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Research on Risk Assessment of Enterprise Public Opinion in Cross Social Media Context and Sustainable Development Strategies

Yan Shen [1,*], Shuo Bian [1], Xinping Song [1] and Xia Geng [2]

[1] School of Management, Jiangsu University, Zhenjiang 212013, China
[2] School of Computer Science and Communication Engineering, Jiangsu University, Zhenjiang 212013, China
* Correspondence: 1000003014@ujs.edu.cn

Abstract: The integrated development of social media makes enterprise public opinion spread across multiple social platforms. The safety of enterprise public opinion affects the sustainability of enterprise development and social stability. The risk assessment of enterprise public opinion in a cross social media context and sustainable strategies is researched to help enterprises and governments better regulate enterprise public opinion and improve their ability to respond to public opinion. We established an enterprise public opinion risk assessment index system in a cross social media context, and an enterprise public opinion risk assessment model was established by using a combination of the entropy method, TOPSIS, grey relational analysis and Fuzzy C-means method. The research results show that, compared with the context of single social media, the analysis of enterprise public opinion in a cross social media context is more comprehensive and accurate. The risk assessment model of enterprise public opinion proposed in our research is more suitable for the judgment of enterprise public opinion in a cross social media context and can comprehensively and accurately grasp the situation of enterprise public opinion. The management significance of public opinion risk management for the sustainable development of enterprises is also discussed.

Keywords: big data; cross social media; enterprise public opinion; risk assessment; sustainable strategy; TOPSIS; grey relational analysis; fuzzy C-means

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1. Introduction

With the development of information technology, all kinds of social media are widely integrated into people's daily lives. Social media plays an important role in the sustainable development and decision making of enterprises [1]. According to the 51st Statistical Report on the Development Status of the Internet in China released by the China Internet Information Centre (CNNIC), as of December 2022, the number of Internet users in China reached 1.067 billion, and the Internet penetration rate reached 75.6%. Among them, the scale of China's online news users reached 783 million. Another identity of Internet users is consumers of enterprise products, who are closely related to enterprises and the audience for enterprise public opinion. They understand important issues and exchange ideas through mutual communication because this is an effective method [2]. As a result, hot enterprise public opinion events would spread rapidly among huge audiences and attract widespread attention. Among them, negative enterprise public opinion events that are not effectively guided would generate enterprise public opinion risks. Marketing can affect values and beliefs [3]. The response of a company to negative public opinion is also a marketing behavior that can change consumers' perception of the enterprise and affect its sustainable development. Compared with traditional online media, the development of cross social media has exacerbated this effect. Enterprise public opinion is brewing in the political, economic, and social environment, mixed with false and harmful information [4]. Its evolution has become extremely complex, presenting characteristics such as cross media and timelessness. The causes of enterprise public opinion events include product quality, service attitude, management loopholes, unfair competition, public safety, inappropriate words and behaviors, and so on. Among them, product quality, service attitude, management loopholes, and unfair competition are the main causes of enterprise public opinion events [5]. Enterprise public opinion risk, as an intangible enterprise reputation risk, not only has a negative impact on enterprise reputation and the sustainability of enterprise development but also causes emotional opposition among netizens. According to the social amplification of risk framework, this impact can lead to unexpected social consequences, which is not conducive to government regulation and social stability. How can we establish effective risk assessment methods and reputation risk management strategies to promote the sustainable development of enterprises? Therefore, the objective of our research is to assess the risk of enterprise public opinion in a cross social media context and develop sustainable strategies. Our research can not only enhance the ability of enterprises to respond to public opinion risks, maintaining enterprise reputation and development, but also have important significance for social stability.

2. Literature Review

(1) Research on Enterprise Reputation and Sustainable Development of Enterprises

Reputation is a business strategy and management issue. Reputation risk refers to all underlying events that cause reputational losses [6]. Reputation can provide competitive support for enterprises. The contribution of reputation to an enterprise is reflected in quality commitment, corporate social sustainability, and sustainable development [7]. Previous studies have found that improving the reputation of social enterprises can help improve economic performance [8]. Also, managerial reputation can promote social capital investment in enterprise innovation, which is crucial for enterprises to transform and upgrade in response to the complex and changeable international economic situation [9]. Enterprise success often depends on the extent to which managers develop an integrated package of policies for systematically building the intangible asset of enterprise reputation [10].

Social media generates and expands reputation risks [11]. Syed found that negative online public opinion can pose a threat to an enterprise's reputation after a data breach event occurs [12]. It is necessary for enterprises to develop a strategy for reputation risk management. Enterprises need to set indicators to measure, assess, and handle reputation risk [13]. Enterprise risk management system quality enhances enterprise reputation. When a crisis stemming from an uncontrollable risk occurs, a high-quality enterprise risk management system helps to reduce the negative impact on reputation because stakeholders will not attribute guilt to a firm which has acted responsibly in its risk management [14].

At present, research on the risk assessment of enterprise public opinion mainly includes the following aspects:

(2) Research on Measuring the Risk of Enterprise Public Opinion

Existing research on measuring the risk of enterprise public opinion mainly focuses on the construction of index systems.

In the construction of an enterprise public opinion risk assessment index system, some studies started from the process of public opinion dissemination. Based on the life cycle theory, an enterprise public opinion risk assessment index system was established from the three aspects of risk generation, risk diffusion, and risk decline and recovery [15]. There were also studies that selected indexes with characteristics such as multiple objects and quantifiability. For example, Dai and Yao [16] constructed a public opinion security assessment index system that contains indexes of public opinion circulation, elements, and state trends. Wang and Sun [17] explored the impact of entities, such as enterprises, netizens, media, and government, on the popularity of enterprise public opinion. Zhao and Qi [18] constructed a risk assessment index system for online enterprise public opinion from the dimensions of subject, object, and influence degree. Xu [19] established a food safety public opinion index system from four aspects, characteristics, subjects, trends, and response elements, to provide theoretical support for food enterprises. Sun et al. [20] found that public opinion affects the production safety of small- and medium-sized enterprises through three aspects: public awareness, media response, and government guidance. Zheng et al. [21] found that feelings of violation lead to individuals being more likely to engage in crisis communication.

(3) Research on Risk Assessment Methods for Enterprise Public Opinion

Multiple-Criteria Decision Making is an effective method for evaluating alternative solutions and making the best decisions. When solving complex problems, it can fully consider uncertainty, conflicting objectives, different types of data, and diverse perspectives. For example, it can be used for location selection problems [22] and special material selection problems [23]. Multiple-Criteria Decision Making can be used for public opinion risk assessment. The existing methods can be divided into two aspects: subjective methods and objective methods. Subjective methods can make full use of the decision maker's experience of the problem to determine the weights reasonably, including the Delphi method [24], analytic hierarchy process [25], DEMATEL [26], Swing Weighting [27], etc. These methods are highly subjective and have limitations in their application. Objective methods are based on the relationship between the original data, including entropy method [28], principal components analysis [29], TOPSIS [30], Grey Relational Analysis [31], etc., which can avoid the interference caused by subjectivity. There are also studies that combine subjective and objective methods for weighting. For example, Yuan et al. [32] combined the entropy method and analytic hierarchy process to calculate the weight of public opinion risk indexes.

