

Article

Design of Evaluation Scheme for Social Responsibility of China's Transportation Enterprises from the Perspective of Green Supply Chain Management

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Abstract: Corporate social responsibility (CSR) in the supply chain has become an increasingly popular research topic, but there are little researches on developing countries or emerging market economies as the research object, let alone providing a framework for assessing CSR in sustainable supply chains in the context of these countries. This paper will make up for these literature gaps. From the perspective of the green supply chain management, this paper integrates various authoritative standards and adopts two methods, “R clustering” and “variation coefficient analysis”, to establish a CSR performance evaluation system of China's transportation industry. Applying the mean square error index weighting method analyzes the performance of 74 companies in China's transportation industry in 2018 to verify the rationality of the evaluation system. The results find that this industry generally scores low and the performance of responsibilities of different sub-sectors in this industry is different, but the overall performance trend is improving. This research has implications for China's transportation industry to improve CSR levels from the perspective of green supply chain management, for managers and stakeholders who are committed to improving China's CSR green and sustainable development, and for the development of CSR in developing countries and emerging markets.

Keywords: corporate social responsibility; R-clustering model; green supply chain management; transportation industry



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1. Introduction

Corporate social responsibility (CSR) has become a topic of widespread concern in business and academic research. It is worth noting that with the deepening of CSR practice, international social responsibility has gradually shown the characteristics of standardization and rigid constraints. Since the 1990s, authoritative organizations around the world began to research and publish a relatively mature CSR performance evaluation system that was applied to the world. Representative ones are Domini Social Index [1], Global Compact [2], Social Accountability 8000 International Standard (SA8000) [3], International Standard Organization 26,000 Social Responsibility Guide (ISO26000) [4], Global Reporting Initiative Sustainability Reporting Guidelines (GRI4.0) [5]. Most of the western CSR performance evaluation studies take these mature CSR performance evaluation systems as the standard research framework. However, despite the increasing focus on CSR in western developed economies in recent years, the awareness of CSR in Asia is quite low at both the company level and the state level [6], and China is Asia's largest developing country and emerging market economy. Compared with the current increasingly important international status, China's attention and research on CSR are very limited, and the social responsibility awareness of Chinese companies is relatively low. To a large extent, this is because China's main policy since the 1990s has been to vigorously develop the economy

and has neglected social responsibilities while the economy is developing rapidly. It was not until China joined the World Trade Organization (WTO) in 2001 that CSR gained attention in China due to the severe situation of social irresponsibility of Chinese enterprises and foreign criticism. After that, the Chinese government and related institutions also promulgated a series of CSR reporting standards to regulate the social responsibility behavior of Chinese enterprises. In 2014, the *Material and Quantitative Indicators Guideline for CSR Report* (MQI) provided critical quantifications applicable to different industries in response to information disclosure issues in the compilation of CSR reports [7]. *Chinese National Standards for Guidance on Social Responsibility Reporting* (GSR) issued in 2015 provided the basic criteria, steps, and methods for compiling social responsibility reports [8]. In 2014, the *Environmental, Social and Governance Reporting Guidelines* of the Hong Kong Stock Exchange (ESG) listed the main categories, levels, general disclosures, and key performance indicators, which are related to environmental, social, and governance areas [9].

CSR continues to evolve in practice, and its reach now often extends to supply chain partners. CSR in the supply chain has gradually become a research topic that scholars are interested in. In recent years, companies have realized the importance of working with supply chain partners to improve their reputation and CSR performance [10]. Especially, in Nike's sweatshop incident, Nike failed to assume the social responsibility of its supply chain partners in the early stage, which affected its reputation and corporate performance [11]. Therefore, scholars and managers began to consider how to manage social responsibility issues in the supply chain to improve corporate performance, such as by formulating and implementing codes of conduct to solve them [12–14]. Hervani and Helms propose to propose a framework for measuring and reporting SSCM practices to solve this problem [15]. Although scholars have made valuable contributions to the SSCM framework and supply chain corporate social responsibility, the following literature gaps cannot be ignored. First, there is a lack of practical and standardized modeling research in this field. Moreover, some of the evaluation frameworks adopt more subjective evaluation methods, which lack objectivity and persuasiveness [16]. For example, Reefke and Sundaram researched the field of sustainable supply chain management through exploratory Delphi research [17]. This empirical summary method is not persuasive and may not apply to all situations. Second, although scholars have constructed supply chain social responsibility evaluation models and frameworks from different aspects and industries, their current research fields focus on the consumer goods industry or various Services and manufacturing [18–20]. Finally, taking developing countries or emerging market economies as the object, there are very few evaluation frameworks to build sustainable supply chain social responsibility [16].

The main objective of this paper is to establish a CSR evaluation system suitable for China's transportation industry by combining the ideas of the green supply chain management, to bridge the literature gap between developing countries or emerging market economies and the transportation industry in terms of CSR in green supply chain. Particularly, this paper will combine the above-mentioned domestic and foreign standards of CSR and the actual situation of enterprises in China's transportation industry and use the method of "R-clustering + coefficient of variation" and the mean square deviation weighting method to establish the evaluation system and apply it in practice. Therefore, the specific goals of this paper (1) aim at the major industry needs of China's Ministry of transport to comprehensively and deeply promote the development of green transportation and green logistics, guided by the "outline for the construction of a transportation power", based on the perspective of green supply chain management, in contrast to the theoretical frontier and innovative practice of the development of international corporate social responsibility, based on the characteristics of China's transportation industry, combined with ISO26000 and GRI4.0 and other domestic and foreign authoritative corporate social responsibility, the first social responsibility evaluation system for China's transportation industry has been constructed. (2) This paper applies the obtained evaluation system to different companies in the transportation industry of China in 2018, to facilitate different types of

companies in the industry the comparison between them, as well as the determination of the rationality of the evaluation system. By constructing a more reasonable CSR evaluation system for China's transportation enterprises, we will promote transportation enterprises to better fulfill their corporate social responsibilities and promote the sustainable and green development of the Chinese transportation industry.

This study is mainly divided into the following parts. First, the literature review describes the relevant theories of CSR and green supply chain management. Secondly, the section of materials and methods introduces the principles and methods of constructing the CSR evaluation system. The third part is the results and discussion, applying the theory to practice, verifying and analyzing the scientificity, rationality, and innovation of the CSR evaluation system obtained. In the last part, the thesis is summarized, and the limitations of the research and the prospect of future research are clarified.

