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Evaluation and Legal Compliance Framework Design of Public Safety Public Opinion Incident Response System Based on Hierarchical Analysis Approach

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ABSTRACT

With the development of the Internet, public safety public opinion events have gradually become an important part of social public opinion and an important content of government response. In order to establish a standard system for evaluating the response effectiveness of the public safety public opinion incident response system, this paper, in accordance with the current status of the government's public safety public opinion incident response system and the literature, selects four indicators, namely, serviceability, dynamics, timeliness and legitimacy, as the criterion layer of the evaluation system. Hierarchical analysis method and TOPSIS method are used to evaluate the public security public opinion incident response system. Finally, in order to verify the reasonableness of the AHP-TOPSIS method for evaluating the response effect of the public security public opinion event response system to public opinion events, 80 cases were selected, which were clustered and analyzed and the proximity scores between the samples and the positive ideal solutions were calculated, and the clustered samples were ranked to obtain the response effect ratings of the system to different events. The analysis of the data shows that timeliness has the most significant effect on the evaluation of the public security public opinion event response system, and the public security public opinion event response system responds best to government-led policy-oriented major public opinion events. The legal compliance framework can be constructed from three aspects: improving the existing laws and regulations on public security public opinion events, strictly enforcing the existing laws and regulations, and carrying out in-depth legal publicity, so as to lay the foundation for the implementation of the legal review work.

Keywords: Hierarchical Analysis, TOPSIS, Public Safety Public Opinion, Cluster Analysis

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1. Introduction

With the development of the Internet, online public opinion has gradually become an important part of social public opinion, which is fast, wide and interactive with the Internet as the medium [1-3]. The so-called public opinion refers to social public opinion, which includes at least three aspects of public sentiment, attitude, and opinion on public issues, and they often appear together in the expressive practices of Internet users [4-8]. The popularization of the Internet and the wide application of Web 2.0 technology have made it possible for people to obtain the information they need while at the same time posting and commenting on it in real time through various social platforms. While encouraging the Internet public to speak freely, the network will inevitably be filled with some negative or inaccurate information. Bad information surrounding some events may develop into public opinion if left unchecked, and if there are some highly influential accounts commenting and forwarding, public opinion will soon ferment rapidly [9-11]. If the relevant departments do not handle and respond in time to the public opinion and mediation pressure will grow, which may lead to a series of uncontrollable events [12-14]. Especially for public safety emergencies, if the control of public opinion is not timely, it is very likely to produce adverse social impacts, and may even pose a threat to people's lives and property safety [15-17]. Improving the effectiveness of the government's response to online public opinion in public safety incidents by evaluating the public opinion response system is important both for improving the government's management ability and public opinion control ability, and for enhancing the public's sense of security, happiness, and acquisition [18-22].

This paper constructs a set of evaluation index system of public security public opinion event response system with three levels by means of literature analysis and expert consultation method, applies hierarchical analysis method to assign weights to the evaluation index system, selects Q-type cluster analysis method to cluster different public opinion events, and then applies the weighted TOPSIS method to carry out empirical research on three major types of public opinion events after clustering. It reveals the response effect of the public security public opinion event response system on different types of public opinion events, and provides assistance to the current government's response management of public security public opinion events.

2. Evaluation index system for public security public opinion incident response system

2.1. Modeling

With the deepening of research related to government response, some scholars have begun to combine the study of responsive behavior with that of responsive government. Responsive government is a participatory government oriented to the interests of the public and realized through the interaction and cooperation between the government and the public. The general knowledge of scholars about the characteristics of responsive government mainly includes people-oriented, service-oriented, cooperative and shared governance, timely response and governance according to law. The government mainly improves its ability to respond to public opinion through timely warning, scientific analysis, proper handling and effective response to public opinion events. More attention should be paid to public opinion in response to emergencies, not only releasing authoritative information in a timely manner, but also evaluating the effectiveness of public opinion response work and establishing an accountability system. In this paper, according to the theory of responsive government and relevant policy requirements, we constructed a systematic response effectiveness evaluation model for online public opinion [23] as shown in Figure 1.

