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Green Supply Chain Management for Listed Companies

--Lenovo Group as an Example

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Abstract: In recent years, China's environmental problems have become increasingly serious, resource depletion, ecological imbalance and a series of problems continue to emerge, due to public pressure, legislation, and policies, green development has emerged as a critical problem that businesses cannot ignore. This paper combing domestic and foreign theories about green supply chain administration in the light of the use of case study methodology, from the perspective of the ESG scores and the economical aspect, to study the green supply chain management on the development of Lenovo Group. It is found that under green supply chain administration, the more Lenovo is recognized by all sectors of the society, the higher the ESG rating is accordingly; the higher the E score in the supplier's ESG rating is, the higher the E in Lenovo's ESG rating is accordingly. To a certain extent, enforcing green supply chain management may enhance the enterprise's short-and long-term solvency.

Keywords: green supply chain management, ESG rating, financial performance

1. Introduction

In the 21st century, the rapid development of human society also produces many environmental problems. The manufacturing industry is an important part of the national economy, and its supply chain structure is intricate and complex, which generates huge material wealth and at the same time consumes a great deal of resources. As a result, a green supply chain management model has emerged that is committed to maximizing the efficiency of resource utilization and reducing negative environmental impacts, so as to optimize the economic benefits of enterprises. However, China is the largest developing country facing serious environmental problems, so adopting green supply chain management is connected to both improving people's health as well as the continuable growth of enterprises.

Therefore, this paper selects Lenovo Group, which has done a better job in green supply chain administration, as an example, and analyzes whether Lenovo is really green in its supply chain and reduces the pollution to the environment by studying the ways and means adopted by Lenovo in its green supply chain management and taking ESG ratings as an entry point. Then we analyze the financial performance of Lenovo Group in recent years to study whether green supply chain control really helps improve economic efficiency of enterprises, so as to provide reference for other enterprises to speed up the realization of green supply chain regulation.

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2. Literature Review

2.1. Domestic and International Literature Review

2.1.1. Research on Green Supply Chain Management

Wang Nengmin, Wang Yingluo and Yang Tong argue that firms must increase the effectiveness of their environmental monitoring due to ecological problems, and that green supply chain supervision is a significant means and effective method for enterprises to achieve compatibility with the environment [1]; According to Wu Hongmei, employing green supply chain management techniques may help businesses function more sustainably, and it can also effectively promote the practice of green innovation [2]; however, Xie Xuemei and Zhu, Qi-Wei argue that the key of green supply chain control practices to promote the growth of enterprise performance lies in the intermediary role played by green innovation in between the two [3].

Muhammad et al. found that the implementation of green supply chain management in enterprises has a significant positive impact on technological innovation as well as operational performance [4]; Zhu et al. demonstrated that the implementation of green supply chain administration reduces the cost of emissions as well as environmental risks of enterprises, and obtains economic benefits, which leads to an increase in market share and customer satisfaction [5]; however, Khan and Dong argued that implementing of green supply chain inevitably requires the investment of a large amount of financial and material resources, which will increase the negative economic performance of enterprises [6].

2.1.2. ESG Rating Study

Wang Linlin et al. argued that high ESG ratings aid in reducing company finance limitations, enhancing operational effectiveness, and lowering financial uncertainty, all of which increase enterprise value.[7]; Liu Zhuocong et al. found that ESG ratings have an active influence on enterprise value, and the positive impact is more significant for enterprises in heavy pollution industries, enterprises in economically developed regions, and non-state-owned enterprises [8]; Hu Jie et al. found that ESG ratings have a positive contribution to the green transition of enterprises, and their effects are stronger especially in the heavily polluted industries and competitive industries [9].

Aslan et al. found that credit default risk is much lower for firms with high ESG performance [10]; however, Zheng and Aishan argued that higher ESG ratings require more resources from the company and tend to be used by management as a tool to further their own interests[11]; Wang found that the positive ESG ratings' green innovation impact is more pronounced in firms with lower levels of investor myopia, non-state-owned firms, and firms with higher levels of financial constraints, in addition to the impact of ESG ratings can improve the quality of green innovations and synergize green innovations [12].