2. Literature Review

2.1. Corporate Social Responsibility

Since the 1950s, the academic field has been increasingly studying CSR. Although there is a lot of research on CSR, the academic circles have not reached a consensus on the definition of CSR. For example, Dao and others believe that CSR is a company's commitment to operating economic, social, and environmental sustainability [21]. Vidal et al. believe that CSR "is a concept that is difficult for companies to explain and implement", because it involves the integration of internal organizations or the rearrangement of business practices and procedures that reflect environmental, social, and ethical issues and may or may not be developed in the supply chain with stakeholders [22]. Although different scholars have different opinions on the definition of CSR, there are generally two trends that can be accepted by everyone: one is related to social management issues, such as the Triple Bottom Line (TBL) proposed by Elkington, and the other is Related to stakeholders, such as Whitten, etc. [23–25]. This can also reflect that stakeholders play an important role in CSR practice. Stakeholder refers to any individual or group that can influence or be affected by the goals of the enterprise [26]. Executives or entrepreneurs need to handle and manage the relationships among customers, suppliers, employees, financiers (shareholders, bondholders, banks, etc.), communities, and managers to create value for the company [27]. This is consistent with the views of Ackermann and Eden, who believe that the senior management team should pay attention to the important concepts that appear in the stakeholder literature to improve the robustness of its strategy [28]. At the same time, investors believe that the decision to participate in CSR is an indicator of future financial performance growth, because consumers tend to support CSR practices, and they tend to buy products and services from socially responsible companies at the same price and quality [29]. Therefore, Egbeleke believes that companies not only need to comprehensively consider economic, social, and environmental factors when formulating the company's overall strategy but also must thoroughly consider the impact of their CSR projects on organizational performance and stakeholder activities [30]. Usually, companies communicate with stakeholders by disclosing corporate social responsibilities and respond to their expectations to prove that the company is responsible for society and the environment and that its behavior follows social values [31]. The main purpose of the company's disclosure of social responsibility information is to show the image of social responsibility so that they can legitimize their actions to stakeholder groups and affect the reputation of external stakeholders [32]. Generally, companies will participate in some form of stakeholder management for two motivations [32]. One is based on a resource point of view. If a company participates in CSR disclosure to show that it operates in accordance with social and ethical standards, it can consolidate the trust of stakeholders and establish a good corporate image, thus bringing more competitive advantages and economic benefits to the company. The other is to engage in CSR activities and disclosure to avoid corporate risks due to external pressure. If not, it may lose this reputation value [33]. Besides, there is evidence that through empirical research on Italian family businesses, Gavana et al. found that when companies are characterized by consumer

proximity, in terms of consumers' visibility of products and services, CSR disclosure has a significant impact on corporate income [34].

Stakeholder theory is often applied to the research of CSP theory (Corporate Social Performance). Unlike CSR, for some scholars, CSP is seen as a "pragmatic approach" to CSR because it "tries to model and measure social responsibility based on performance" [35] (pp.110). However, according to the definition first described by Carroll (1979), CSP is a three-dimensional integration of CSR, corporate social response, and social issues, and the concept of corporate social performance includes CSR [36]. Moreover, due to the multidisciplinary nature of measuring the different behaviors and methods displayed by CSP, the measurement of CSP will consider multiple dimensions and provide a clearer understanding of CSR viewpoints [37–39]. The CSP model relies on this extended version of social responsibility and this principle/process/policy method to provide a unique perspective for the overall efforts of enterprises to fulfill their social obligations [40]. Obviously, as with CSR research, different stakeholders must also be considered when measuring CSP. Colle believes that measuring CSP must include quantifying employee working conditions, harmful emissions, relationships with key stakeholders (such as shareholders, customers, suppliers, employees, and local communities), and a wide range of other social and environmental indicators [41]. Some scholars combine stakeholder theory to measure CSP using a variety of methods and propose many valuable CSP models. For example, based on the stakeholder theory, Crian-Mitra et al. propose a summary model of responsible management behavior and a CSP evaluation framework for large emerging market companies [42]. Chang and Yeh also combine the views of internal and external stakeholders, using the analytic hierarchy process and decision-making laboratory methods to measure the social responsibility performance of Taiwan Taoyuan International Airport [43].

Besides, current research on CSR/CSP will also pay more attention to the impact on performance. Performance is now described as a multidimensional concept, including financial and non-financial aspects, and covers the interests of all stakeholders [44,45]. Some scholars say that CSR practices can improve a company's business performance, while others deny or neutralize or state that its impact is difficult to measure [37,46–51]. At the same time, it should be noted that social responsibility may have different results on performance in the context of emerging markets. For example, Brik et al. believe that in the context of emerging economies, CSR has a synergistic effect on the impact of market orientation on corporate performance. Although CSR regulates the relationship between customer orientation and corporate performance, it does not regulate the relationship between competition orientation and inter-functional coordination and performance [52]. Zhao et al. study China's Shanghai and Shenzhen A-share listed companies from 2009 to 2016 and find that in the short term, the company's CSR report had no obvious impact on the efficiency of capital allocation, but in the long run, it can improve the efficiency of capital allocation [53]. Some scholars also use the transportation industry as the research object to study the impact of CSR on corporate performance. Evidence shows that the performance of CSR in the transportation industry has an obvious positive effect on the current financial performance indicators, and financial performance will be positively affected by both the lagging period and the lagging two periods of CSR [54]. This shows that the CSR evaluation system of China's transportation industry to be created in this paper has a positive impact on the performance of the industry, and the research in this paper will generate theoretical and practical value. The next part will review the literature on specific methods, models, and evaluation systems of CSR evaluation.

2.2. The Corporate Social Responsibility Evaluation System

The implementation of CSR development framework and formal tools is an important research method in the field of social responsibility [55]. Just like Vidal, such tools usually include codes of conduct, policies that address specific issues such as the social environment that companies face, key performance indicators and monitoring of social and environmental behavior, and CSR reports [22]. Researchers have also made a lot of ef-

forts in the above aspects. The social participation disclosure indicator system constructed by Abbott and Monsen inspires CSR practices [56]. Moreover, Carroll's framework of CSR pyramid including economy, law, ethics, and charity also prompts companies to reconfigure business strategies oriented to the environment and society [36]. However, for the evaluation of CSR/CSP, sometimes a certain model and framework established by a single theory and method may not be suitable for all complex situations. The use of a comprehensive model may allow all stakeholders to pay attention to the CSR practices in daily business [57]. Therefore, researchers learn from international authoritative standards, such as SA8000, ISO2600, GRI4, United Nations Convention Framework, etc., and try to adopt different methods and construct comprehensive CSR/CSP models from different dimensions to enrich related models research. For example, Costa and Menichini, based on the balanced scorecard (BSC) perspective and sustainability dimensions, use the Global Reporting Initiative (GRI) indicator framework to establish a multi-dimensional model of CSR evaluation, which assesses and analyzes CSR activities in the eyes of stakeholders [58]. Wang et al. borrow from the leading framework of the United Nations (UN) and adopt a mixed multi-criteria decision-making (MCDM) method to propose a CSR model that can alleviate potential information asymmetry problems and improve corporate performance [59].

It needs to be realized that the application of the CSR/CSP framework and model may also be different due to differences in the cultural systems of different economies and different countries [60,61]. Chinese scholars are also trying to use different theories and methods to establish a CSR evaluation model suitable for China's national conditions. Chen et al., based on the practice of Chinese CSR, combined with the triple bottom line and stakeholder theory, construct a detailed, comprehensive, and authoritative Chinese CSR evaluation model [62]. Although the transportation companies are also given specific scores, this industry has not been analyzed in detail, including the comparison between its sub-sectors, which cannot be well demonstrated. Later, some scholars use a variety of comprehensive methods to construct the CSR evaluation system of China's transportation industry and compare and analyze the performance of the sub-sectors involved. For example, Qi et al. use "R clustering and coefficient of variation analysis" to screen indicators and construct the CSR evaluation system of China's transportation enterprises with seven standard levels, including responsible governance, human rights, environment, fair operation, product responsibility, community development, and economic contribution [63]. On the other hand, Meng Bin adopts the main basic analysis and related analysis methods to establish a CSR evaluation index system for China's transportation industry, including 6 first-level standard levels, 12 s-level standard levels, and 39 indicators [64]. However, neither the CSR framework nor the evaluation system established by scholars emphasizes the importance of green supply chain management. The research in this paper will bridge this literature gap. The next part will review the relationship between supply chain management and CSR, as well as the evaluation methods and evaluation models of supply chain corporate social responsibility.

