarer. External force alone is not enough, it can only be supplemented by internal talent training. However, the training of internal employees takes a certain amount of time, and the supply of senior management talents in enterprises is in short supply. The quality and ability of some employees cannot meet the development needs of the company and the market, which creates the risk of weakening market competitiveness.

The core problem of technical personnel: The core technical personnel of high-tech enterprises are the core of their development. Judging from the current market phenomenon, the final competition of enterprises is the competition of products themselves, while talents provide high-quality products. If an enterprise wants to improve its own competitiveness, it must first rely on talents.

The ecological problem of business efficiency: The interests of enterprises include not only the results of direct output, but also long-term social interests, sustainable development of society and enterprises. If fundamental values are not respected, the effect would be more pronounced. The damage to society, enterprises and the ecological environment would be more serious and the benefits would be lower. On the long-term development of society, enterprises and natural ecological environment, it may cause huge negative impact, and even cause the collapse of enterprises and industrial recession. In today's rapid development of enterprises, in order to realize the ecologicalization of enterprise operating benefits, enterprises must realize efficient ecological operation in the whole process of enterprise operation, so as to achieve sustainable development of customers, enterprises, supply chains, society and other aspects.

The problem of operating expenses: Operating costs refer to the cost of the company selling products or services, and operating expenses should be determined in proportion to the revenue

from the sales of products or services. As the center of business activities, the business activities of the enterprise are directed, coordinated and supervised by managers, and the operating expenses of the operators would directly affect the operating expenses of the enterprise. At the beginning of the company's establishment, the core of the company is to rapidly develop and seize a high market share, without effective management of operating costs. Therefore, the company's operating cost management system is not perfect.

3.5 Construction method of decision model

In terms of decision information (generally attribute weights and attribute values are correct or have some value), there are many mature technologies and analysis methods. However, the change of the market economy is a complex and variable process, and the uncertainties in it are also various. The model only comprehensively determines the weight of each indicator, and the comprehensive attribute values of each scheme are still in the form of interval numbers, which is difficult to perform a simple sorting. On this basis, this paper proposes a distance-based fuzzy optimization method and combines it with a single-objective optimal model to solve the decision-making problem of ecological enterprises in an incomplete information environment.

$X = \{x_1, x_2, \ldots x_n\}$ is assumed to be a set of scenarios and $U = \{u_1, u_2, \ldots u_m\}$ is a set of attributes. In the multi-attribute decision-making process, the use of interval numbers to express uncertainty information is the most common one. The interval number $\tilde{a}_{ij} = [a_{ij}^L, a_{ij}^U]$ is used for the calculation. Among them,. N={1,2,..n}, M={1,2,...m} represents the attribute value u_j of the scheme, and the attribute value of each scheme is:

$$W = (w_1, w_2, \ldots w_m)^T \quad (1)$$

W represents a weighted vector for an attribute., H represents the weight of a set of attributes determined by local weighting information:

$$H = \{W = (w_1, w_2, \ldots w_m)^T \mid 0 \ll w_j^L \leq w_j \leq w_j^U\} \quad (2)$$

Among them, w_j^L and w_j^U represent lower and upper layers, respectively. The problem to be solved here is to use the existing decision information (that is, the incomplete attribute weight information W and the interval number decision matrix $\tilde{A}$) and an appropriate algorithm to sort the solutions, so as to obtain the best solution.

Normalized application of interval number decision matrix: The most commonly used attribute types include benefit attribute and cost attribute. I_j and j=(1,2) are assumed to represent diagonal sets of benefit-type and cost-type properties, respectively. In order to reduce the restriction on properties of various physical condition classes, I_j and j=(1,2) is assumed to be a subscript set of benefit type and cost type, respectively. In order to overcome the limitations of different physical conditions on the decision-making results, the following formulas for the calculation of the rule-based decision matrix are introduced first. This criterion matrix $\tilde{A}$ is converted into a normalization matrix. Among them, on this basis, a rule-based criterion decision matrix is proposed.

$$\widetilde{r_{ij}} = \widetilde{a_{ij}} / \left\| \widetilde{a_{ij}} \right\| \quad (3)$$

$$\widetilde{r_{ij}} = (1/\widetilde{a_{ij}}) / (1/\left\| \widetilde{a_{ij}} \right\|) \quad (4)$$

Among them:

$$\left\| \widetilde{a_{ij}} \right\| = \sqrt{\sum_{i=1}^{n} \widetilde{a_{ij}}^2} \quad (5)$$

$$\left\|1/\widetilde{a_{ij}}\right\| = \sqrt{\sum_{i=1}^{n}(1/\widetilde{a_{ij}})^2} \tag{6}$$