2.2. Literature Review

According to the previous literature review, it is found that most of the scholars at home and abroad focus on the connection between green supply chain administration and enterprise value or with the environment, the relationship between ESG ratings and enterprise value or with green innovation, and there are very few articles exploring the green supply chain management of enterprises in the view of ESG ratings, so, this paper explores the green supply chain management of enterprises from the view of ESG ratings.

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3. Introduction to Lenovo's Green Supply Chain Management Approach

3.1. Green Supply Chain Management

Green supply chain management, that is, from the view of ecological protection, by reducing energy consumption and pollution in each link of the entire production process, so as to achieve the optimal use of resources.

3.2. Lenovo Group Green Supply Chain Management Approach

3.2.1. Green Supplier Management

(1) Comprehensive Assessment of Suppliers

Lenovo issued a Supplier Code of Conduct in 2015 to greenly manage, assess and monitor suppliers. Presently, 83% of the suppliers in Lenovo's procurement allotment possess third-party proof of their emission reduction statistics, 91% of them have declared public emission reduction objectives, and 72% of them have established renewable energy goals.

(2) Supplier Hazardous Substance Control

As shown in Table 1, Lenovo is the first manufacturer in the industry to promote suppliers to introduce the "declaration of all substances" measure to control the use of hazardous substances, which promotes the substitution and reduction of hazardous substances in the entire industrial chain.

In order to achieve the compliance management of dangerous materials, Lenovo has actively promoted the disclosure of all substance information since 2014. It has also changed the compliance approach for dangerous materials in products, increased the effectiveness of environmental compliance confirmation, and provided a foundation for product disassembly, overturned supply chain.

Table 1: Substance-wide disclosure.

Type	Proportion (%)
Cell phone	100
Tablet	100
Notebook	100
Desktop computers and servers	92

Data from Lenovo 2022 social value report.

3.2.2. Green Manufacturing

Lenovo broke through the difficult problem of high temperature in the production process of solder paste and realized low-temperature production, which not only abolished the use of lead, a hazardous substance, in the production process, but also significantly improved the yield rate of PCB. Lenovo began pushing it to all industry in 2018, which had a significant impact on the whole PC producing supply chain. Lenovo also supported the green advancement and transition of the entire industrial chain as well as the green making conversion of the electronics sector.

3.2.3. Green Logistics

Lenovo is promoting emission reduction through multimodal transportation and optimizing transportation modes. For example, Lenovo reached an agreement with Maersk, the world's biggest container transport firm, in 2022, whereby Maersk will provide Lenovo with eco-friendly transportation solutions and the two parties will jointly explore emission reduction in the shipping

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sector; in addition, the world's initial all-cargo routine service powered by renewable airline fuel, which will run between Shanghai Pudong Airport and Frankfurt Airport in Germany, was declared by Lenovo.

3.2.4. Green Recycling

Lenovo is committed to minimizing the negative environmental effects of its product life cycle and boosting the reclaiming of reusable goods and accessories. Lenovo has reclaimed 60,000 tons of garbage by operating and producing itself and nearly 90,000 tons of refuse from clients across the world.