2.3. Corporate Social Responsibility and Green Supply Chains Management

A supply chain is a set of organizations that involve upstream and downstream processes of products, services, and finance, and the flow of information from initial suppliers to channel members to end-users or customers [65,66]. By this definition, the supply chain involves multiple organizations and many stakeholders, so it is particularly important to handle these relationships well. There is evidence that the integration of practices and policy consistency between supply chain partners affects the final performance of the organization [67]. Customers and organizations operating in the supply chain must rely on and trust each other to achieve their ultimate goals [68]. In the business environment within and between organizations, this integration of supply-demand relationship management is often referred to as supply chain management [69]. The advantage of supply chain management lies in the effective operation of every organization in the supply chain that

participates in value delivery through value-added channels, and in this process, these organizations have a stronger cooperative relationship, and thus, in their respective supply chains, they obtain a higher level of efficiency in operation than the individual independent competition [70–73].

Besides, it should be noted that sustainable development strategies play an increasingly important role in enterprise supply chain management. Many scholars have turned to research on green sustainable supply chain management to improve the environmental performance of the entire supply chain. Unlike traditional supply chain management, sustainable (green) supply chain management (SSCM) requires detailed consideration of the economic, ecological, and social aspects of business practices [74]. Environmentally sustainable supply chain management (GSCM) not only can reduce environmental risks and impacts, improving the ecological efficiency of these organizations and their partners, but can also help achieve company profit and market share goals [75]. The current research on green sustainable supply chain management (GSCM) is mainly focused on reducing the impact on the environment through effective design or energy use and considers the social impact on individuals, communities, and wildlife, as well as the commercial impact on profitability [76]. For example, in the design of a reverse supply chain network for a used car resale company, Thank Sathiyi et al. propose a mobile robot-solar automated guided vehicle (AGV) strategy and a new multi-objective optimization model strategy to reduce logistics costs and reduce greenhouse gases emission [77]. They fully consider social, economic, and ecological goals in the design of green supply chain management, which not only helps the company improve efficiency and social attention but also promotes environmental sustainability and increases social benefits.

Although supply chain practitioners have been slow to adopt CSR considerations, the concept of social responsibility in the supply chain is becoming more and more important [78]. The consideration of social responsibility in the supply chain can be traced back to Poist, who adds social issues to the traditional economic driving force of the supply chain [79]. After that, many scholars analyze the types and characteristics of supply chain social responsibility from various aspects through different empirical studies and emphasize the importance of social responsibility in the supply chain [18,80–83]. For example, Poist points out that social responsibility in the supply chain should consider employee training, philanthropy, environment, urban renewal, workplace diversity, health and safety, and community issues such as hunger and homelessness [79]. Carter and Jennings establish business ethics-related supply chain corporate social responsibility categories based on case studies and surveys, such as business ethics, charity, community, workplace diversity, safety, human rights, and the environment [18,80]. Tate et al. conduct a central resonance analysis on the content of the CSR report, and conclude that the 10 major themes in the supply chain management in the CSR reports: Supply Chain, Institutional Pressure, Community Focus, Consumer Orientation, External Environment, Risk Management, Measures, Energy, Health, Green Building [84]. Some scholars have tried to summarize the elements of supply chain social responsibility suitable for all industries, such as logistics social responsibility (LSR) and procurement social responsibility (PSR), and strive to explore how to improve approaches to overall supply chain performance [80,81]. Bowrey and Clements propose a conceptual framework for reviewing the CSR performance and reporting of the entire supply chain and point out that the adoption of social auditing methods can improve the level and consistency of the CSR management and performance reporting of the supply chain and the entire supply chain organization [70]. However, most of the above studies are aimed at large global supply chain multinational companies, which makes it necessary to study different types of supply chain objects. Lindgreen et al. use Danish small and medium-sized enterprises as an example to analyze the characteristics of small and medium-sized enterprises (SMEs) that manage CSR in the supply chain [85]. Yoon et al. also find that the application of SC-CSR enhances the willingness of small and medium-sized enterprises to fulfill their social responsibilities by promoting situational needs [86].

In addition to analyzing the elements, characteristics, and categories of supply chain social responsibility that are suitable for various industries, the second way to explore supply chain social responsibility is to explore specific CSR issues, because different industries may have relatively unique supply chains and follow-ups and the unique SC-CSR issue that comes from [87]. A single SC-CSR model is not enough to adapt the SC-CSR to the characteristics of a specific industry [88]. Scholars have also made a lot of efforts in exploring supply chain social responsibility issues in different industries. For example, Perry and Towers analyzed the inhibitors and driving factors of the implementation of corporate social responsibility in fashion supply chain management [89]. Keating et al. take banks as the research object, trying to establish a best practice model of sustainable supply chain social responsibility from the discussion [90]. Kogg conducts case studies in the textile sector and constructs a framework for CSR upstream of the supply chain [91]. Maloni and Brown have constructed a comprehensive supply chain CSR framework for the food industry, including animal welfare, biotechnology, environment, health and safety, labor and human rights, community, fair trade, and procurement in eight dimensions [88]. The above scholars' research provides a good template for exploring the supply chain social responsibility framework of specific industries. However, it is not difficult to find that this type of research rarely takes developing countries or new market economies as the background, and there is also a lack of exploration of social responsibility models and frameworks on the supply chain of the transportation industry. Therefore, it is necessary to explore a CSR evaluation model suitable for the supply chain of the transportation industry in China. It is helpful to explore the specific issues of the SC-CSR of the transportation industry, and it can also provide a reference for the SC-CSR of developing countries or emerging market economies.

3. Materials and Methods

3.1. Principles of the Sea Election Index System Construction

3.1.1. Construction of Evaluation System Criteria Layers

The CSR of transportation industry in this study means that transportation enterprises should not only undertake the responsibility to shareholders, employees, consumers, environment, community, and other stakeholders but also promote the development of green, low-carbon and intelligent safety, strengthen the implementation of responsibility, improve the quality of safety management, and achieve the goal of sustainable development of transportation green supply chain. CSR has a complex hierarchical structure, which contains many elements, such as social issues, stakeholder issues, performance, etc., all of which affect the business activities of enterprises. The manifestation of CSR is the countermeasures taken by these enterprises when facing these elements. First, the important stakeholders faced by different companies are different. Second, although all companies have a common problem of social expectations, they can circumvent this common problem through the weight of different industries on the theme of "environment". Therefore, if you want to design an indicator system based on sustainable development, you should stratify the core social themes. Based on the survey of relevant information, this study combined ISO26000, GRI4.0, GB/T 36001-2015, and ESG core content design ideas and designed China's transportation industry CSR evaluation system of 7 dimensions of the standard. Eventually, they verified the reliability and validity of the indicators system through the questionnaire method. The criterion levels of these seven categories are respectively responsible governance, economic performance, environmental protection, basic human rights, product responsibility, fair operation, and community development, as shown in Table 1.

Table 1. Classification details of each authoritative index system and proposal of the criteria level of this study.

Criteria	Material and Quantitative Indicators Guideline for CSR Report (MQI) for the Transportation and Postal Industry (2012)	The Global Reporting Initiative Sustainability Reporting Guidelines (GRI4.0) (2013)	Chinese National Standards for Guidance on Social Responsibility Reporting (GSR) (2015)	The Environmental, Social and Governance Reporting Guidelines of the Hong Kong Stock Exchange (2018)	The Criteria Layer of the Transportation Industry in This Study
	Economy	Economy	Organizational Governance	Work Environment Factor	Responsible Governance
	Environment	Environment	Human Rights	Environmental Protection	Economic Performance
	Society	Labor Practices and Decent Work	Labor Practices	Operating Practice	Environmental Protection
	Labor	Human Rights	Environment	Community Participation	Basic Human Rights
	Product	Society	Fair Operation Practice		Product Liability
		Product liability	Consumer Problem		Fair Operation
			Community Participation and Development		Community Development

3.1.2. Interpretation of the Criteria Layers

1. Responsible governance

The core of an enterprise is the board of directors, and the labor unions can also be said to be individuals. They control the enterprise and determine the direction of the enterprise's development. Therefore, the enterprise should establish a corresponding responsible governance organization so that social responsibility can be assumed. The lower levels include three second-level regulatory levels, including governance structure, interest-related, and responsibility response.