Risk classification methods for enterprise public opinion include fuzzy mathematical methods, the ABC classification method [33], and the method of combining an accelerated genetic algorithm and projection pursuit (AGA-PP) [34]. Li et al. [35] classified enterprise online public opinion into four judging intervals, which were weak alert, medium alert, strong alert, and heavy alert. Tian and Lyu [36] used latent semantic analysis and support vector machines to classify enterprise public opinion documents. Chen et al. [37] combined user portrait technology and the random forest algorithm to help enterprises identify high-risk users. Sonalitha et al. [38] used the Fuzzy C-means method to classify comments. The Fuzzy C-means method is also applicable to the classification of risk levels.

(4) Research on Sustainable Development Strategies for Enterprise Public Opinion Management

Li et al. [39] explored the reasons for the imbalance in the network public opinion ecosystem and proposed optimization strategies for the network public opinion ecosystem from the dimensions of whole, system, hierarchy, ecological chain, and field domain, providing a theoretical reference for the balance and sustainable development of the network public opinion ecosystem. Zhang [40] proposed that a good public opinion ecosystem can provide strong ideological support for the sustainable and high-quality development of enterprises. Yang and Xie [41] proposed a sustainable development path for government public opinion governance. Zhang et al. [42] conducted research on enterprise trust restoration from three aspects: the affective repair strategy, the informational repair strategy, and the functional repair strategy; this provides directional guidance for the sustainable development of enterprises. You et al. [43] proposed public opinion guidance strategies from the perspectives of the government, platforms, and media. Stieglitz et al. [44] investigated the application of a silence strategy in enterprise public opinion crises.

Due to the new influence of cross social media, enterprise public opinion crises still occur frequently. Some scholars have noticed the importance of studying enterprise public opinion in a cross social media context. They conducted research from theoretical aspects such as public opinion dissemination and data fusion. Yang et al. [45] constructed a cross-platform communication model of public opinion based on the SEIR model and analyzed the influence of individual factors and external environment on public opinion communication. Zhang et al. [46] believed that cross media and multi-terminal heterogenous information is the new challenge of online public opinion. Zhang et al. [47], from the perspective of multidimensional data fusion, believed that multidimensional data processing and analysis are the foundation of public opinion guidance in a cross social media context. Eachempati [48] studied the different views of public opinion on COVID-19 on Twitter, Facebook, and YouTube.

However, the current literature still faces a series of problems: (1) The research on the risk assessment of enterprise public opinion in a cross social media context is mostly explored from the theoretical level, and there is a lack of closed-loop research on theories linked to practical big data. (2) The existing enterprise public opinion risk assessment index system cannot meet the needs of mining different indexes and heterogeneous information from multiple sources in a cross social media context, which leads to difficulties in assessing the risk of enterprise public opinion. (3) Subjective methods lead to results that vary from person to person.

In order to enrich the existing research, our research took the traditional risk assessment research of enterprise public opinion in the context of single social media as the basis, combined the characteristics of cross social media, and constructed a risk assessment index system of enterprise public opinion in a cross social media context. With the support of big data, we integrated the entropy method, TOPSIS, grey relational analysis, and Fuzzy C-means method to establish a risk assessment model for enterprise public opinion in a cross social media context. Strategies were proposed to provide a reference for the sustainable development of enterprises and long-term social stability.

3. Methodology

Firstly, we used crawler tools to crawl relevant data. Secondly, we established an index system based on the characteristics of enterprise public opinion and the cross social media context. Subsequently, the entropy method was used to allocate index weights. Then, we used TOPSIS and grey relational analysis to evaluate the cases. Finally, we used FCM to classify the evaluation results.

The research framework is shown in Figure 1.

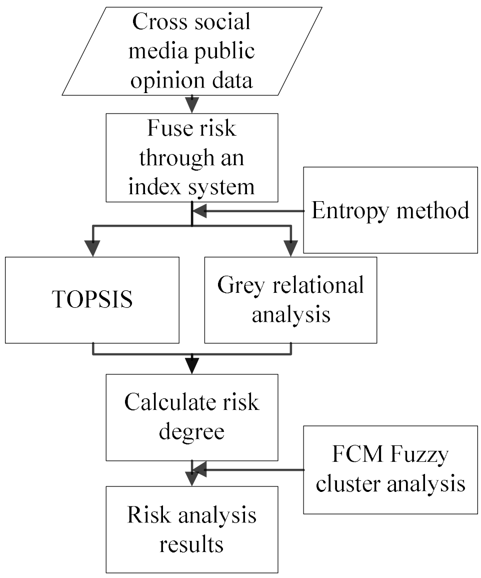

Figure 1. Research framework.

In the process of establishing an index system, we considered the characteristics of the cross social media context, such as user preferences. We incorporated emotional divergence into the index system based on the characteristics of enterprise public opinion. Our weight allocation method was objective. Therefore, this research avoided the interference of subjective factors. The combination of TOPSIS and grey relational analysis can fully consider both positional distance and geometric similarity. Our FCM risk classification method achieved classification results based on the similarity of data, which was also objective.

3.1. The Data Collection

This article selected 14 enterprise public opinion events that occurred from 2021 to 2022, covering product quality, service attitude, management loopholes, unfair competition, public safety, inappropriate words and actions, and other categories, as shown in Table 1. These events had a certain degree of influence. Therefore, the amount of data was considerable. These events can represent various types of the enterprise public opinion mentioned above.

Table 1. Cases of enterprise public opinion events.

Event Numbers	Enterprise Public Opinion Events	Starting Time
E1	Pit Sauerkraut	15 March 2022
E2	Haitian Taste Double Standard	30 September 2022
E3	Zhongxuegao Doesn't Melt at High Temperature	1 July 2022
E4	Audi Advertisement Plagiarism	21 May 2022
E5	Zhangxiaoquan's Garlic Broken Knife Gate	12 July 2022
E6	Tesla Accident in Chaozhou	5 November 2022
E7	P&G Accused of Insulting Women	13 March 2022
E8	Li Ning Winter Clothing Design Controversy	17 October 2022
E9	MINISO is Exposed to Have a Pro Japanese Crash	25 July 2022
E10	CNKI Monopoly under Investigation	28 April 2022
E11	Starbucks Drives Away Civilian Police	13 February 2022
E12	MIXUE Ice Cream & Tea Changes Date of Expired Ingredients	14 May 2021
E13	Donation Fiasco at ERKE	21 July 2021
E14	Sudden Death of a PDD Employee	3 January 2021

This study used web crawlers to crawl relevant data from Sina Weibo, Toutiao, and Hupu. Our data collection time frame was from the occurrence of the event to two months later. After removing duplicate data and cleaning, a total of 370,834 pieces of data were collected. The data we collected were visible on the front end of the webpage. We did not collect and analyze private data from netizens.

3.2. Enterprise Public Opinion Risk Assessment Index System in a Cross Social Media Context

3.2.1. Principles for the Construction of the Risk Assessment Index System

Consumers have a strong will to express themselves in order to safeguard consumer rights and interests and social justice. Therefore, enterprise public opinion events are repeatedly disseminated and continuously fermented on various media platforms, setting off a public opinion frenzy. When monitoring enterprise public opinion, it is important not only to obtain basic statistical information about public opinion but also to dig deeper into the emotional risks of netizens. Since this research focuses on the cross social media context, it is important to not only consider the generic indexes of each social media but also incorporate the individual indexes of each social media into the index system, so as to fully explore the influence and mechanism of each social media on enterprise public opinion. Based on the above considerations, the construction of the risk assessment index system for enterprise public opinion in a cross social media context should follow the following principles:

(1) Principle of science: The selected indexes have cross-platform literature support and data basis, and can reflect the objective facts of the development of enterprise public opinion in a cross social media context.
(2) Principle of comprehensiveness: The selected indexes can be applied to the accurate portrayal of public opinion on various platforms, so as to realize an all-round assessment of the development of enterprise public opinion.