The Formulas of 3 and 4 can be written respectively according to the calculation rules of interval numbers:

$$r_{ij}^{L} = a_{ij}^{L}/\sqrt{\sum_{i=1}^{n}(a_{ij}^{U})^2} \tag{7}$$

$$r_{ij}^{U} = a_{ij}^{U}/\sqrt{\sum_{i=1}^{n}(a_{ij}^{L})^2} \tag{8}$$

When determining the comprehensive indicators of each scheme, the weight of each indicator must be determined first, and the weighting is calculated as follows.

$$\min Z_i(W) = \sum_{j=1}^{m} r_{ij}^{L} w_j \ (i \in N) \tag{9}$$

$$s.t\ W = (w_1, w_2, \ldots w_m)^T \in H \tag{10}$$

$$\max Z_i(W) = \sum_{j=1}^{m} r_{ij}^{U} w_j \ (i \in N) \tag{11}$$

The optimal solutions can be obtained from Formulas 9 and 11, respectively:

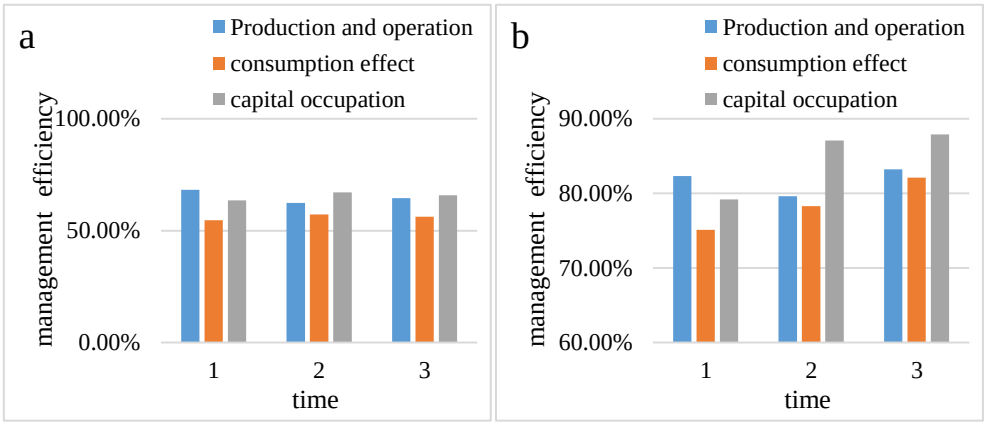
$$w_{i'} = (w_{i1'}, w_{i2'}, \ldots w_{im'})^T \tag{12}$$

$$w_{i''} = (w_{i1''}, w_{i2''}, \ldots w_{im''})^T \tag{13}$$

In this way, it can be calculated that the total attribute value of a scheme is the number of intervals of. On this basis, 2 n linear programming models need to be solved, and the overall characteristics of each scheme are obtained. After determining the weight of each attribute, the probability matrix is used to rank each scheme. Finally, a calculation of the degree of separation is used to make partner decisions.

4. Comparison of results between traditional enterprises and ecological enterprises

In this paper, 200 different companies are investigated through surveys to learn about corporate information. The number of traditional enterprises and ecological enterprises is the same, and three surveys are conducted to verify the accuracy of the data. This paper mainly compares four aspects of enterprise economic management efficiency, product utilization rate, enterprise profit improvement point and enterprise competitiveness.

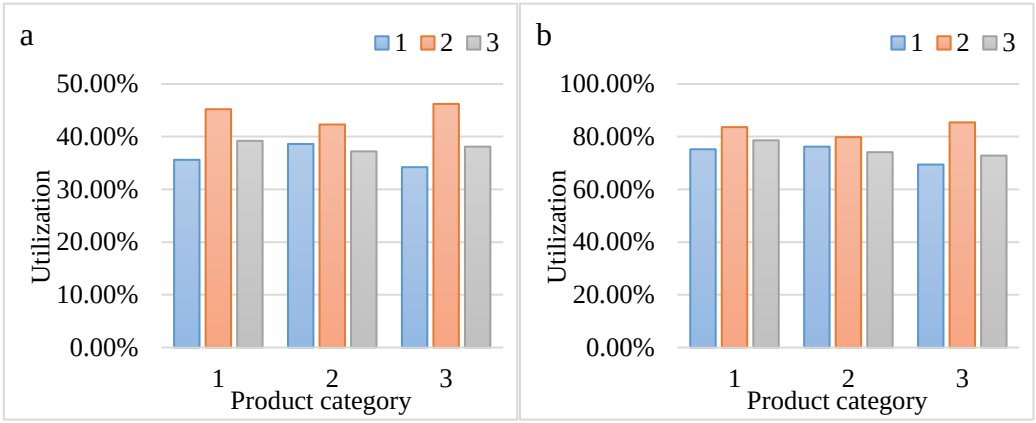


a: Traditional enterprise; b: Ecological enterprise
Figure 1. Comparison of economic management efficiency