2. Economic performance

The purpose of the enterprise is to make a profit, but while creating benefits, the enterprise should also adhere to the interaction of saving resources and protecting the environment. It should not seek personal gains in unfair ways, wantonly destroy the environment, and willfully waste resources. We should adhere to sustainable development and take ensuring and improving economic quality as the ultimate goal of accelerating economic growth. There are two secondary levels of criteria, including direct economic and social contribution and indirect economic and social contribution.

3. Environmental protection

The business development of enterprises depends on the environment and resources, and the behaviors of enterprises will also affect the environment. Now the world is facing severe environmental problems, such as climate warming, air pollution, reduced species diversity while protecting the environment and cherishing our common homeland is the foundation of human prosperity. Therefore, enterprises should take active responsibility in pollution prevention and control, sustainable resource utilization, mitigation, and adaptation to climate change, environment, and biological diversity. Under this indicator layer, there are 4 secondary standard layers, including resource sustainability, biodiversity, pollutant discharge, environmental investment, and impact assessment.

4. Basic human rights

Human rights are innate, inalienable, universal, indivisible, and interdependent. Companies will directly or indirectly affect the interests of employees. The company has the responsibility to respect and protect finances within its scope of influence. The

company's respect and protection of interests are mainly manifested in the rights to survival and development; civil and political rights; and the rights of economic, social, cultural, and other aspects. This level includes four secondary standard levels, including employee basic rights, employment relationship, health and salary benefits, and training and development.

5. Product liability

Consumers are the key to the survival and development of an enterprise. Whether their rights can be guaranteed determines the sustainable development of the enterprise. At present, although the country bears the burden of ensuring the interests of consumers, it needs to be implemented in the enterprise. Companies should actively assume social responsibilities in terms of consumer privacy, rights, and complaint mechanisms. The sample layer includes three secondary scale layers, including customer rights protection, product service, and supplier evaluation.

6. Fair operation

In today's general environment, global economic integration has reached a consensus. The international market needs a fair operation. As a link to the global supply chain, every company can also have a fair, just, and open business environment. Therefore, in business practice, companies should achieve compliance management, achieve supply chain management, respect property rights, and other aspects. There are three secondary levels of standards under this standard, including anti-corruption, compliance and a law-abiding, and appeal mechanism.

7. Community development

Enterprises exist in the community. The resources needed by the enterprise need to be provided by the community. The culture of the enterprise is also affected by the community. The operation of the enterprise in turn affects the economy, politics, culture, and even education of the community residents. The enterprise will also promote the community's development. Welfare levels can even improve the quality of life of community residents. Therefore, companies should actively seek opportunities to promote community prosperity in various aspects, such as community participation and community wealth creation. The sample layer includes four secondary regulatory layers, including community participation, health education and culture, skill development and employment, and wealth and income creation.

3.2. Determine the Sea Election Index System

According to the criteria of the evaluation system determined above, focusing on the high-frequency indicators of the classic views of domestic and foreign authoritative institutions, this paper combines with literature review and investigation research to conduct the audit of indicators. The principles of the indicators of the audit are according to the seven mentioned above. A first-level criterion level establishes the second-level criterion level under each criterion level. Responsible governance is divided into three second-level criteria levels: governance structure, stakeholders, and responsibility response; economic performance is divided into two second-level criteria levels: direct economic and social contributions, and indirect economic and social contributions; environmental protection is divided into four second-level criteria levels: resource sustainability, biodiversity, pollutant discharge, environmental investment, and impact assessment; basic human rights are divided into two second-level criteria levels: health and salary and benefits, training and development; product liability is divided into three second-level criteria levels: customer rights protection, product service, and supplier evaluation; fair operation is divided into three second-level criteria levels: anti-corruption measures, compliance and law-abiding, and grievance mechanisms; community development is divided into four second-level criteria levels: community participation, health education and culture, skill development and employment, wealth and income. Relevant evaluation indicators under each level

of the second-level standard are established. These evaluation indicators should be representative, judging, and distinguishable and fully reflect the good performance of the responsibility under the standard level, such as governance structure guidelines. This study constructs the evaluation index system which includes qualitative and quantitative, financial and non-financial indicators according to the characteristics of transportation industry. Good financial performance directly affects the performance of corporate social responsibility. Only with good support of fund chain can it ensure its development and operation. Transportation industry belongs to capital intensive industry, so it is necessary to set up indicators such as “total asset return rate”; because of the particularity of the profession of the employees in the transportation industry, the proportion of male employees is larger than that of female employees, so the index of “equal employment and elimination of discrimination” is set to measure its equal employment status; because recycling materials are an important measure of environmental protection in transportation industry, recycling materials can be used as packaging and transportation materials, which can not only contribute to environmental protection but also reduce the operating cost of enterprises, so the indicator “use of recycled recreation” is set up; because of the transportation, recycling materials are an important measure of environmental protection. The industry needs customers to use personal information to purchase bills, and personal information is easily disclosed, so the indicator “customer information security mechanism” is set up; because the audience of transportation industry is wide, customers require a variety of requirements. For high-end customers, their demand for service is high efficiency, comfort, and speed. For the middle and low-end customers, the service price performance is more important, so the indicator “whether to provide personalized service” is set; because the transportation industry does not fully realize the unmanned driving stage, the quality of employees directly determines the level of customer service, so the indicator “performance and professional development evaluation” is set. According to the principle of observability, the index of audition that cannot be obtained from the data is deleted to ensure that the index after preliminary screening can be quantified, and 112 index layers are finally established.

3.3. Data Collection and Standardization

3.3.1. Data Acquisition

Many companies respond to stakeholder expectations by publishing annual CSR reports, which also deliver activities and strategies to address social and environmental issues [92]. This article uses various channels, such as Juchao Information, Oriental Wealth, corporate website, and MQI, to find out the CSR reports, sustainability reports, and social, environmental, and governance reports of all listed companies in the transportation industry in 2018 (as of July) reports. If the company only releases one type of report, the report is the main one. If the company releases the above-mentioned multiple reports, all reports should be integrated for judgment.

We carefully read all the reports of each listed company and compare them with the indicator system table of CSR performance evaluation made in the previous chapter to find out whether the criteria in the table are mentioned in the report and score the indicators in each criterion layer according to the indicator scoring standards. The scoring standards are roughly as follows:

- For qualitative indicators, no disclosure or explanation in the report will be scored 0 points; mentioning in the report but not clear and not detailed scores between 0.25 and 0.75 points; the complete and clear explanation in the report scores 1 point.
- For directional indicators, the data of relevant indicators in the report can be directly recorded as the score. If there is no disclosure in the report, the negative indicator takes the maximum value in the score of the indicator of all enterprises, and the positive indicator takes the minimum value in the score of the indicator of all enterprises.

The above-mentioned data acquisition process mainly uses data mining and text analysis methods. The reason for using these two methods is that the data obtained in this way is accurate, true, reasonable, and available. Through the above process, we have obtained the complete score data of various indicators of the enterprise. The acquisition of this set of data consumes a lot of energy, but it is an important part of the entire CSR report, which has made the necessary preparation for future report analysis. Without the support of data, the entire report will lack credibility and accuracy, but after all, scoring is a man-made work. Even if a detailed and reasonable scoring standard is made, it will inevitably be subjective, but the overall data is an absolute reference.