(3) The principle of seeking common ground while reserving differences: The indexes of each social media are not the same, so the construction of the index system should not only cover the common indexes but also retain the individuality of the social media indexes, so as to fully explore the impact and mechanism of various social media on enterprise public opinion.

(4) Principle of fairness: This study assesses the risk of enterprise public opinion in a cross social media context, and the indexes chosen should ensure fairness across events and media.

3.2.2. Construction of the Index System

The current risk assessment systems of enterprise public opinion were mostly built in the context of single social media, which cannot be fully applied to the risk assessment of enterprise public opinion in a cross social media context. Therefore, on the basis of various studies about risk assessment, our research integrated the risk of public opinion in a cross social media context from the aspects of breadth [49,50], heat [51,52], and netizens' emotion [53,54]. Our research constructed an enterprise public opinion risk assessment system with three first-level indexes and twelve quantifiable second-level indexes, as shown in Table 2.

Table 2. Index system for risk assessment of enterprise public opinion.

System of Indexes	First-Level Indexes	Second-Level Indexes	Source
Enterprise Public Opinion Risk Assessment Index System S	Breath of public opinion A	Publication volume $A1$ Duration $A2$	Tan et al. [49,50]
	Heat of public opinion B	Number of recognitions $B1$ Number of comments $B2$ 24-h posting volume $B3$ Peak of topic comments $B4$ Number of forwarding $B5$ Originality $B6$ Views $B7$	Yang et al. [51,52]
	Emotions of netizen C	Number of positive emotions $C1$ Number of negative emotions $C2$ Emotional divergence $C3$	Zhu et al. [53,54] and this research proposed

(1) Breadth of public opinion

Focusing on the breadth of enterprise public opinion can provide an initial understanding of the impact of a public opinion crisis. Among the second-level indexes, publication volume determines the trend of public opinion development. Topic duration indicates how long the topic has been fermenting on the Internet, which is important for public opinion assessment. $A1$. Publication volume: Messages about enterprise public opinion posted on social media, measured by the total number of articles. The total number of public opinion messages in a single platform is $post$. $A2$. Duration: This represents the total time from the occurrence of an enterprise event to the dissipation of attention, counted by day. The time period for which comments exist in a single platform is $date$. The dissipation of attention is signified by the absence of public opinion about the event on each platform in one day. $plat1,\ plat2,\ \cdots,plat N$ represent various media platforms.

$$A1 = post_{plat1} + post_{plat2} + \cdots + post_{platN} \tag{1}$$

$$A2 = MAX\left[LAST\left(date_{plat1} \cup date_{plat2} \cup \cdots \cup date_{platN}\right)\right] \tag{2}$$

$LAST$ is the number of days in the consecutive time period.

(2) Heat of public opinion

Heat of public opinion is the degree of concern of each public opinion subject for an enterprise public opinion event. $B1$. Number of recognitions: Number of recognitions can reflect the approval of netizens for comments. Number of recognitions has different forms in different platforms, such as the number of likes, recommendations, and highlights. The total number of articles is Q, and the number of recognitions on the article q is recorded as $postlike_q$. $B2$. Number of comments: The number of comments refers to the number of comments posted by netizens in all reports. The total number of articles is Q, and the number of comments in the article q is $comcount_q$. $B3$. The 24 h posting volume: It refers to the number of articles published by media or bloggers within 24 h of an enterprise public opinion event, representing the level of attention from opinion leaders, recorded as $postoneday$. $B4$. Peak of topic comments: This represents the peak of comments made by netizens throughout the entire life cycle of an enterprise public opinion event. The number of comments on the day t is $comment_t$, and the number of total days is T. $B5$. Number of forwards: the total number of forwards made by netizens on all blogs. The total number of blogs is Q, and the number of forwards for the blog q is $forwardcount_q$. $B6$. Originality: Originality indicates the willingness of opinion leaders to write the first report on a certain public opinion event, and its number is important in assessing the seriousness of the situation. The total number of reports is Q, and the originality of the report q is $original_q$. If the report is original, mark it as 1. $B7$. Views: The total number of views on a post by netizens. The total number of posts is Q; the number of views on the post q is $views_q$.

The number of recognitions in a single platform is:

$$postlike = \sum_{q=1}^{Q} postlike_q \tag{3}$$

$$B1 = postlike_{plat1} + postlike_{plat2} + \cdots + postlike_{platN} \tag{4}$$

The number of comments in a single platform is:

$$comcount = \sum_{q=1}^{Q} comcount_q \tag{5}$$

$$B2 = comcount_{plat1} + comcount_{plat2} + \cdots + comcount_{platN} \tag{6}$$

$$B3 = postoneday_{plat1} + postoneday_{plat2} + \cdots + postoneday_{platN} \tag{7}$$

The number of comments in the day t is:

$$comment_t = comment_t plat1 + comment_t plat2 + \cdots + comment_t platN \tag{8}$$

$$B4 = \{\max comment_t | t = 1,2,\cdots,T\} \tag{9}$$

$$B5 = \sum_{q=1}^{Q} forward_q \tag{10}$$

$$B6 = \left\{ \sum_{q=1}^{Q} original_q \middle| original_q = 1 \right\} \tag{11}$$

$$B7 = \sum_{q=1}^{Q} views_q \tag{12}$$

(3) Emotions of netizen

Using text mining technology to make a judgement on netizens' emotions and assess the risk of online public opinion at a deep level is important for risk assessment and guidance of enterprise public opinion. Jieba and SnowNLP are Python text analytic libraries for Chinese text mining. The former has strong Chinese lexical ability, which can assist the latter to better complete the sentiment analysis. This research mainly evaluates the impact of netizen sentiment on enterprise public opinion risk through the following aspects: $C1$. Number of positive emotions; $C2$. number of negative emotions representing the number of comments with positive and negative sentiment, respectively. The sentiment tendency of the comment z is $sentiment_z$, with a positive value of 1 and a negative value of -1. When calculating the number of both, it is necessary to consider the likes of netizens on comment z, that is, $commentlike_z$. The total number of comments is Z, and the sentiment contained in the comment z is $senti_z$.

$C3$. Emotional divergence: Existing research [55] focuses more on the emotional tendencies of the public towards a certain event. This research proposes the concept of emotional divergence, which represents the degree of difference and opposition in the public perception of events. The greater the degree of emotional divergence, the more intense the public's controversy over the event, and the greater the enterprise and social risks involved.

$$senti_z = (1 + commentlike_z) \times sentiment_z \tag{13}$$

The number of positive emotions in a single platform is:

$$poscount = \left\{ \sum_{z=1}^{Z} senti_z | senti_z > 0 \right\} \tag{14}$$

The number of negative emotions in a single platform is:

$$negcount = \left\{ \left| \sum_{z=1}^{Z} senti_z \right| | senti_z < 0 \right\} \tag{15}$$

$$C1 = poscount_{plat1} + poscount_{plat2} + \cdots + poscount_{platN} \tag{16}$$

$$C2 = negcount_{plat1} + negcount_{plat2} + \cdots + negcount_{platN} \tag{17}$$

$$\text{C3} = 1 - \frac{|\text{C1} - \text{C2}|}{\text{C1} + \text{C2}} \tag{18}$$

3.3. Risk Assessment Methods for Enterprise Public Opinion

3.3.1. Entropy Method to Determine Index Weights

The entropy method is an objective weighting method that uses entropy to measure data uncertainty and, thus, assign weights to indexes. It reduces the influence of subjective factors on the weights.