4. The Effectiveness of Lenovo's Green Supply Chain Management from a Non-financial Perspective

4.1. Lenovo Group ESG Rating

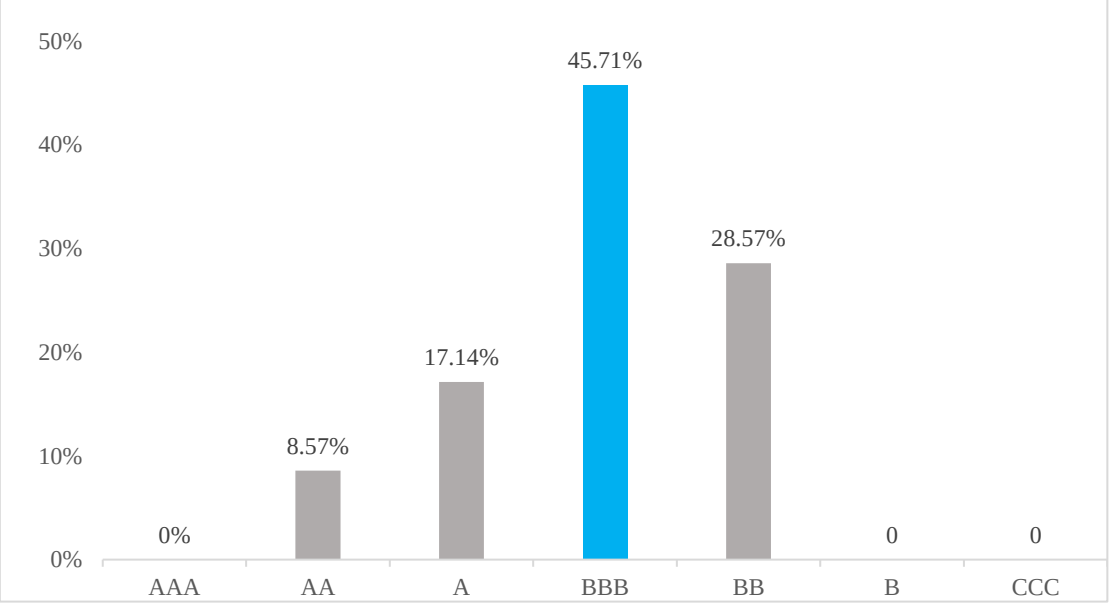

Figure 1: Computers & Peripherals industry rating distribution (2023) (Data from wind database).

As a non-financial indicator, ESG rating contains three major aspects of environment, society and governance, which can reflect the development status of enterprises to a certain extent. This paper adopts the ESG rating data provided by Wind, which has a wider coverage and a more complete evaluation system in China, as a reference to start the analysis. The wind ESG assessment method is a comprehensive assessment system consisting of three dimensions and assigns a seven-point rating on a scale of AAA-CCC.

Since 2007, Lenovo has been gradually realizing the green transformation of its supply chain, and in 2019, Lenovo was awarded the title of "Green Manufacturing Enterprise" by the Information Technology and Industry Ministry. Lenovo was ranked ninth in the Gartner Global Supply Chain Ranking 2022, with a perfect score in ESG. From the higher recognition of various authoritative officials that Lenovo has received in recent years, it can be concluded that Lenovo has performed excellently in green supply chain management. From Figure 1, we know that Lenovo is in the industry at the BBB level, which is in the middle-upper position, and from the statistics of wind database 2023, Lenovo is ranked the ninth among 35 enterprises in the same industry, which indicates that Lenovo is in a better state of development at the present time.

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Table 2: 2023 Lenovo group ESG rating score.

ESG rating	Environment	Social	Governance
BBB	6.16	5.33	6.39

Data from wind database.

Table 3: 2023 average ESG score for computer and peripherals industry.

Environment	Social	Governance
4.56	4.32	6.26

Data from wind database.

This paper concentrates on the green supply chain administration of Lenovo Group, and therefore focuses on the score of E (Environment) in Lenovo's ESG rating. As shown in Table 2, according to the ESG rating data released by Wind database for the year 2023, it can be seen that Lenovo scored 6.16 (out of 10) on E. As shown in Table 3, the average score of E of the industry Lenovo is in is 4.56, which is lower than Lenovo's score on environment, which indicates that Lenovo has taken effective measures on environmental management and achieved relatively good results on environmental greening.

Table 4: Associated greenhouse gas emissions (metric tons of carbon dioxide equivalent).

Index	2017/18 fiscal year	2018/19 fiscal year	2019/20 fiscal year	2020/21 fiscal year	2021/22 fiscal year
Scope 1	6371	6031	7766	7269	6069
Scope 2	176800	26029	23852	21519	21160
Emission intensity	0.69	0.64	0.53	0.48	0.43

Data from Lenovo 2022 Social Value Report

From Table 4, it can be seen that Lenovo's 2018-2022 Scope 1 and Scope 2 carbon dioxide emissions are generally on a downward trend, and the emissions intensity is decreasing more significantly, from 0.69 in 2018 to 0.43 in 2022, which indicates that Lenovo is doing better and better in carbon emission reduction and environmental protection, which is also due to Lenovo's green supply chain management, which infiltrates the green concept into production, packaging, logistics, recycling, truly reducing environmental pollution from the source and realizing sustainable development of the enterprise.