3.3.2. Standardization of Evaluation Index Data

To eliminate the influence of dimensions on quantitative analysis, it is necessary to standardize the original data.

1. Standardization of positive indicators

The larger the positive index value becomes, the better the practical performance of a certain company in the transportation industry on this index becomes. Assuming that: P_{ij} is the standardized value of the i -th index of the j -th evaluation object; V_{ij} be the original value of the i -th index of the j -th evaluation object; n is the number of objects to be evaluated. According to the standardization equation of positive indicators, P_{ij} is

$$P_{ij} = \frac{V_{ij} - \min_{1 \leq j \leq n} (V_{ij})}{\max_{1 \leq j \leq n} (V_{ij}) - \min_{1 \leq j \leq n} (V_{ij})} \quad (1)$$

The meaning of Equation (1) is the relative distance between the deviation of the i -th index value and the minimum value to the deviation of the maximum value and the minimum value. The greater the deviation becomes, the greater the distance is, and the higher the value becomes after scoring.

2. Standardization of negative indicators

The better the performance of an enterprise in the transportation industry on this indicator becomes, the smaller the negative indicator index becomes.

The standardized equation for negative indicators is:

$$P_{ij} = \frac{\max_{1 \leq j \leq n} (V_{ij}) - V_{ij}}{\max_{1 \leq j \leq n} (V_{ij}) - \min_{1 \leq j \leq n} (V_{ij})} \quad (2)$$

The symbols of the above two equations have the same meaning. The meaning of Equation (2) is that the relative distance between the deviation of the maximum value of the index and the i -th index value is relative to the deviation of the maximum value and the minimum value. The greater the deviation is, the greater the distance is, and the higher the value becomes after scoring.

3.4. Construction Methods of Index System

3.4.1. The First Index Screening Based on "R Clustering"

R clustering analysis is a type of cluster analysis, which is generally used to classify indicators. In daily work, to avoid missing some important factors, when choosing indicators, we often consider relevant factors as comprehensively as possible, but the result is that there are too many variables, which brings a lot of inconvenience to statistical analysis. Therefore, we introduce R clustering analysis, which is to classify variables. The main function of R clustering analysis is to get the closeness or distance of each variable or variable group.

The purpose of R clustering is to determine the type and quantity of indicators within each criterion layer. First, R clustering is used to classify the indicators in each criterion layer,

so that each category represents a different aspect, and the indicators selected from different categories will reflect different information. The selected indicators can completely cover all aspects of the criteria layer. Particularly, it is pointed out that the reason for clustering the indicators in the criterion level instead of the entire system is that the quantitative clustering method classifies the indicators according to the data relationship without considering the actual meaning of the indicators. Moreover, according to the criteria, the hierarchical clustering ensures that the indicators grouped into one category are related in meaning and avoids to cluster the indicators that have strong data correlation but no correlation into one category. In this study, the R-type hierarchical clustering of evaluation indicators was used by the sum of squared deviation method. The steps of R-type hierarchical clustering can be divided into the following steps:

Step 1: Artificially determine the number of clusters L , that is, artificially determine that m evaluation indicators will eventually be divided into L categories. If the following test passes, it means that the number of clusters is reasonable; otherwise, it is determined again.

Step 2: Treat each indicator as one category and divide m indicators into m categories.

Step 3: For the convenience of the narrative, the definition of the merger is given here.

The two types of indicators are artificially regarded as the same category as the merger. In the m -category indicators of Step 2, any two categories are combined into one category. According to the principle of permutation and combination, there are a total of $C_m^2 = m(m-1)/2$ merging schemes. Calculate the total sum of squared deviations S of each merging plan by Equation (2), and determine the merging plan according to the smallest sum of squared deviations. In this way, the m -category indicators are divided into $m-1$ categories.

Hypothesis: Divide the m evaluation indicators into L categories; S^h is the sum of squared deviations of the h category ($h = 1, 2, \dots, L$); m^h is the number of indicators in the h category; X_i^h is the standardized numerical vector of the i -th index of h -th category ($i = 1, 2, \dots, m^h$); \bar{X}^h is the sample mean vector of the h -th index, then the sum of squared deviations S^h of the h -th index is

$$S^h = \sum_{i=1}^{m^h} (X_i^h - \bar{X}^h)(X_i^h - \bar{X}^h)' \quad (3)$$

The sum of squared deviations of L categories S is

$$S = \sum_{h=1}^L \sum_{i=1}^{m^h} (X_i^h - \bar{X}^h)(X_i^h - \bar{X}^h)' \quad (4)$$

The effect of Equations (3) and (4): Calculate the sum of squared deviations of the h -th category by Equation (3), calculate the sum of squared deviations of all classes by (4), and select the minimum of Equation (4) as the goal the best merger plan.

Step 4: Repeat Step 3 until the final classification number is L determined in Step 1.

Step 5: Check the rationality of the clustering results. Perform K-W test on each type of index after clustering to judge whether the number of clusters L is reasonable.

The null hypothesis of K-W test is that different indicators have no significant differences in data characteristics. If the significance level of each type of index $\text{Sig} > 0.05$, then the null hypothesis is accepted, indicating that there is no significant difference between these indicators, and they can be clustered into one category, and the clustering results are reasonable. Otherwise, the null hypothesis is rejected, indicating that there are significant differences among such indicators, and they cannot be clustered into one category. Return to Step 1 to re-determine the number of clusters. The principle of R clustering is shown in Figure 1.