There are m enterprise public opinion events and n risk assessment indexes. The public opinion risk assessment matrix is $X = (x_{ij})_{m \times n}$, $i = 1, 2, \cdots, m$, $j = 1, 2, \cdots, n$, where x_{ij} represents the value of the risk assessment index j for the enterprise public opinion event i. The risk assessment indexes are standardized to eliminate the influence of sample size:

Standardization of positive indexes:

$$x'_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}} \tag{19}$$

Standardization of negative indexes:

$$x'_{ij} = \frac{\max x_{ij} - x_{ij}}{\max x_{ij} - \min x_{ij}} \tag{20}$$

There are zero values in the processed data, so the data are overall levelled to $x'_{ij} = x'_{ij} + 0.001$. The indexes are normalized after the levelling:

$$p_{ij} = \frac{x'_{ij}}{\sum\limits_{i=1}^{m} x'_{ij}},\ i = 1,2,\cdots,m,\ j = 1,2,\cdots,n \tag{21}$$

The information entropy of the risk assessment index j is:

$$e_j = -\frac{1}{\ln n}\sum_{i=1}^{m} p_{ij}\ln p_{ij},\ i = 1,2,\cdots,m,\ j = 1,2,\cdots,n \tag{22}$$

Redundancy is:

$$d_j = 1 - e_j,\ j = 1,2,\cdots,n \tag{23}$$

The weight of the risk assessment index j is:

$$\omega_j = \frac{d_j}{\sum\limits_{j=1}^{n}\left(d_j\right)},\ j = 1,2,\cdots,n \tag{24}$$

3.3.2. TOPSIS Method

TOPSIS is a comprehensive assessment method that calculates the close degree through the distance between the assessment object and the optimal solution and the worst solution, so as to judge whether the assessment object is good or bad. The steps to assess enterprise public opinion risk using the TOPSIS method are as follows:

(1) Standardize the original data matrix.
(2) Calculate the weighted evaluation matrix R.

$$R = \left(r_{ij}\right)_{m\times n}, r_{ij} = x'_{ij}\cdot\omega_j, i = 1,2,\cdots,m, j = 1,2,\cdots,n \tag{25}$$

(3) Obtain the optimal and worst solutions of each risk assessment index. The optimal solution for the risk assessment index j is $solu_j^+$, and the worst solution is $solu_j^-$.

$$solu_j^+ = \left\{\max r_{ij}|i = 1,2,\cdots,m\right\} \tag{26}$$

$$solu_j^- = \left\{\min r_{ij}|i = 1,2,\cdots,m\right\} \tag{27}$$

(4) Calculate the distance to the optimal solutions and the worst solutions for each enterprise public opinion event. In this research, the distance to the optimal solutions and the worst solutions is denoted by D_i^+ and D_i^-, respectively.

$$D_i^+ = \sqrt{\sum_{j=1}^{n}\left(r_{ij} - solu_j^+\right)^2},\ i = 1,2,\cdots,m \tag{28}$$

$$D_i^- = \sqrt{\sum_{j=1}^{n}\left(r_{ij} - solu_j^-\right)^2},\ i = 1,2,\cdots,m \tag{29}$$

(5) Calculate the close degree to measure the risk level of enterprise public opinion.

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-},\ i = 1,2,\cdots,m \tag{30}$$

3.3.3. Grey Relational Analysis

Grey relational analysis is a method of determining whether the relationship between the target sequence and the reference sequence curve is close by comparing their geometric similarity. The steps of this method are as follows:

(1) The first step is to determine the reference sequence for enterprise public opinion risk assessment. The sequence composed of the maximum value of each index value after standardization is taken as the reference sequence.

$$X_0 = \{x_0(1),\ x_0(2), \cdots,\ x_0(n)\} \quad (31)$$

The sequence of index data for each enterprise public opinion events is represented as:

$$X_i = \{x_i(1), x_i(2), \cdots, x_i(n)\}, i = 1, 2, \cdots, m \quad (32)$$

(2) Calculate the grey relational coefficient. The grey relational coefficient between the sequence X_i of the enterprise public opinion event i and the reference sequence X_0 is:

$$\eta_i(k) = \frac{\min_i \min_j |x_0(j) - x_i(j)| + \rho \max_i \max_j |x_0(j) - x_i(j)|}{|x_0(j) - x_i(j)| + \rho \max_i \max_j |x_0(j) - x_i(j)|} \quad (33)$$

$\rho \in (0, 1)$, ρ is usually taken as 0.5 [56].

(3) Calculate the relational degree of enterprise public opinion events. The relational degree between the sequence of each enterprise public opinion event and the reference sequence can reflect the risk level of this public opinion event in the whole case database. The relational degree of the enterprise public opinion event i is:

$$\gamma_i = \sum_j^n \omega_j \eta_i(j) \quad (34)$$

3.3.4. Calculation of Risk Degree

The enterprise public opinion risk is composed of a weighted combination of the close degree and the relational degree. The formula for calculating the risk degree is:

$$\theta_i = \alpha C_i + (1 - \alpha)\gamma_i, i = 1, 2, \cdots, m \quad (35)$$

C_i and γ_i are the close degree and the relational degree derived above. α represents the weights of the two. TOPSIS and grey relational analysis can measure the proximity of the enterprise public opinion to the optimal object in terms of both positional distance and geometric similarity, and they complement each other. Considering the balance in this research, $\alpha = 0.5$ is taken.

3.3.5. FCM Fuzzy Cluster Analysis

Compared with equal frequency and equal distance methods, clustering group data based on the similarity between them, it is more reasonable to classify the risk level of enterprise public opinion. The similarity calculation of clustering in this research adopts Euclidean distance. The results of risk degree calculation are transferred to the input data $\theta = [\theta_1, \theta_2, \cdots, \theta_m]$. Fuzzy C-means algorithm is applied to obtain the cluster centers, and the midpoints of adjacent centers are used as boundary points. Compared to hard clustering, soft clustering provides more flexibility as it allows data points to have varying degrees of membership in multiple clusters. The algorithm principle is as follows:

(1) Minimize the objective function.

$$J_m = \sum_{i=1}^{N}\sum_{j=1}^{C} u_{ij}^{m} \|x_i - c_j\|^2, 1 \le m < \infty \tag{36}$$

m is the number of clusters, and u_{ij} represents the membership degree of the sample belonging to class j.

(2) Iteratively calculate membership and cluster centers.

$$u_{ij} = \frac{1}{\sum\limits_{k=1}^{C}\left(\frac{\|x_i-c_j\|}{\|x_i-c_k\|}\right)^{\frac{2}{m-1}}}, c_j = \frac{\sum\limits_{i=1}^{N} u_{ij}^{m}\cdot x_i}{\sum\limits_{i=1}^{N} u_{ij}^{m}} \tag{37}$$

(3) The termination condition for iteration is:

$$\max_{ij}\left|u_{ij}^{k+1} - u_{ij}^{k}\right| < \varepsilon \tag{38}$$

ε is the error threshold.