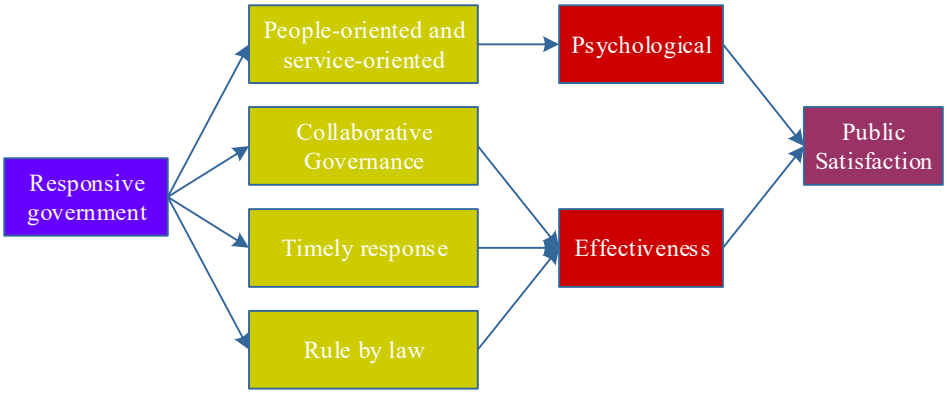

Fig. 1. Online public opinion response to the performance evaluation model

2.2. Construction of the indicator system

In accordance with the relevant policies of government response and the current situation of government response, this paper refers to the relevant literature and takes relevance, systematic, hierarchical and operability as the principles of the construction of the indicator system, and selects serviceability, dynamics, timeliness and legitimacy as the second-level indicators, and the dimensions are explained as follows.

Serviceability. According to the characteristics of responsive government which is people-oriented and service-oriented, serviceability is selected as one of the secondary indicators. The evaluation of serviceability mainly considers two aspects: first, the smoothness of communication with the public; and second, the attitude of government response.

Dynamicity. According to the characteristics of cooperative and shared governance of responsive government and the requirements of relevant policies, dynamism is selected as one of the secondary indicators. The evaluation of dynamism is mainly considered from two aspects: first, the ex ante warning; second, the ex post warning.

Timeliness. According to the characteristics of timely response of the responsive government and reading the relevant literature about the influence factors of government response, timeliness is identified as one of the secondary indicators. The evaluation of timeliness should mainly consider two aspects: first, whether the content of the response is effective; second, whether the response behavior works.

Legality. According to the characteristics of the responsive government's legal governance and the requirements of relevant policies, legality is taken as one of the secondary indicators. The evaluation of legitimacy should mainly consider two aspects: first, compliance with the law during the incident; and second, accountability after the incident.

The set of indicators for the effectiveness of government response to online public opinion on public safety incidents is shown in Table 1.

Table 1. Public security event network public opinion system response index

Primary indicator	Secondary indicator	Tertiary index
Public safety public opinion response system response	Service sex	Demand smooth
		Response speed
		Response attitude
	Dynamism	Advance warning
		Real-time warning
		Response frequency
	Timeliness	Information transparency
		Response timeliness
		Response accuracy
		Respond to authority
		Oemotropy
	Legitimacy	Law-abiding
		Postmortem
		Fairness

3. Hierarchical analysis-based systematic assessment methodology

3.1. Hierarchical Analysis

In the early 1970s, the hierarchical analysis method [24] (AHP) was proposed, which is a multi-level, multi-objective decision analysis method. Firstly, it establishes a multilevel structure, determines the relative importance of each element in the hierarchy by comparing two by two, and at the end gives the order of advantages and disadvantages of the alternatives through people's subjective judgment and scientific calculation. When using hierarchical analysis for decision-making, there are mainly the following steps:

1) Analyze and decompose the elements of complex problems and their interconnections to establish a hierarchical structure.

2) Compare the elements in the same level, and form a judgment matrix, which is a $[1,9]$ interval scale.

3) According to the judgment matrix, the weight of each element in the hierarchy can be calculated by a specific calculation method, which reflects the influence size of the element on the hierarchy.

4) Conduct consistency test on the judgment matrix, if it is satisfied, then determine the value of all element weights and sort, otherwise return to step 2 to modify the judgment matrix coefficients and then solve.

In the hierarchical analysis method, when the matrix order in the third order or more (including third-order matrix) is required to carry out consistency testing, consistency index is derived by calculating the random consistency index RI and consistency index CI. The stochastic consistency index is the arithmetic mean of a large number of random matrix eigenvalues calculated.