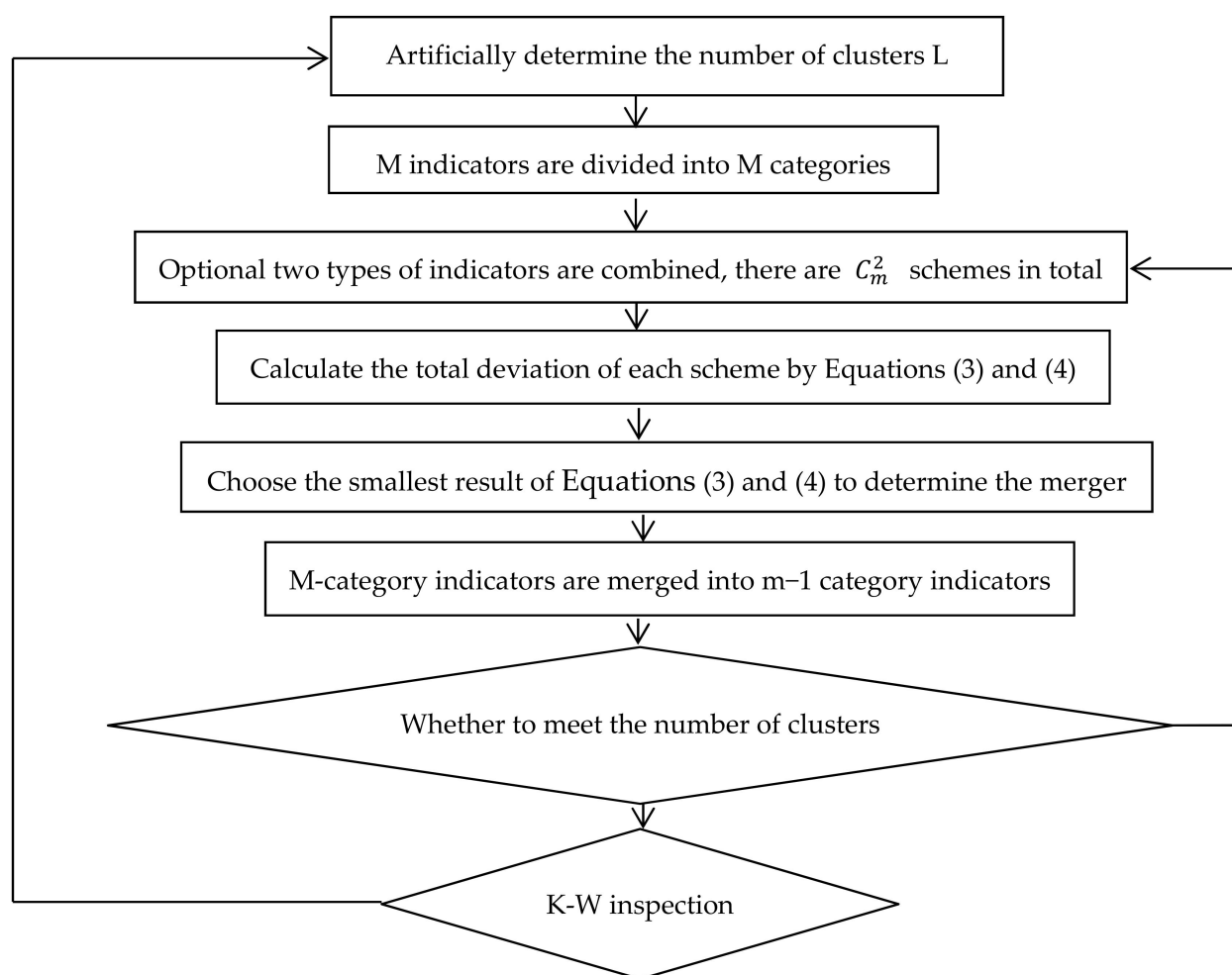


Figure 1. Principle of R clustering.

3.4.2. The Second Screening Based on the “Coefficient of Variation” Method

The purpose of the coefficient of variation analysis is to select effective indicators in the same type of information and delete other indicators, which not only ensures that the selected indicators have the greatest impact on the evaluation results in the category but also avoids the duplication of information in the same type of indicators.

The coefficient of variation of the indicator reflects its ability to discriminate in the evaluation. If the table coefficient of variation of an indicator is larger, it proves that the indicator’s information resolving ability is stronger, and it will play a more important role in the overall evaluation. The indicator with a smaller coefficient of variation is the opposite. Therefore, if you want to ensure the simplicity and efficiency of the index system, we should delete those indicators with a small coefficient of variation that has little impact on the evaluation results. The coefficient of variation is a statistical indicator that is commonly used in economic statistics to measure data differences. The calculation equation for the coefficient of variation of the i -th indicator is:

$$v_i = \frac{s_i}{X_i} \quad (5)$$

where X_i is the mean of the population and S_i is the population standard deviation.

$$X_i = \frac{1}{n} \sum_{j=1}^n X_{ij} \quad (6)$$

$$S_i = \sqrt{\frac{1}{N} \sum_{j=1}^n (X_{ij} - X_i)^2} \quad (7)$$

In Equation (6), where S_i represents the relative degree of variation of each indicator, X_i as a reference for the degree of variation of each indicator, then Equation (7) reflects the degree of standardized variation of each indicator.

4. Results and Discussion

4.1. Index Screening Based on R Clustering-Coefficient of Variation

To facilitate understanding, the following takes the “stakeholder” secondary criterion layer as an example to carry out R clustering-coefficient of variation index screening.

1. Determine the number of clusters in the first level of secondary criteria. There are 5 indicators in the second-level criterion level of “stakeholders”, and the number of clusters at the second-level criterion level is determined to be 4.
2. Determine the index merger plan. Regarding 5 indicators as 4 categories and combining any two of these 5 indicators into 4 categories, we can get $C_5^2 = 10$ combinations; thus, there are 10 categories of 4. The 4 categories here are any combination of two categories. In 10 categories of 4, calculate 10 Equation (2), keep the 4 categories corresponding to the smallest S in Equation (2), and delete the remaining 4 categories.
3. By analogy, until the number of clusters is the determined 4 types in Step 1, the clustering results are shown in Table 1. The first category is indicators: X1,6 identify stakeholders and X1,8 establish special communication channels for stakeholders. The second category is X1,7 clear stakeholders’ demands. The third category is X1,9 response to interests Stakeholders’ demands. The fourth category is X1,10 whether the report contains substantive issues. A non-parametric K-W test is performed on the first category to verify whether the number of clusters is reasonable.
4. A non-parametric K-W test is performed on the first type of indicators to verify whether the number of clusters is reasonable. The results are shown in Table 2. Among them, the non-parametric test value is greater than the critical value, indicating that there is no significant difference between similar indicators, and the classification result is reasonable. It is pointed out that if the test result is unreasonable, you need to return to Step 1 to re-determine the number of clusters.
5. Carry out the screening of the coefficient of variation indicators, take the “stakeholder” secondary criterion level as an example, calculate the standard deviation and mean value of the scores of each indicator under the criterion level under all companies, and calculate each index variation coefficient according to Equation (3). According to the results, the index with the larger coefficient of variation in the same cluster is retained. The results are shown in Table 3.

Table 2. Clustering analysis results of “stakeholders” secondary criteria levels.

Stakeholder Indicators	Clustering Categories	Nonparametric Test	Rationality of the Number of Clusters
X1,6 Identify stakeholders	1	0.0410	Retain
X1,8 Establish special communication channels for stakeholders	1		
X1,7 Clarify stakeholder demands	2		Rational
X1,9 Respond to stakeholder appeals	3		Rational
X1,10 Whether the report contains substantive issues	4		Rational

Finally, the screening results based on the R clustering-coefficient of variation index are obtained, as shown in Table 4.

Table 3. Analysis results of the coefficient of variation of “stakeholders” level II criteria.

Secondary Criteria Layers	Governance Structure Indicators	Clustering Categories	Coefficient of Variation	Whether or Not to Retain
Stakeholders	X1,6 Identify Stakeholders	1	0.6575	Delete
	X1,8 Establish special communication channels for stakeholders	1	0.7511	Retain
	X1,7 Clarify stakeholder demands	2	1.0735	Retain
	X1,9 Respond to stakeholder appeals	3	0.8501	Retain
	X1,10 Whether the report contains substantive issues	4	1.1741	Retain

Table 4. R clustering-coefficient of variation index screening results.

First-Order Criteria Layers	Secondary Criteria Layers	Indicators Layers
X1 Responsible governance	Governance structure	X1,5 Commitment, accountability, and importance of leadership X1,7 Clarify stakeholder demands
	Stakeholders	X1,8 Establish special communication channels for stakeholders X1,9 Respond to stakeholder appeals X1,10 Whether the report contains substantive issues
	Responsible response	X1,12 Degree of perfection of risk management control system X1,13 Explain the CSR concept or goal X1,14 Identify CSR reports
		X1,15 Comply with or refer to the relevant domestic and foreign standards to prepare the report
		X1,16 Participate in CSR related public welfare organizations
	Basic rights of employees	X2,3 The right to participate in public affairs and the right to freedom of association X2,4 The right of democratic management of employees and the protection of basic rights
	Employment relationship	X2,6 Whether to do maternity leave X2,8 Whether to benefit from bad labor practices X2,9 Whether to implement paid vacation X2,10 Equal pay for equal work
	Health and compensation and benefits	X2,13 Provide a healthy and safe working environment X2,16 Provide regular physical examination for employees
X2 Basic human rights	Training and development	X2,17 Whether the company’s labor union provides an assistance mechanism for employees X2,18 Strengthen the ability of sustainable employment and skills management and provide a lifelong learning program X2,20 Performance and career development assessment X2,21 Establish and improve communication mechanisms X2,22 Achieve work-life balance
	Resource sustainability	X3,1 Environmentally friendly products X3,4 Comprehensive energy consumption per 10,000 yuan output value X3,5 Degree of use of renewable materials in packaging and transportation X3,7 Water consumption per unit of income
	Biodiversity	X3,8 The total amount of energy saved through energy-saving measures and increased utilization efficiency X3,10 Campus afforestation X3,11 Biodiversity Planning
		X3,12 Transportation or disposal of hazardous wastes X3,13 Reduce sewage discharge X3,14 Major pollution incident
		X3,16 The plan to reduce carbon emissions
	Pollutant discharge	X3,18 Ten thousand yuan of output reduced greenhouse gas emissions X3,19 Environmental expenditure and investment
X3 Environmental protection	Environmental investment and impact assessment	X3,20 The number of incentives for environmental protection

Table 4. Cont.