4. Empirical Analysis

The Section 4 presents our research findings.

The crawled data were counted according to the enterprise public opinion risk assessment index system constructed above. Some data are shown in Table 3.

Table 3. Part of the data on enterprise public opinion events.

Events	Publication Volume (Articles) A1	Duration (Days) A2	Number of Recognitions (Times) B1	Number of Comments (Comments) B2	24 h Posting Volume (Articles) B3	Peak of Topic Comments (Comments) B4
E1	942	60	2,850,043	72,978	405	24,135
E2	560	48	212,000	28,709	32	5613
E3	798	51	3,254,651	36,601	104	10,645
E4	566	29	245,162	14,531	155	9125
E5	825	37	476,002	48,247	70	12,372
Events	**Number of Forwarding (Times) B5**	**Originality (Articles) B6**	**Views (Times) B7**	**Number of Positive Emotions (Comments) C1**	**Number of Negative Emotions (Comments) C2**	**Emotional Divergence C3**
E1	91,074	241	34,539,309	392,969	635,583	0.7641
E2	8190	155	3,471,737	229,513	182,144	0.8849
E3	51,700	109	6,934,041	216,853	339,247	0.7799
E4	12,248	144	1,294,145	98,707	71,846	0.8425
E5	15,641	200	4,356,020	219,723	315,636	0.8208

4.1. Calculating Weights

Public opinion data were standardized, and the entropy method was applied to obtain the information entropy e_j and weight ω_j of each index, as shown in Table 4.

Table 4. Entropy and weights of risk assessment indexes.

Term	A1	A2	B1	B2	B30	B4
e_j	0.9176	0.9079	0.7594	0.8177	0.8387	0.8646
ω_j	0.0469	0.0524	0.1370	0.1038	0.0918	0.0771
Term	**A1**	**A1**	**A1**	**A1**	**A1**	**A1**
e_j	0.7760	0.9004	0.6849	0.9574	0.8599	0.9590
ω_j	0.1275	0.0567	0.1794	0.0242	0.0798	0.0233

4.2. Calculating Close Degree

According to the TOPSIS method, the optimal solution $solu_j^+$ and the worst solution $solu_j^-$ for each risk assessment index were determined. The distance to the optimal solution D_i^+, the distance to the worst solution D_i^-, and the close degree C_i for each enterprise public opinion event were calculated. Some of the calculation results are shown in Table 5.

Table 5. Distance and the close degree to optimal and worst solutions.

Events	D_i^+	D_i^-	C_i
E1	0.0327	0.3201	0.9072
E2	0.2838	0.0755	0.2100
E3	0.1941	0.1843	0.4870
E4	0.2890	0.0671	0.1884
E5	0.2532	0.1133	0.3091

4.3. Calculating the Grey Relational Degree

According to the grey relational analysis method, the reference sequence of the data in this research was $X_0 = \{1, 1, \cdots, 1\}$,which indicated the sequence data with the highest risk level. The grey relational coefficient and grey relational degree calculated after the sequence construction of the enterprise public opinion data are shown in Tables 6 and 7.

Table 6. Grey relational coefficient of some enterprise public opinion events.

Events	A1	A2	B1	B2	B3	B4
E1	1	1	0.7939	1	1	1
E2	0.5045	0.6667	0.3387	0.4300	0.3496	0.3762
E3	0.7298	0.7272	1	0.4787	0.3998	0.4530
E4	0.5085	0.4364	0.3412	0.3637	0.4451	0.4267
E5	0.7688	0.5106	0.3593	0.5746	0.3744	0.4871
Events	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**
E1	1	1	1	0.3333	1	0.4742
E2	0.3395	0.5249	0.3573	0.4738	0.4008	0.6645
E3	0.5197	0.4185	0.3848	0.4898	0.5059	0.4926
E4	0.3509	0.4948	0.3418	0.7149	0.3499	0.5824
E5	0.3610	0.6985	0.3639	0.4861	0.4867	0.5478

Table 7. Grey relational degree of some enterprise public opinion events.

Events	E1	E2	E3	E4	E5
Grey relational degree	0.9433	0.4069	0.5534	0.3979	0.4579

4.4. Calculating Risk Degree

According to the formula for calculating the risk degree, the results of the risk degree were obtained, as shown in Table 8. It can be seen from Table 8 that the greatest risky enterprise public opinion event was E1: Pit Sauerkraut event with a risk degree of 0.9253. The least risky enterprise public opinion event was E12: MIXUE Ice Cream & Tea Changes Date of Expired Ingredients event, with a risk degree of 0.2325.

Table 8. Risk index results of enterprise public opinion events.

Events	C_i	γ_i	θ_i
E1	0.9072	0.9433	0.9253
E2	0.2100	0.4069	0.3085
E3	0.4870	0.5534	0.5202
E4	0.1884	0.3979	0.2932
E5	0.3091	0.4579	0.3835
E6	0.3978	0.5002	0.4490
E7	0.1937	0.3894	0.2916
E8	0.2126	0.4206	0.3166
E9	0.1766	0.3945	0.2856
E10	0.3673	0.4717	0.4195
E11	0.3240	0.4374	0.3807
E12	0.0989	0.3662	0.2325
E13	0.1926	0.3767	0.2846
E14	0.1556	0.3863	0.2710

4.5. FCM Fuzzy Clustering Results

In this study, we divided the risk assessment of enterprise public opinion into four levels. Therefore, four clustering centers were set up for clustering. The results are shown in Table 9. The four centers obtained from clustering were 0.2857, 0.3993, 0.5110, and 0.9252. The centers represented the average risk degree of each risk level.

Table 9. Level classification results of risk assessment and warning.

Risk Level	LV.3 Risk	Lv.2 Risk	Lv.2 Risk	Lv.0 Risk
Centers	0.2857	0.3993	0.5110	0.9252
Risk range	[0, 0.3425)	[0.3425, 0.4551)	[0.4551, 0.7181)	[0.7181, 1]
Warning level	slight	medium	high-risk	extremely dangerous

The four risk levels were named from smallest to largest as Level 3 (Lv.3) risk, Level 2 (Lv.2) risk, Level 1 (Lv.1) risk, and Level 0 (Lv.0) risk. This served as a warning to enterprise public opinion, including slight, medium, high-risk, and extremely dangerous situations. Managers should invest more resources to guide public opinion events with high risk levels.

The membership degree of some events to each cluster center is shown in Table 10. The membership degree represented the probability that an event belonged to different risk levels.

Table 10. Membership degrees of some events.

Events	0.2857	0.3993	0.5110	0.9252
E1	4.59×10^{-9}	6.78×10^{-9}	1.09×10^{-8}	0.9999
E2	0.9288	0.0583	0.0117	0.0013
E3	0.0015	0.0058	0.9921	0.0005
E4	0.9938	0.0049	0.0012	0.0001
E5	0.0248	0.9597	0.0146	0.0008
E6	0.0531	0.5722	0.3684	0.0062

The warning results of 14 enterprise public opinion events in this article are shown in Table 11. Among them, there were eight cases of a slight public opinion event, four cases of a medium public opinion event, one case of a high-risk public opinion event, and one case of an extremely dangerous public opinion event.