The first-order and second-order judgment matrices are considered to be in full consistency in the hierarchical analysis method, which only requires the division of importance between the indicators. When $N \geq 3$, the judgment matrix consistency index CI is calculated as:

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{1}$$

In Eq. (1), n is the order of the matrix and $\lambda_{\max}$ is the largest characteristic root under the current matrix. Consistency ratio CR is a measure of matrix consistency and represents the ratio of matrix consistency index CI to random consistency index RI.

$$CR = \frac{CI}{RI} \tag{2}$$

It is generally accepted that the matrix is considered consistent if CR is less than 0.1. Otherwise, the weights in the matrix need to be readjusted or the matrix needs to be reconstructed until the consistency requirement is satisfied. If the judgment matrix has full consistency, this means that the consistency index is equal to 0. So the following equation can be obtained:

$$\sum_{j=1}^{n} a_{ij}\omega_j = \sum_{j=1}^{n}\left(\omega_i / \omega_j\right)\omega_j = n\omega_i, (i = 1, \cdots, n) \tag{3}$$

$$\sum_{i=1}^{n}\left|\sum_{j=1}^{n}\left(a_{ij}w_j\right) - nw_i\right| = 0 \tag{4}$$

The value on the left side of Equation (3) reflects the consistency of the weight value ω_i with the judgment matrix A, the smaller the value is, the higher the consistency of the weight value with A. When Equation (3) is satisfied, the matrix A has full consistency. So the consistency test problem can be converted to the following nonlinear programming problem:

$$\begin{aligned} &\min CIF(n) = \sum_{i=1}^{n}\left|\sum_{j=1}^{n}\left(a_{ij}\omega_j\right) - n\omega_i\right| / n \\ &s.t.\ \sum_{j=1}^{n}\omega_j = 1\omega_j > 0, j = 1, 2, \cdots, n \end{aligned} \tag{5}$$

where, $\min CIF(n)$ is the consistency index, n is the number of elements of the matrix, a_{ij} is the element of the ith row and jth column of the matrix. ω_j and ω_i are the values of the jth and ith element weights, which can be used as optimization variables in the subsequent work. The basic procedure of the operation is to solve for the eigenvalues and the weight values of the indicators corresponding to the eigenvectors.

3.2. Steps in analyzing the TOPSIS method

TOPSIS method [25], also known as the distance between superior and inferior solutions method, also translated as the ideal distance method, is a multi-objective decision-making program analysis method, which first seeks a positive ideal solution and a negative ideal solution, and then calculates the degree of distance of the evaluation object from the sought ideal solution, in order to obtain the best decision-making target program of the evaluation object, the closer the evaluated object is to the positive ideal solution and the further it is from the negative ideal solution, the better the program is. The method does not have strict requirements for the data distribution of the sample and the capacity size of the sample, which can circumvent the human subjectivity of auditors in the audit risk evaluation of multiple construction projects. In this paper, we take the scoring data of experts on public works projects affecting the audit order as the object of TOPSIS analysis, which usually includes the following steps:

1) Homotrending the indicator data;

2) Compute the normalization matrix. Normalize the feature matrix to obtain the specification vector r_{ij} and construct the normalization matrix B with respect to the specification vector r_{ij}.

Normalize the sample data by sum of squares normalization (SSN) to solve the magnitude problem with Eq:

$$X\left(SSN\right)=X/Sqrt\left[Sum\left(X^2\right)\right] \tag{6}$$

3) Construct the weighted normalization matrix. Combine the weights of the indicators calculated by the hierarchical analysis method to derive the weighted data, and establish the weighted normalization matrix S about the weighted normalization value v_{ij} by calculating the weighted normalization value v_{ij}.

4) Determine the positive ideal solution and negative ideal solution. Determine the positive ideal solution V^+ and negative ideal solution V^- based on the weighted normalization value v_{ij}.

5) Calculate the distance of each evaluation object from the positive and negative ideal solutions D^+ and D^-, respectively, with the formula:

$$D^+=\sqrt{\sum_{j=1}^{m}\left(z_{ij}-S^+\right)^2}\,(i=1,2,\ldots\ldots,p) \tag{7}$$

$$D^-=\sqrt{\sum_{j=1}^{m}\left(z_{j}-S^-\right)^2}\,(i=1,2,\ldots\ldots,p) \tag{8}$$

6) Calculate the closeness of each evaluation objective to the ideal solution C_i, which is given by:

$$C_i=D_i^-\Big/\left(D_i^++D_i^-\right) \tag{9}$$

7) Analyze the influence size of each influence factor on the evaluation object based on the closeness.