First-Order Criteria Layers	Secondary Criteria Layers	Indicators Layers	
X4 Fair operation	Anti-corruption measures	X4,3 The response to corruption incidents X4,4 Operation point internal control evaluation implementation degree	
	The law of compliance	X4,6 Number of fines and non-economic penalties X4,7 Status of Title action X4,8 Compliance training	
	The complaint mechanism	X4,9 Is there an appeal body for fair operations X4,10 Appeal means X4,11 Follow-up measures to appeal incidents	
	X5 Product liability	Protection of customer rights	X5,1 Customer complaint channel X5,6 Customer complaint handling rate X5,7 The number of inspections of production safety
		Product service	X5,8 Safety hazard correction rate X5,10 There is no product or service violation X5,13 Do not engage in vicious advertising competition
		Supplier evaluation	X5,14 There is no supplier access screening mechanism X5,15 Whether to conduct comprehensive monitoring on cooperating suppliers
		X6 Community development	Community participation
Health, education, culture			X6,7 Focus on the physical and mental health of community residents X6,9 Promote the development of community culture
Skills development and employment			X6,10 Create local jobs X6,11 Provide skills training to community residents
Wealth and income creation			X6,12 Efforts to Eradicate poverty X6,14 Creating an entrepreneurial environment
X7 Economic performance	Direct economic and social contribution		X7,2 Quick ratio X7,6 Rate of Payment (reflecting the payment of wages) X7,7 Accounts payable turnover rate X7,8 Rate of tax increase
	Indirect economic and social contribution		X7,9 Government subsidies receivable (100 million yuan) X7,10 Endowment income ratio X7,13 Implementation of public welfare projects

4.2. Index Weighting Method Based on Mean Square Error

4.2.1. Overview of Mean Square Error

The mean square error is also called the standard deviation. The standard deviation is the commonest quantitative form to reflect the degree of dispersion of a set of data. It is an important indicator of accuracy and is most frequently used as a measure of the degree of statistical distribution in probability statistics. The standard deviation is defined as the arithmetic square root of the variance, which reflects the degree of dispersion between individuals in the group and the result of measuring the degree of distribution. The standard deviation is calculated by subtracting the sum of the squares of the average of this group of numbers from all the numbers, dividing the result by the number of regrouping numbers, and then taking the root of the obtained value which is the standard deviation of this group of data. In principle, the standard deviation has two properties: One is a difference between the standard deviation of a total amount or the standard deviation of a random variable, and another is the standard deviation of the number of samples in a subset. A small standard deviation means that these values are close to the mean; a large standard deviation means a large difference between most of the values and their mean values. The mean square deviation is used to assign values.

4.2.2. Mean Square Error Assignment

Step 1: Find the mean square error.

Based on R clustering—coefficient of variation screening, the remaining index is obtained and the mean square error is calculated.

Suppose the average value of each index is μ .

$$\mu = \frac{1}{N} \sum_{i=1}^N x_i \quad (8)$$

Let the mean square error be σ .

$$\sigma = \sqrt{\frac{\sum_{i=1}^N (x_i - \mu)^2}{N}} \quad (9)$$

Step 2: Normalize the variance of each indicator, and the value of each indicator after normalization is the indicator weight.

Step 3: Calculate the total score of each enterprise.

Finally, apply the equation $s_j = \sum_{i=1}^m W_i x_{ij}$ to calculate the total scores of each company.

4.2.3. Analysis of Calculation Examples

Step 1: For some indicators, the mean square error of each indicator is obtained as shown in Table 5.

Table 5. Mean square difference of some indicators.

Indicators	X1,5 Commitment, Accountability, and Importance of Leadership	X1,7 Clarify Stakeholder Demands	X1,8 Establish Special Communication Channels for Stakeholders
Mean square error	0.32	0.42	0.40
Indicators	X1,9 Responding to stakeholders	X1,11 Establish CSR risk management mechanism	X1,12 Degree of perfection of risk management control system
Mean square error	0.39	0.36	0.35

Step 2: Normalize the score of each indicator to obtain the weight of each indicator. The weight table of some indicators is shown in Table 6.

Table 6. Weight of some indicators.

Indicators	X1,5 Commitment, Accountability, and Importance of Leadership	X1,7 Clarify Stakeholder Demands	X1,8 Establish Special Communication Channels for Stakeholders
The weight	0.0151	0.0196	0.0189
Indicators	X1,9 Respond to stakeholder appeals	X1,11 Establish CSR risk management mechanism	X1,12 Degree of perfection of risk management control system
The weight	0.0183	0.0169	0.0166

Step 3: Obtain the total scores and ranking of the company through the score and weight of each indicator of each company.

4.3. Results Analysis

As of 20 July 2018, a total of 74 listed companies in the transportation industry have released 2018 CSR reports. This paper makes a reasonable evaluation and scoring of the CSR performance of these 74 listed companies. The overall CSR performance scores and rankings of 74 companies are shown in Table 7.

Table 7. Scores and ranking of Corporate social responsibility (CSR) performance of listed companies in the transportation industry in 2018.