The efficiency of enterprise economic management affects to a large extent the efficiency of the enterprise. Based on the Internet of Things, the experience management efficiency of different enterprises is also very different, and the comparison between the two is shown in Figure 1.

Through the management efficiency of the two, it can be found that the management efficiency of traditional enterprises is generally only about 62.5%, while the management efficiency of ecological enterprises based on the Internet and low-carbon economy reaches 83.4%. The overall efficiency increases by 20.9%, which greatly helps enterprises improve operational efficiency and also shows that ecological enterprises are more valuable than traditional enterprises.

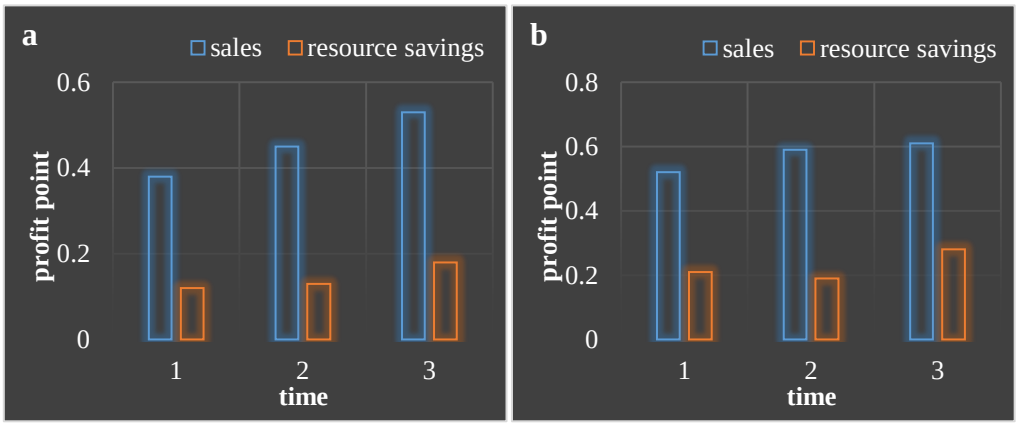
Under the low-carbon economy of enterprises, enterprise products would be reused to reduce product waste, and the comparison chart of product utilization rate between the two companies is shown in Figure 2.



a: Traditional enterprise; b: Ecological enterprise

Figure 2. Product utilization comparison

Through two sets of data, it can be found that the product utilization rate of traditional enterprises is below 40%, while the product utilization rate of ecological enterprises is much higher, reaching 78.5%, and the overall product utilization rate increases by 38%. Enterprises in a low-carbon economy would also pay more attention to product waste and the utilization rate would also increase, which shows that the operation of enterprises in this mode would also have more development prospects.



a: Traditional enterprise; b: Ecological enterprise

Figure 3. Comparison of profit improvement points

The different experience management modes of two different enterprises bring different economic benefits to the enterprises. Economic management is mainly to bring certain value to the enterprise, which would also be in line with the core idea of the enterprise, and the comparison chart of the two at the point of profit improvement is shown in Figure 3.

Through the comparison of the two data, it can be found that the profit improvement point of traditional enterprises is about 60%, but the relative increase of ecological enterprises is 2 points, which is about 80%. It shows that ecological enterprises are more conducive to the economic development of enterprises, and this new economic management model is more in line with contemporary ecological enterprises.

5. Conclusion

In the environment of the Internet of Things and low-carbon economy, this paper compared the feasibility of economic operation management between ecological enterprises and traditional enterprises. By explaining the characteristics of the behaviors, management methods and theories under the ecological enterprise, it was compared with the management under the traditional enterprise mode to illustrate the gap between the two and complement the advantages, problems and development directions of enterprises in a low-carbon economy. By explaining the problems under enterprise management and introducing decision-making models, the problems of enterprise management were solved. Finally, traditional enterprises and ecological enterprises were compared in four aspects: enterprise economic management efficiency, product utilization rate, profit improvement point, and enterprise competitiveness. The results found that the new type of enterprise was more in line with the current social development environment, which also showed the feasibility of ecological enterprises.

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