Table 11. Risk warning results of enterprise public opinion.

Warning Level	Slight	Medium	High-Risk	Extremely Dangerous
Events	E2, E4, E7, E8, E9, E12, E13, E14	E5, E6, E10, E11	E3	E1

5. Discussion

5.1. Analysis of Enterprise Public Opinion with Different Risk Levels and Strategies for Sustainable Development

The response strategies for guiding public opinion at different risk levels to assist enterprises in normal production, operation, and sustainable development are as follows:

The triggers for slight enterprise public opinion include plagiarism, double standards, rumors, and inappropriate words and actions. Consumer rights and interests are not substantially infringed upon. Slight enterprise public opinion only has issues with brand reputation. Therefore, the dissemination cycle of slight enterprise public opinion is relatively short, and the popularity is low. It would not cause repeated cross social media dissemination and harm to the sustainability of enterprise development. As can be seen from Figure 2, most risk indexes of slight enterprise public opinion were not prominent, and the overall score was low. However, netizens' denunciation of enterprises for the purpose of upholding social justice would still impact the reputation of enterprises. Response measures, such as telling the truth, eliminating misunderstandings, and calming consumers' emotions, were reflected in the handling of the Sudden Death of a PDD Employee and the Audi Advertisement Plagiarism, which achieved better results. It is worth noting that the MIXUE Ice Cream & Tea Changes Date of Expired Ingredients infringed on consumers' rights and interests but did not spread on a large scale and cause the situation to escalate. This was due to rapid and effective public relations measures.

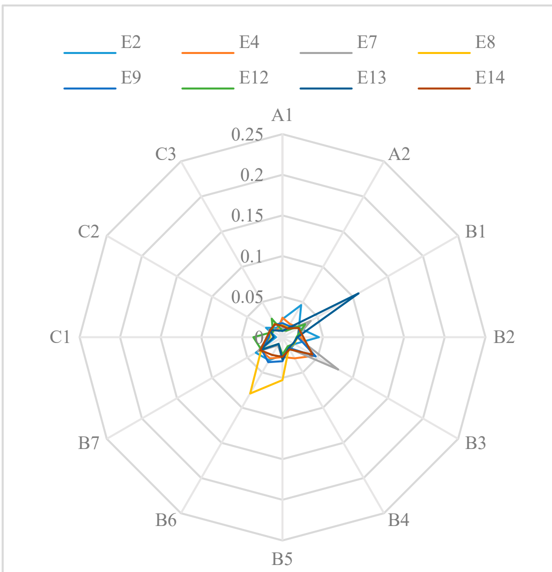

Figure 2. Index scores of slight enterprise public opinion.

From this, it can be seen that when dealing with slight enterprise public opinion, enterprises can best maintain their reputation by clarifying the facts and eliminating misunderstandings. Rapid and effective response measures can also keep an enterprise public opinion event within the lowest risk range, creating a favorable development environment and social response.

The triggers for medium enterprise public opinion include product quality issues, monopoly issues, etc. Consumer rights and interests are substantially infringed upon.

Medium enterprise public opinion spreads repeatedly across social media, with a long period of time and a high level of discussion heat. It has a moderate impact on the sustainability of enterprise development. As can be seen in Figure 3, medium enterprise public opinion had individual indexes with high scores, such as the number of forwards, comments, and recognition, which made the total risk level reach Lv.2. The triggers for E5 Zhangxiaoquan's Garlic Broken Knife Gate, E6 Tesla Accident in Chaozhou, and E10 CNKI Monopoly under investigation were product quality, public safety, and unfair competition. These events caused a substantial infringement of consumers' rights and interests and triggered heated discussions among netizens. All of the above three incidents were characterized by a long period of time and repeated cross media dissemination. Therefore, all of them reached medium enterprise public opinion. The Starbucks Drives Away Civilian Police was an enterprise public opinion event caused by service attitude problems. However, it continued to ferment into medium enterprise public opinion. The key was that the unique nature of civilian police stimulated a strong desire among netizens to uphold justice, resulting in offline confrontational behavior between netizens and the involved stores, which was not conducive to social stability.

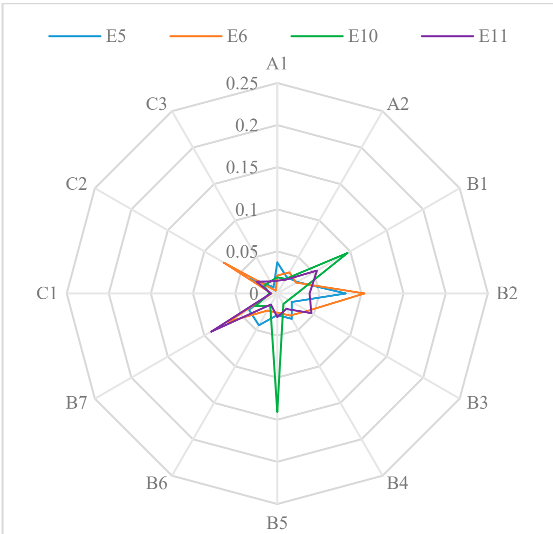

Figure 3. Index scores of medium enterprise public opinion.

When dealing with medium enterprise public opinion, enterprises should quickly take public relations actions. They should also pay attention to the derivative public opinion and prevent public opinion from spreading repeatedly across social media. At the same time, it is necessary to calm netizens' emotions and prevent antagonistic attitudes and behaviors between netizens and enterprises to avoid risk escalation. At this point, the media should extensively collect information from relevant parties to avoid one-sided and biased reporting. Creating a good social atmosphere is conducive to the high-quality development of enterprises.

High-risk enterprise public opinion is a more serious enterprise public opinion, which is fermented by medium enterprise public opinion. Netizens sharply criticize the enterprise on various social media platforms, which stimulates antagonistic attitudes between netizens and the enterprise. This leads to an escalation of risks, ultimately resulting in a public opinion disaster, which has a significant impact on the sustainability of enterprise development. As can be seen in Figure 4, high-risk enterprise public opinion had indexes with high scores, making the risk degree reach a high level. The E3 Zhongxuegao Doesn't Melt at High Temperature was triggered by product quality issues and subsequently led to derivative public opinion hotspots such as the "Ice Cream Assassin". Because it was in serious conflict with the enterprise image of Zhongxuegao, which was marketed on the basis of good raw materials and high cost, for consumers, "Zhongxuegao" became synonymous with "arrogance". False publicity became a psychological shadow that cannot be erased. Public opinion festered repeatedly across social media, causing serious impacts on enterprise operations. Netizens' opposition to the enterprise was the reason for the high score of B1. This kind of antagonistic behavior due to deception directly caused an escalation in risk, making the event reach high-risk enterprise public opinion.