Ranking	The Enterprise Name	Scores	Centesimal System	Ranking	The Enterprise Name	Scores	Centesimal System
1	CIMC	0.6623	66.23	38	SF Express	0.3541	35.41
2	Qingdao Port	0.6598	65.98	39	SIPG	0.3522	35.22
3	China Southern Airlines	0.5682	56.82	40	PDA	0.3498	34.98
4	AIR CHINA	0.5248	52.48	41	CATHAY PACIFIC	0.3485	34.85
5	CMG	0.5170	51.70	42	Zhejiang Expressway	0.3457	34.57
6	CISCO SHIPPING	0.5138	51.38	43	Johnson Holdings	0.3406	34.06
7	Xiamen Port	0.5137	51.37	44	YTO International	0.3063	30.63
8	BCIA	0.5045	50.45	45	Transport International	0.2992	29.92
9	COSCO SHIPPING Energy Transportation	0.5039	50.39	46	Yantian Port	0.2934	29.34
10	Jiangsu Expressway	0.4934	49.34	47	MTR	0.2934	29.34
11	COSCO SHIPPING Specialized Carriers	0.4884	48.84	48	Lianyungang Port	0.2929	29.29
12	CMAL	0.4795	47.95	49	Dragon Crown	0.2924	29.24
13	Anhui Expressway	0.4787	47.87	50	Jinzhou Port	0.2888	28.88
14	COSCO SHIPPING Ports	0.4750	47.50	51	Daqin Railway	0.2827	28.27
15	Yueyun Transportation	0.4605	46.05	52	Tangshan Port	0.2775	27.75
16	OOIL	0.4577	45.77	53	KLN	0.2746	27.46
17	QHD Port	0.4514	45.14	54	Ningbo Marine	0.2726	27.26
18	China Eastern Airlines	0.4452	44.52	55	Hainan Airlines	0.2705	27.05
19	Shenzhen Expressway	0.4383	43.83	56	Dazhong Transportation	0.2704	27.04
20	Sinotrans	0.4372	43.72	57	Pacific Basin	0.2623	26.23
21	STO Express	0.4290	42.90	58	Ningbo Zhoushan Port	0.2610	26.10
22	China Development Bank Leasing	0.4269	42.69	59	Jiangxi Changyun	0.2590	25.90
23	YTO EXPRESS	0.4251	42.51	60	YUNDA EXPRESS	0.2529	25.29
24	Tielong Logistics	0.4238	42.38	61	Heilongjiang Transport	0.2523	25.23
25	CMSTD	0.4161	41.61	62	Worldgate Express	0.2406	24.06
26	Shenzhen International	0.4152	41.52	63	Shanghai Shentong Metro	0.2402	24.02
27	Daido Group	0.4146	41.46	64	Yingkou Port	0.2279	22.79
28	Rizhao Port	0.4109	41.09	65	Deppon Express	0.2186	21.86
29	COSCO SHIPPING Development	0.3961	39.61	66	Shandong Expressway	0.2163	21.63
30	Tianjin Port	0.3907	39.07	67	Henan Zhongyuan Expressway	0.2025	20.25
31	Singamas	0.3894	38.94	68	Fujian Expressway	0.1784	17.84
32	CKSG	0.3850	38.50	69	Delixi Xinjiang Transportation	0.1574	15.74
33	GUANGSHEN Railway	0.3818	38.18	70	Jiangxi Ganyue Expressway	0.1569	15.69
34	World-link Logistics	0.3799	37.99	71	Jilin Expressway	0.1480	14.80
35	Yuexiu Transport Infrastructure	0.3748	37.48	72	Jinhui Shipping and Transportation	0.1212	12.12
36	Sichuan Expressway	0.3707	37.07	73	Huayu Expressway	0.1190	11.90
37	Guangzhou Port	0.3596	35.96	74	Baiyun Airport	0.0828	8.28

As shown in Table 7, the results of the study show that CIMC and Qingdao Port rank the top two among all companies and are the only two companies that score above 60 points. Among the scores of these two companies, the relevant indicators of the green

supply chain score higher, and they actively assume the responsibilities to stakeholders in the supply chain, including environmental responsibility, product responsibility, and responsibility to supply chain partners. According to the survey of transportation behavior of Chinese urban residents, green travelers who care about the environment and have a positive environmental attitude are more willing to choose green public transportation [93]. Obviously, the performance of these two companies meets the requirements of China's green travelers to choose transportation and can also meet the requirements of different stakeholders, and the scores are also in line with China's reality. In contrast, Baiyun Airport can only get 8.28 points, which is 57.95 points away from the highest scored CIMC Group. This shows that different companies in the transportation industry still have a large gap in the performance of social responsibility in the green supply chain. This may be because the sub-sectors of each company in the transportation industry have a large span, such as railways, waterways, aviation, high-speed, etc., which have different characteristics among each other, which leads to differences in the performance of corporate social responsibilities [64]. It is worth noting that only two companies achieved a "pass" performance score, which means that the whole transportation industry still has many shortcomings in terms of green supply chain CSR, and there is still a lot of room for improvement. This is consistent with Gao et al.'s CSR analysis of China's top 100 companies in 2007 [23]. In their research, compared with the top 100 Chinese companies in other industries, the transportation industry is less concerned about all issues.

From the perspective of the sub-sectors of China's transportation industry, among the top ten companies this year, companies in the air transportation industry and port transportation industry account for more. These two industries have performed well in the indicators of social responsibility in the green supply chain and can serve as benchmarks for the entire transportation industry. The main reason is that these two sub-sectors have a large market extension, a high degree of nationalization, and fierce market competition [94]. In contrast, the problems in the performance of the duties of the entire transportation industry are reflected in the bottom ten enterprises. It is worth mentioning that among these companies, the expressway transportation industry accounts for half, which reflects that the overall performance of this industry is not optimistic. Checking their reports shows that there are still many problems to be solved, and many aspects need to be improved. The reason is mainly due to the relative monopoly of the industry, strong regionality, and low market competition [94]. The difference in CSR performance of sub-sectors can be explained by Macdonald's CSR stakeholder influence dynamic model, that is, consumer market, NGO, and financial market pressure will affect the fulfillment of social responsibilities [95]. However, this year, 37 companies score higher than the industry average, accounting for half of the total number of companies. This means that the overall development of CSR in the transportation industry supply chain is improving. All in all, the social responsibility performance of the supply chain in China's transportation industry is poor, and the entire industry needs to work together to improve the level of green supply chain management and improve the overall CSR performance. Although the development of social responsibility of listed companies in the industry is still uneven, the gap is gradually narrowing. The corporate green supply chain social responsibility of China's transportation industry is still in the preliminary stage of development [94].

Through the above analysis, this paper provides some enlightenment. First, the government strengthens the legislative work of CSR, especially the CSR of green supply chain management. The Chinese government should formulate certain laws and regulations to put forward the requirements for enterprises to disclose CSR information and urge enterprises to perform social responsibilities following with the requirements of the state through the inspection, guidance, and restraint of laws and regulations. Second, companies should establish a green supply chain CSR concept and strengthen their sense of responsibility. Companies in the transportation industry should take the lead in actively fulfilling their social responsibilities, establish a correct sense of responsibility, and promote the development of CSR throughout the industry. For example, the establishment of a special

CSR department within the enterprise, which is incorporated into the daily business life and benefit evaluation of the enterprise, encourages the enterprise to actively perform CSR. The third is that companies should accurately make up for their shortcomings to eliminate polarization. From the conclusions, it can be noted that the differences in the performance of social responsibilities among companies in the transportation industry are also obvious, and even their polarization. Therefore, companies that perform poorly should learn from “benchmark” companies that perform well, recognize their shortcomings, and work hard. To narrow the gap, for example, the transportation equipment industry should learn from CIMC’s experience and strive for better development in the future.

5. Conclusions

This paper, from the perspective of green supply chain management, uses the “R clustering-variation coefficient analysis” method and establishes a responsibility evaluation system for listed companies in China’s transportation industry. The evaluation system is applied to 74 listed transportation companies in China, using the mean square error index weighting method to assign weights, and a comparative analysis of sub-sectors in the transportation industry is carried out. Besides, the main contributions of this article are to (1) provide a reference for CSR/CSP research in developing countries and emerging markets and (2) employ empirical research methods to establish CSR assessment framework in the green supply chain of the transportation industry, which provides clues for companies in the transportation industry to pursue SC-CSR and at the same time makes up for the shortcomings of insufficient empirical research in the literature on SC-CSR [16].

This study is not without some limitations. The CSR evaluation system designed in this paper is established for China’s transportation industry, which may limit the universality and applicability of the evaluation system in this paper. Besides, the data of some private enterprises and foreign enterprises are not easy to obtain, and the selected companies are listed in China. Therefore, the evaluation system designed is not necessarily applicable to private enterprises and foreign enterprises in China’s transportation industry.

It is necessary for future research to develop a brand-new method to properly handle some valuable but difficult to obtain and inappreciable indicators to improve the existing performance evaluation system. Secondly, the main evaluation materials in this article come from the CSR report, with other materials, such as Information disclosed by the company’s official website or news media, as supplementary materials. Therefore, for some companies that have not released CSR reports but perform well in various aspects, how to evaluate their CSR performance has become the content of the next step of research.

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