4. Evaluation weighting results

The weights of the four levels of serviceability, dynamics, timeliness and legality and the 14 factor layers under them were judged to form four sets of judgment matrices. After the questionnaire on the evaluation weights of 15 experts on the evaluation factor indicators of the public security public opinion incident response system was recovered, the results were entered into the Yaahp10.3 software for consistency testing. Then Yaahp10.3 software was used to weight and average the result weights of each expert and calculate the weights of each indicator factor. The weight distribution of the evaluation indicators was finally obtained as shown in Table 2.

The highest weight among the 14 factor layers is the degree of public opinion control (C11), with a combined weight of 0.1987. The second is the fluency of the appeal (C1), with a combined weight of 0.1059. The lowest weight is the timeliness of response (C8), with a combined weight of 0.0330.

In Guideline Tier B, timeliness has the highest weighting of 0.3849. It is followed by serviceability, and the weight of the element is 0.2456. It can be concluded that the evaluation factor of timeliness has the greatest impact on the evaluation of public safety public opinion incident response systems, while serviceability is second and legitimacy is relatively low.

Table 2. Evaluation weighting

Target layer A	Criterion layer B	Weight	Factor layer C	Index weight	Sort	Index composite weight	Sort
Public safety public opinion response system	Service sex B1	0.2456	Demand smooth C1	0.4256	2	0.1059	2
			Response speed C2	0.3259	6	0.0754	4
			Response attitude C3	0.2485	8	0.0643	7
	Dynamism	0.2113	Advance warning C4	0.3156	7	0.0698	5

response (A)	B2		Real-time warning C5	0.4578	1	0.0921	3
			Response frequency C6	0.2266	10	0.0494	11
	Timeliness B3	0.3849	Information transparency C7	0.1690	11	0.0523	8
			Response timeliness C8	0.1452	14	0.0330	14
			Response accuracy C9	0.1624	12	0.0511	9
			Respond to authority C10	0.1577	13	0.0498	10
			Oemotropy C11	0.3657	4	0.1987	1
	Legitimacy B4	0.1582	Law-abiding C12	0.4156	3	0.0697	6
			Postmortem C13	0.2451	9	0.0396	13
			Fairness C14	0.3393	5	0.0489	12

5. Cluster analysis of major public security public opinion events

This paper focuses on cluster analysis of selected samples by using SPSS software. Cluster analysis is a multivariate statistical method designed to analyze the study sample. The software automatically categorizes the sample data based on the characteristics of the sample data, where the same class has similar or identical characteristics and the characteristics between different classes have different properties. The main objective of this section is to identify the types of relationships of major public opinion events in the era of big data, it is necessary to analyze the selected samples by clustering, so Q-type clustering is used, and the average distance between samples is calculated through the method of intergroup connection, and the Euclidean distance method is chosen to measure it. The clustering membership table is shown in Table 3, and the final analysis results are displayed in the cluster tree diagram, and the final analysis results are shown in Figure 2.

The basic idea of clustering is that each individual sample is first considered as a class and the distances between the samples as well as the distances between the classes are specified. Then the two closest classes are merged into a new class and the distance between the new class and the other classes is calculated; iterating this process until all cases are merged into one. The distance value of the top line indicates the distance between an individual and an individual. The 80 cases were clustered into 3 classes.

Table 3. Custer members

Case	Custer	Case	Custer
1	2	41	1
2	1	42	3
3	2	43	3
4	2	44	3
5	2	45	3
6	2	46	3
7	2	47	1
8	3	48	3
9	3	49	1
10	3	50	2
11	1	51	2
12	1	52	1
13	3	53	1
14	1	54	2
15	1	55	1
16	3	56	2
17	1	57	3
18	1	58	3
19	1	59	1
20	1	60	1
21	3	61	1
22	1	62	2
23	1	63	2
24	2	64	1
25	1	65	1
26	3	66	2
27	1	67	2
28	3	68	2
29	1	69	3
30	1	70	1
31	1	71	1
32	3	72	1
33	3	73	1
34	1	74	2
35	3	75	1
36	1	76	1
37	1	77	1
38	1	78	1
39	3	79	1
40	3	80	1