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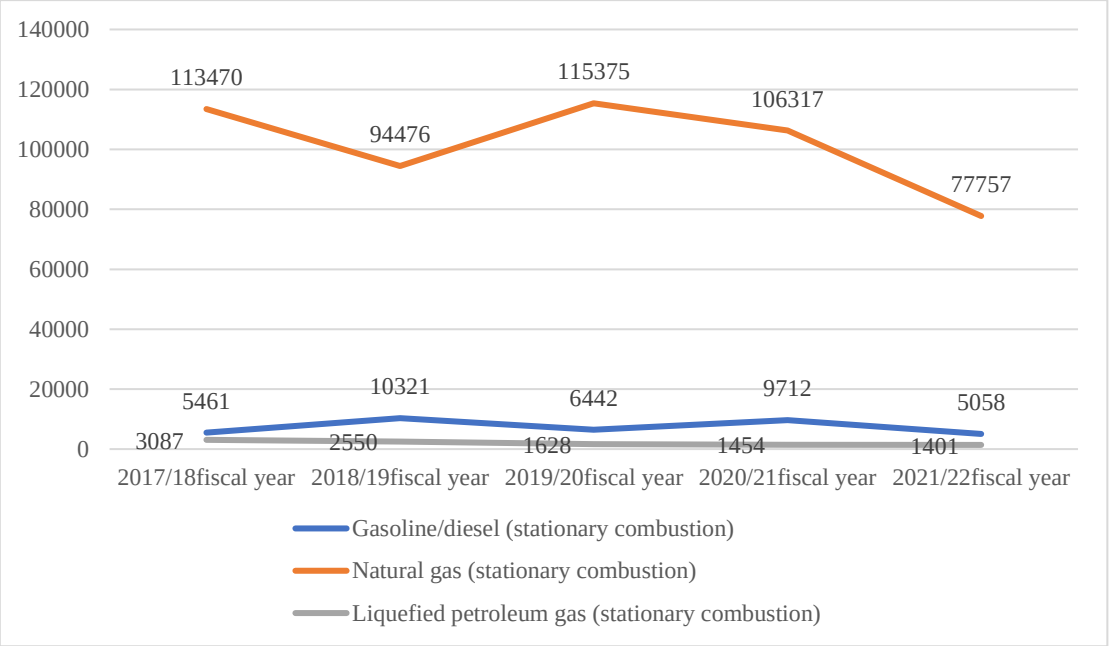

Figure 2: Lenovo direct energy consumption (gigajoules) (Data from Lenovo 2022 social value report).

As shown in Figure 2, the general trend of Lenovo's fossil fuel use over the past five years has been decreasing, with natural gas, the main source of energy consumed by Lenovo, plummeting from 106,317 gigajoules (GJ) in 2021 to 77,757 GJ in 2022, a reduction of 28,560 GJ in natural gas losses. Gasoline / diesel fuel had the most pronounced decrease from 2021 to 2022, dropping by 47.92%, while LPG has a smaller decrease of 3.65%. From the above data, it can be concluded that Lenovo closely follows the national low-carbon emission reduction policy and brings the concept of green development into reality, which not only reduces the consumption of non-renewable resources, but also reduces greenhouse gas emissions, actively practices green supply chain management.

4.2. Lenovo Group Supplier ESG Ratings

As a crucial link in the supply chain, providers play a pivotal role in putting green supply chain administration into practice. Lenovo Group, as a globalized technology manufacturing enterprise, has many suppliers around the world, and the following will study the effect of Lenovo's green supply chain administration through the dimension of E in the ESG rating of Lenovo's major suppliers.

Table 5: 2023 Lenovo supplier ESG ratings.