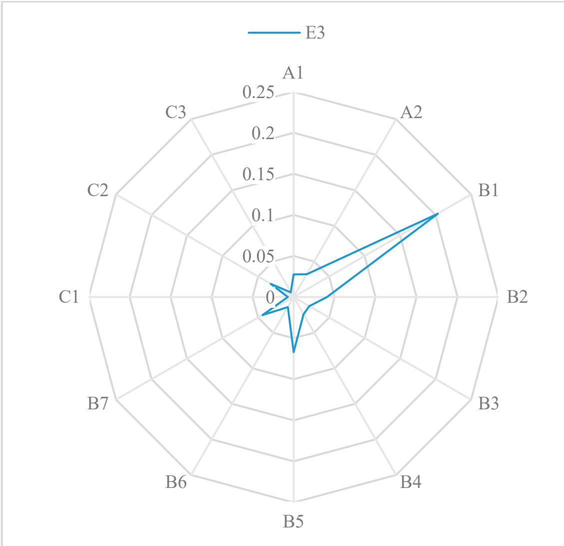

Figure 4. Index scores of high-risk enterprise public opinion.

It can be seen that when dealing with high-risk enterprise public opinion, enterprises need to apologize for the infringement of rights and interests caused, as well as monitor and guide derivative public opinion and public opinion tendencies. During this process, it is necessary to listen to the netizens' opinions extensively and release the corrective measures. Enterprise public relations should aim to reduce the adverse impact of the event while maintaining the enterprise reputation as much as possible. Media should objectively and accurately report on the statements and corrective measures issued by enterprises to assist in quelling high-risk enterprise public opinion. At this time, the platforms need to intervene and take on the responsibility of harmonious network public opinion and cautiously push unofficial and controversial information. All parties should maintain the balance of the network public opinion ecosystem to provide guarantees for the sustainable development of enterprises and social stability.

Extremely dangerous enterprise public opinion is the most serious enterprise public opinion, with the greatest scope of dissemination, heat of discussion, and impact on society and enterprises. It deprives the sustainability of enterprise development. Enterprises may face the situation of closure and rectification. As can be seen in Figure 5, the scores of some indexes were prominent. The Pit Sauerkraut event was exposed in the 3·15 broadcast, later reprinted by major media. The companies involved included instant noodle giants such as Master Kong and Uni-President, which ultimately became a catastrophic public opinion for the entire industry. The "jar sauerkraut" changed from a product-selling point to a risk point, which caused emotional confrontation between netizens, sauerkraut companies, and instant noodle companies and triggered an escalation of risk. The source of the public opinion event was authoritative media, so the score of views was as high as 0.23. It was an extremely dangerous enterprise public opinion that had been fermented by multiple channels across social media.

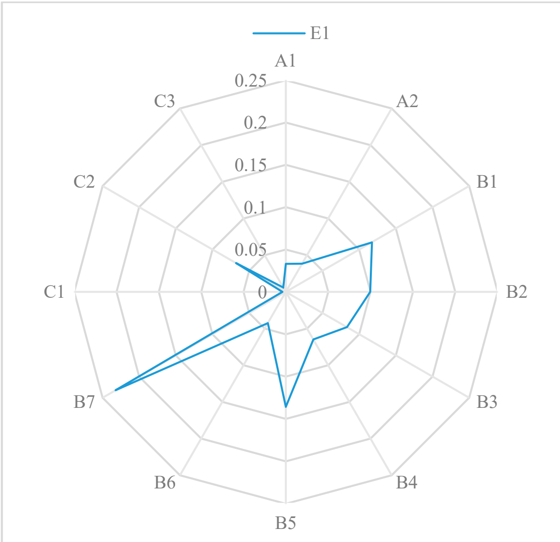

Figure 5. Index scores of extremely dangerous enterprise public opinion.

Enterprises should be cautious and maintain attention when dealing with extremely dangerous public opinion. Enterprises should also listen to opinions to prepare for rectification measures and publicly announce the progress of rectification in real time and transparently. The media not only needs to objectively and accurately report on the rectification process of enterprises but should also guide netizens to think rationally and reduce the degree of emotional opposition among netizens. When necessary, platforms and relevant government departments may take measures to control the spread of public opinion, review the sources of public opinion, and increase the exposure of official information. All measures are based on the principle of reducing the adverse effects of the event. Extremely dangerous enterprise public opinion is both a danger and an opportunity. All parties should work together to repair the network public opinion ecosystem, achieve the goal of turning danger into safety, and provide solid support for the sustainable development of enterprises and society.

Overall, enterprise public opinion with a high risk level has the following four risk points: (1) Infringement of consumer rights and interests. (2) Multiple rounds of derivative public opinion. (3) Emotional confrontation. (4) Multiple communication channels.

Based on the above four points, we summarized the key to the sustainable development of enterprises. Enterprises should address the issue of infringement on consumer rights, as it can attract consumer attention. Enterprises need effective public relations measures to prevent derivative public opinion. Enterprises and media should learn to appease and guide the emotions of netizens to prevent the escalation of public opinion risks. All public opinion entities, including enterprises, media, platforms, and governments, should control the channels of public opinion dissemination, especially opinion leaders and authoritative media. These key points need to be applied to the different risk levels mentioned above.

5.2. Analysis of Comparison with Existing Methods

We used the entropy method and rank–sum ratio (RSR) method [57] to validate the model proposed in this research. We used the RSR method to divide the samples into four levels. The R-squared of RSR model is 0.965.The analysis results are as follows:

From the ranking column in Table 12, it can be seen that the method proposed in this article was effective. There were six samples with completely correct rankings. There were four samples with almost no difference in rankings. Only four samples had slightly different rankings.

Table 12. RSR risk assessment and warning results.

Events	This Research		Entropy Method and RSR		
	Risk Degree	Ranking	Fitted Value	Ranking	Level
E1	0.9253	1	0.9058	1	4
E2	0.3085	8	0.5366	7	3
E3	0.5202	2	0.7837	2	3
E4	0.2932	9	0.4674	9	2
E5	0.3835	5	0.6108	5	3
E6	0.4490	3	0.6542	4	3
E7	0.2916	10	0.5020	8	2
E8	0.3166	7	0.3497	12	2
E9	0.2856	11	0.4316	10	2
E10	0.4195	4	0.5724	6	3
E11	0.3807	6	0.7072	3	3
E12	0.2325	14	0.2202	14	2
E13	0.2846	12	0.3931	11	2
E14	0.2710	13	0.2967	13	2

The RSR method evaluates the samples according to the rank of the original data. Therefore, it cannot consider the influence of the original data value on the sample. This will reduce the difference between the fitted values. In cases where there is a significant difference in the original data, the final evaluation and classification results will be affected. For example, the raw data in this study had a significant difference. The RSR method did not correctly classify events that should have been classified as the lowest risk, such as E2, E4, E7, E8, E9, E12, E13, and E14. This also had an impact on the assessment of public opinion at a medium risk level. The method we used can consider the difference in data values. Therefore, it is more accurate in cases where there is a large difference in the original data.

5.3. Analysis of Differences in Results between Single and Cross Social Media

In order to explore the development differences in enterprise public opinion between single social media and the cross social media context, we compared and analyzed the results of risk assessment and warning in different contexts.

By comparing the risk interval results in Figure 6 horizontally, it can be seen that the risk level intervals were divided differently in different contexts. The results of risk assessment and warning in the context of single social media cannot represent the development situation in a cross social media context. The analysis results of Weibo show that the Lv.1 risk public opinion was easy to exaggerate, and the Lv.2 risk public opinion was easy to ignore, which was not conducive to the judgement and management of medium-risk enterprise public opinion by public opinion managers. The analyses of Toutiao and Hupu show that the Lv.3 risk, Lv.2 risk, and Lv.1 risk cases of enterprise public opinion were easy to exaggerate, resulting in a waste of public relations resources.