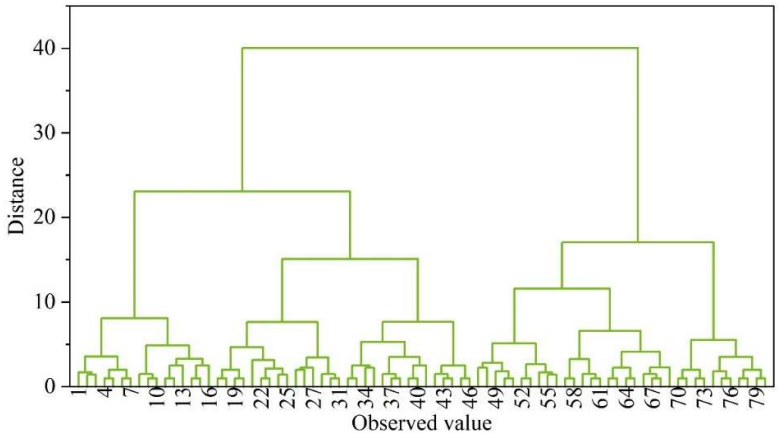

Fig. 2. Major public opinion events cluster analysis tree chart

Based on the clustering results and analyzing the common features exhibited by the five indicators, these samples can be classified into three classes, namely, citizen-led rights and interests maintenance, media-led value orientation, and government-led policy orientation. Combing the feature representation of each class, the description of each class relationship type is obtained. The results of the descriptions are shown in Table 4. It can be seen that the characteristics of different classes of events in the evolutionary process of public opinion have large differences.

The first category is the media-driven value-oriented major public opinion events. Value-oriented major public opinion events have little to do with citizens, but citizens are still eager to participate in them. This is because the public has broadened the channels for people to express their opinions, and citizens are becoming more and more concerned about social phenomena unique to the era of big data, and more and more aware that as a citizen, they have the right to participate in basic democratic politics, which covers not only the supervision of governmental behavior, but also the supervision of social morality, traditional beauty, and the development of the public opinion. This not only covers the supervision of governmental behavior, but also shows some positive values such as the promotion of social morality and traditional virtues, and the development of the spirit of courage and courageousness.

The second type of major public opinion events is citizen-led major public opinion events on protection of rights and interests. This type of major public opinion events has very different characteristics from the previous types. These events are closely related to the immediate interests of citizens, and citizens play a leading role throughout these events, mainly to protect their own rights and interests.

The third type is government-led policy-oriented major public opinion events. This type of incident is caused by the inadequacy or lack of existing laws, systems and social ethics. Although citizens have no direct interest in the incident, every citizen may encounter such a situation.

Table 4. Relational types of major public opinion events

Serial number	Relational type	Event
1	The value orientation of the media	1,3,4,5,6,7,24,50,51,54,56,62,63,66,67,68,74,81,87,89
2	The protection of the rights of the Internet users	2,11,12,14,15,17,18,19,2022,23,25,27,29,30,31,34,36,37,38,41,47,49,52,53,55,59,60,61,64,65,70,71,72,73,75,76,77,78,79,80
3	Policy oriented	8,9,10,13,16,21,26,28,32,33,35,39,40,42,43,45,46,48,57,58,69

6. Results of the TOPSIS analysis of evaluation indicators

The TOPSIS descriptive statistical results of the public safety public opinion event response system are shown in Table 5. According to the TOPSIS calculation and analysis results of the public safety public opinion event response system, the three clustered samples of significant public safety public opinion events are ranked, and the ranking results are shown in Table 6. From the weighted TOPSIS ranking results, the public opinion events of Cluster 3 and Cluster 2 ranked first and second respectively, and the public opinion events of Cluster 1 ranked third. This indicates that the public safety public opinion event response system is more effective in responding to government-led policy-oriented major public opinion events and citizen-led rights and interests protection major public opinion events than media-led value-oriented major public opinion events.

Table 5. TOPSIS describes statistics

Tertiary index	Sample size	Mean value	Standard deviation
Demand smooth	3	82.56	20.56
Response speed	3	85.89	5.89
Response attitude	3	77.48	7.85
Advance warning	3	86.79	4.21
Real-time warning	3	25.85	5.69
Response frequency	3	94.12	3.05
Information transparency	3	15.98	11.02
Response timeliness	3	89.56	15.12
Response accuracy	3	48.54	10.23
Respond to authority	3	78.51	16.21
Oemotropy	3	89.56	12.06
Law-abiding	3	84.21	13.45
Postmortem	3	65.12	14.15
Fairness	3	32.12	5.41

Table 6. TOPSIS evaluation sorting

Sample	The distance of the right point	The distance of the ideal solution	Relative approach	Sorting result
1	15.15	10.45	0.45	3
2	8.98	13.25	0.61	2
3	9.23	14.31	0.63	1