	ESG rating	Environment	Social	Governance
Foxconn Industrial Internet Co., Ltd.	A	4.13	6.45	7.79
Lingyi Itech Company	A	6.46	7.75	6.94
Suzhou Chunqiu Electronic Technology Co., Ltd.	BBB	5.54	2.77	6.65

Data from wind database.

Table 6: 2023 average ESG score for electronic equipment, instruments and components industry.

Environment	Social	Governance
2.17	3.58	6.29

Data from wind database.

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As seen in Table 5, Lenovo's three suppliers scored 4.13, 6.46, and 5.54 on ESG environment, respectively. From Table 6, we know that Lenovo's suppliers are located in the industry's average ESG score of 2.17, and as Lenovo's suppliers, their scores on the environment are much higher than the industry's average, which indicates that the suppliers are better in terms of environmental greening and stick to the concept of green development. Higher environmental scores of suppliers also mean that when Lenovo purchases raw materials from suppliers, Lenovo will get greener raw materials and reduce pollution to the environment from the source. Lenovo as a green supply chain management "chain master", bears the main responsibility for environmental protection, so Lenovo's choice of suppliers and requirements are also very demanding, which also leads to the supplier to supply Lenovo, first of all, they have to meet Lenovo's standards for the degree of environmental greenery, so from the perspective of the supplier's ESG ratings to help So from the perspective of supplier ESG rating, it helps to study the effectiveness of Lenovo's green supply chain administration.

5. The Effectiveness of Lenovo's Green Supply Chain Management from the Perspective of Solvency

The business situation of enterprises can be measured by financial indicators on the one hand, and analyzed by non-financial indicators on the other hand. The above illustrates that Lenovo has performed well in supply chain greenness by using non-financial indicators ESG ratings, and it is possible to see whether the green supply chain administration improves the enterprise's financial performance through the financial indicators, which in turn promotes the implementation of the green supply chain. This paper analyzes Lenovo's financial performance in recent years to see Lenovo's operation, thus reflecting the effectiveness of Lenovo's green supply chain control.

In the essay, while ensuring the availability of data, the following financial indicators are chosen to evaluate the effectiveness of the enterprise's green supply chain management, the specific indicators are shown in Table 7.

Table 7: Financial performance indicators.

Key capability aspect	Selected indicators (100%)
Debt-servicing aspect	Current ratio = current assets÷current liabilities
	Quick ratio = quick assets÷current liabilities
	Gearing ratio = shareholders' equity/total assets

Solvency is the ability of an enterprise to repay its debts when they fall due, and by analyzing the solvency, it is possible to examine the enterprise's ability and risk of sustainable development. Green supply chain management involves various links in the supply chain, and each link is inseparable from the assets and liabilities of the enterprise in order to operate normally. Solvency and enterprise creditworthiness is related, strong solvency, high creditworthiness, enterprise sustainable development ability is good. Therefore, this paper selects current ratio, quick ratio and gearing ratio to analyze Lenovo's short-term and long-term solvency.