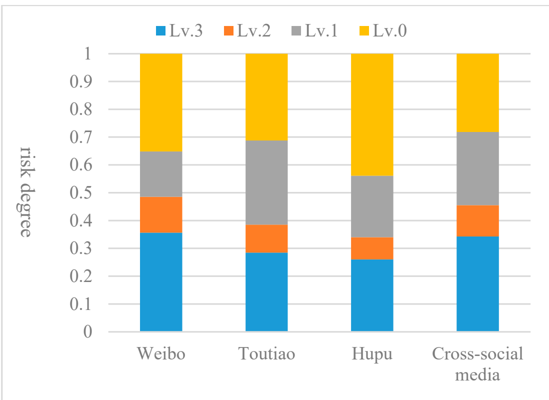

Figure 6. Comparison of risk levels in different contexts.

This shows that the classification of enterprise public opinion risk levels in the cross social media context is more reasonable, and the risk assessment and waring of enterprise public opinion are more accurate, which can help public opinion managers better coordinate resources to deal with different levels of enterprise public opinion.

As shown in Tables 13–15 below, users of different platforms have different characteristics and do not give the same feedback to the same events. This is the reason for the differences between the single social media context and cross social media context. Compared with the cross social media context, Weibo users were more concerned about E3 Zhongxuegao Doesn't Melt at High Temperature, E10 CNKI Monopoly under Investigation, and E4 Audi Advertisement Plagiarism. Among them, the Zhongxuegao Doesn't Melt at High Temperature event had the highest risk level. It can be seen that Weibo users are mainly young and energetic, willing to pay attention to monopoly, plagiarism, and other intellectual property opinions and have wider exposure to netroots products. Users of Toutiao preferred E5 Zhangxiaoquan's Garlic Broken Knife Gate, E6 Tesla Accident in Chaozhou. They were not very fond of Internet celebrity products or high-brand-effect products, so they paid less attention to E3 Zhongxuegao Doesn't Melt at High Temperature. Hupu community has columns for sports, entertainment, automobile, digital, stock, etc. Its users have obvious thematic preferences. E6 Tesla Accident in Chaozhou, E11 Starbucks Drives Away Civilian Police, and E2 Haitian Taste Double Standard generated a lot of topics in the automobile and stock columns, as they catered to the preferences of users. Users were keen on discussing and analyzing the above three public opinion events.

Table 13. Risk assessment and warning results of Weibo.

Risk Level	LV.3 Risk	Lv.2 Risk	Lv.1 Risk	Lv.0 Risk
Centers	0.3038	0.4094	0.5613	0.7351
Risk range	[0, 0.3566)	[0.3566, 0.4853)	[0.4853, 0.6482)	[0.6482, 1]
Events	E2, E7, E8, E9, E12, E13, E14	E4, E5, E6, E11	E10	E1, E3

Table 14. Risk assessment and warning results of Toutiao.

Risk Level	LV.3 Risk	Lv.2 Risk	Lv.1 Risk	Lv.0 Risk
Centers	0.2418	0.3272	0.4433	0.9320
Risk range	[0, 0.2845)	[0.2845, 0.3853)	[0.3853, 0.6877)	[0.6877, 1]
Events	E12, E13	E2, E3, E4, E7, E8, E9, E10, E11, E14	E5, E6	E1

Table 15. Risk assessment and warning results of Hupu.

Risk Level	LV.3 Risk	Lv.2 Risk	Lv.1 Risk	Lv.0 Risk
Centers	0.2205	0.3002	0.3800	0.7422
Risk range	[0, 0.2603)	[0.2603, 0.3401)	[0.3401, 0.5611)	[0.5611, 1]
Events	E4, E7, E8, E9, E10, E12, E13, E14	E5	E2, E3, E11	E1, E6

It can be concluded that the preferences of social media users would have a differential impact on the development of enterprise public opinion. Our methods were able to take this preference into account. When evaluating the risk of enterprise public opinion and formulating strategies, public opinion managers should not rely on the development of public opinion in a single social media platform. Only by taking the cross social media context into consideration can they accurately grasp the emotional attitudes of all netizens and, thus, help enterprises to smoothly overcome public opinion crises.

6. Conclusions

We established a risk assessment index system from the three aspects of breadth, heat, and netizen's emotion to measure the risk of enterprise public opinion. An enterprise public opinion risk assessment model was established by using a combination of the entropy method, TOPSIS, grey relational analysis, and Fuzzy C-means method.

6.1. Contributions

(1) This research proposed an effective method for assessing the risk of enterprise public opinion in a cross social media context. The fusion method of enterprise public opinion risk indexes proposed in this research can effectively fuse enterprise public opinion risk indexes in a cross social media context. Complemented by objective risk assessment methods, it can achieve better results of enterprise public opinion risk assessment in a cross social media context. Therefore, it can provide effective warnings to enterprise public opinion. For practitioners, our research provides a feasible approach to assess public opinion risk in a cross social media context. This approach considers the impact of user preferences on the development of public opinion and can provide a reference for risk fusion in a cross social media context.

(2) This research summarizes the external manifestations of enterprise public opinion with a high risk level. They usually infringe on consumer rights and may further develop emotional opposition. They also have broad communication channels and multiple rounds of derivative public opinion. Developing strategies based on the above four points is the key to achieving sustainable development. For practitioners, the above four points are not only beneficial for making preliminary judgments on public opinion risks but also the focus of public opinion management.

(3) This research confirms the feasibility and necessity of risk assessment of enterprise public opinion in a cross social media context. The preferences of social media users have a differentiated impact on the development of enterprise public opinion, so the analysis results of enterprise public opinion in a single social media platform cannot represent the development of enterprise public opinion on the whole Internet. For practitioners, formulating strategies should not only consider the development of public opinion in a single social media context. Only by taking the cross social media context into consideration can they accurately grasp the emotional attitudes of all netizens and help enterprises to smoothly overcome crises.

6.2. Significance

Our research is of great significance for assessing the risk of enterprise public opinion in a cross social media context. It not only considered the impact of user preferences on public opinion risk in a cross social media context. Based on the characteristics of enterprise public opinion, emotional divergence was also used to measure the degree of emotional confrontation among netizens. The effective combination of methods can also more accurately and objectively grasp the development of enterprise public opinion on the Internet. Our research also proposed some constructive suggestions, including measures to deal with public opinion at different risk levels and four key factors for managing enterprise public opinion risks. These suggestions can help enterprises manage reputation risks caused by public opinion and achieve sustainable development.

For society, managing enterprise public opinion risks helps to build a clear cyberspace. A harmonious public opinion environment can reduce the social amplification effect of risks and, thus, reduce secondary impacts. This is conducive to social stability. Social stability will ultimately benefit everyone in society.

6.3. Limitations

The sample size of this article was limited. Due to the wide variety of data on social media, including text, images, audio, and video, we only selected text data from social media as the source of information. Various language environments were not taken into account.

In the future, we need to expand the sample size. More information sources and heterogeneous multimodal information will be integrated. We will extend the method proposed in this article to different language environments.

Author Contributions: Y.S. described the proposed framework and revised the manuscript. S.B. collected data, implemented the experiments and wrote the manuscript. X.S. provided guidance on the theory. X.G. provided technical support for big data. All authors have read and agreed to the published version of the manuscript.

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