7. Legal compliance framework design

Formulating and improving laws and regulations to strengthen the guidance and supervision of Internet public opinion. Strengthening the guidance and supervision of Internet public opinion in accordance with the law is, first and foremost, to realize that there is a law to follow. By formulating and improving relevant laws and regulations, the reliability and completeness of the guidance and supervision of online public opinion is guaranteed at the source, and the guidance and supervision of online public opinion is given a support point under the rule of law. In view of the fact that China has not yet formulated a systematic and specialized law on network management, and the legislative system of network management is not yet perfect, it is recommended to formulate as soon as possible a Network Law as the “basic law” in the field of network regulation, so as to clarify the relationship of power and responsibility of various online actors, such as the network regulatory department,

network operators, network service providers, information providers, and netizens, and to establish a legal basis for the regulation of the network.

Strictly enforcing existing laws and regulations on guiding and regulating online public opinion. Law enforcement in the online virtual society is a new field and a new thing, and currently faces many problems, such as the inadequacy of law enforcement teams, the urgent need to improve the quality and capacity of law enforcement personnel, and the urgent need to explore and strengthen law enforcement procedures, platforms and means. In terms of the legal regulation of guiding and regulating online public opinion, there are both problems arising from the imperfection of the existing legal system and problems arising from the lax enforcement of existing laws. It can be said that the Internet is currently in a period of high public opinion, while the supervision of the Internet by the relevant departments is still in the initial stage, and the phenomena of non-compliance with the law, lax law enforcement, and difficulty in investigating violations of the law are still relatively prominent. Although some localities and departments are strengthening the guidance and supervision of online public opinion in accordance with the law, they are still not commensurate with the rapid development of computer and Internet technology, and there is a tendency to "formalize", "slogan", and "put into practice", resulting in some network chaos that is difficult to contain.

In-depth publicity and education on the legal system has been carried out to raise netizens' awareness of the rule of law. Internet users are the important main body of network public opinion guidance, and are the basic force for promoting the orderly operation of the network in accordance with the law. To this end, it is necessary to further strengthen the publicity of laws and regulations related to network regulation, carry out in-depth and sustained publicity and education activities on network management laws and regulations, enhance the legal awareness of netizens, vigorously advocate surfing the Internet in accordance with the law, civilized surfing the Internet, and guide netizens to correctly exercise their right to supervise public opinion on the Internet, so that network public opinion supervision can be effectively carried out within the boundaries of legitimacy. Full use is made of radio, television, newspapers, the Internet and other media to publicize network management laws and regulations, and attention is paid to popularizing knowledge of network management laws and regulations in legal literacy activities. Timely investigation, handling and disclosure of typical cases of online violations. Most of China's 500 million Internet users are young people, and publicity and education on network management laws and regulations should start with young people, so as to improve their legal literacy in the use of the Internet. Through multi-channel and multi-level dissemination of legal knowledge to Internet users, the building, use and protection of the Internet in accordance with the law has gradually taken root in people's minds, and a favorable atmosphere of learning, complying with, observing and using the law has been promoted on the Internet.

8. Conclusion

This paper uses hierarchical analysis to evaluate the response effectiveness of the public security incident online public opinion event response system, and makes a relevant design for the legal compliance framework.

At the criterion level, the most important factor is timeliness, with a weight of 0.3849, followed by serviceability and dynamism, and the weight of legality is relatively low, at 0.1582. At the factor level, the most important factor is public opinion control, and the least important factor is timeliness of response. It can be concluded that the evaluation factor of timeliness has the greatest influence on the evaluation of public security public opinion incident response system, which indicates that when facing public opinion incidents, the public wants the public security public opinion incident response system to have the ability to solve problems, and the public desires to accurately understand the truth.

From the ranking results of TOPSIS, the public safety public opinion event response system has the best effect on responding to government-led policy-oriented major public opinion events, the second

best effect on responding to citizen-led rights and interests protection major public opinion events, and the worse effect on responding to media-led value-oriented major public opinion events. Through a series of methods, the legal compliance of different categories of public opinion events is revealed.

Therefore, the public safety public opinion event response system should respond quickly when an online public opinion event occurs, and continuously send out the most authoritative, effective, and secure response on behalf of the government, so as to avoid deterioration of the public opinion situation caused by the public's listening to online rumors.

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