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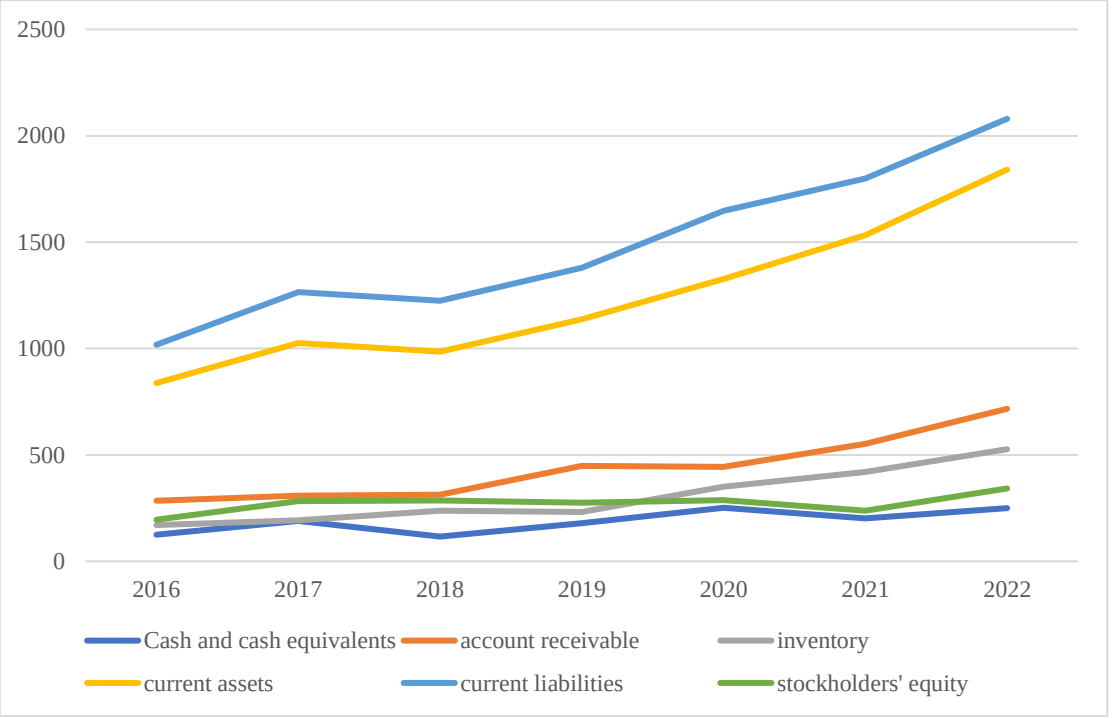

Figure 3: Lenovo Group's assets, liabilities and equity, 2016-2022 (RMB billion).

It can be seen from Figure 3: money funds are basically rising steadily in the rest of the years except for the sudden drop in 2018. In 2018, due to the profound changes in the external environment, the state strengthened the environmental regulation and punishment, Lenovo further improved the green supply chain administration and invested a large amount of money, which led to a big drop in money funds in 2018. The amount of accounts receivable increased year by year, indicating that Lenovo practiced green supply chain management to enhance its corporate image, the number of Lenovo's customers increased, so the scale of production expanded, and accounts receivable increased along with it, and the corresponding values of the enterprise's inventory, current assets, current liabilities and other values increased along with the growth of the year.

According to the relevant financial data of Lenovo Group from 2016 to 2022, the data of relevant indicators are calculated, as shown in Table 8.

Table 8: Solvency data table for Lenovo Group, 2016-2022.

Financial indicators	2016	2017	2018	2019	2020	2021	2022
Quick ratio	0.6556	0.6587	0.6099	0.6563	0.5925	0.6161	0.6318
Current ratio	0.8230	0.8111	0.8047	0.8239	0.8052	0.8521	0.8851
Total debt ratio	0.8783	0.8491	0.8404	0.8633	0.8739	0.9050	0.8786

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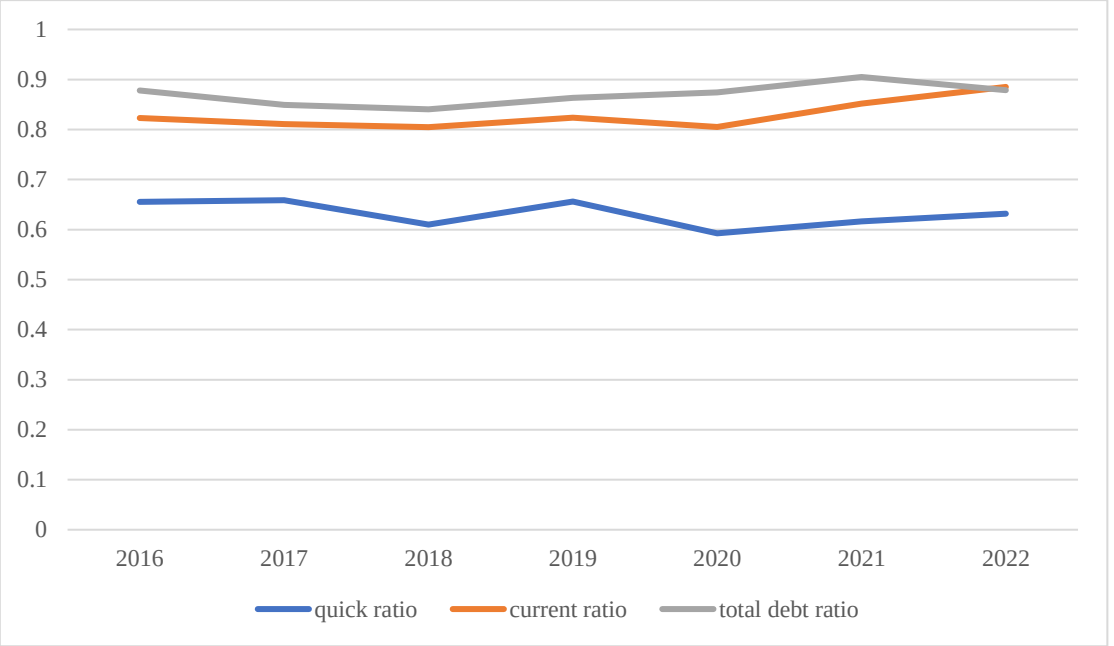

Figure 4: 2016-2022 Lenovo Group solvency change data chart.

From Figure 4 it can be seen that Lenovo's quick ratio and current ratio as a whole is showing an upward trend, due to the quick ratio of different industries will have a large difference, so there is no uniform standard quick ratio.

$$\text{Quick ratio} = (\text{current assets} - \text{inventory}) \div \text{current liabilities} \quad (1)$$

Lenovo from 2016-2022 quick ratio is below 0.7, generally not high because Lenovo in the green supply chain management has been constantly practicing, whether it is from the production of products or to the selection of suppliers, will take the green concept as a crucial link of the supply chain management, in the green above to invest a lot of money, the current assets reduce, resulting in a lower quick ratio.

$$\text{Current ratio} = \text{current assets} \div \text{current liabilities} \quad (2)$$

From 2016 to 2022, Lenovo's current ratio is much higher than the quick ratio, especially in the period of 2020-2022, during which Lenovo's green supply chain management has been more perfect and reached a high level, which reduces Lenovo's environmental pollution and waste of resources, and reduces Lenovo's production costs, and since the costs are included in the expenses, Lenovo As costs are included in expenses, Lenovo's expenses are reduced, owner's equity increases, assets increase, which in turn affects the current ratio, and Lenovo's short-term solvency increases. Although Lenovo's gearing ratio as a whole is in the range of 0.8-0.9, which is higher than the normal level, according to the survey, the gearing ratio of the companies that are also at the top of the industry, such as Hewlett-Packard and Dell, is higher than that of Lenovo, but with such a high gearing ratio, they are still able to operate normally, due to the fact that Lenovo and others, as the giants of the industry, are extremely competitive and have the right of speech, and they have an absolute say over the upstream suppliers. Therefore, Lenovo relies on borrowing money from upstream suppliers, produces equipment and sells it to customers, receives money from customers and then returns it to suppliers, so the gearing ratio will be high, but during the period of 2021-2022, there is a certain decline in the gearing ratio of Lenovo, which indicates that the green supply chain management has

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increased Lenovo's corporate image to a certain extent, and more and more suppliers are willing to cooperate with it, and Lenovo's financial pressure has been somewhat alleviated, and the long-term repayment pressure has been reduced. has been eased to a certain extent, and the long-term debt-servicing ability has been enhanced.

6. Conclusion

Nowadays, environmental protection is increasing, the traditional manufacturing enterprises sacrificing the environment for the cost of the development mode has been detached from the social development, with the introduction of a series of green development policies and regulations, enterprises want to attain sustainable development, the implementation of green supply chain management is imminent. This essay takes Lenovo, as an example, and analyzes the actual effect of Lenovo's implementation of green supply chain management from the perspective of ESG rating and financial perspective, and finds that green supply chain management helps to reduce pollution, increase corporate value, and realize long-term development of the enterprise.

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