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Construction of a Framework for Response Assessment and Legal Compliance of Public Safety Public Opinion Events Based on Entropy Approach

Hongdian Ma^{1,*}

¹ Hunan International Economics University, Changsha, Hunan, 410205, China

Corresponding authors: (e-mail: mahongdian1986@126.com).

Abstract Internet public opinion triggered by public safety incidents, as an important content of government response, its response effectiveness profoundly affects the life of the public and the work of the government. In this paper, based on the online public opinion response ability of W Municipal Government on public security incidents, a set of government online public opinion response ability evaluation system consisting of 3 primary indicators and 12 secondary indicators is initially designed. And the index structure is reasonably modified by calculating and analyzing the principal components of each secondary index. Then the hierarchical analysis method is used to quantify the logic and association in the indicators into numerical values. Combining the hierarchical analysis method with the entropy value method, the AHP-entropy value method combining subjectivity and objectivity is formed to determine the weights of each indicator. Taking the trend of online public opinion in the viaduct collapse incident of City W as an experimental object, the evaluation system of governmental online public opinion response capacity is adopted to evaluate the online public opinion response performance of City W government. After calculation, the performance of Municipality W in the 10 secondary indicator dimensions is recognized by the public. It indicates that in the management of public safety online public opinion, the W municipal government has a relatively fast and reasonable response capability.

Index Terms public security incident, hierarchical analysis method, entropy value method, public opinion response ability

I. Introduction

With the development of the Internet, online public opinion has gradually become an important part of social public opinion, which is disseminated at a fast speed, wide range, and high interactivity with the Internet as the medium [1], [2]. In the era of big data, public safety public opinion incident response is an important element of government response and an important support for achieving social stability and orderly network participation [3]. On the one hand, it provides a platform for the public to discuss social policies, pay attention to social events, monitor government behavior, and realize their interests [4], [5]. On the other hand, improper network information dissemination also has the danger of jeopardizing social stability, affecting social harmony, reducing government credibility, and even evolving into network group events and public crisis events [6]-[8].

Based on this, modern governments must recognize the great influence of public opinion management on modern social governance, raise the awareness of crisis alertness, and regulate by constructing a network public opinion assessment mechanism in public security governance [9], [10]. The significance of the network public opinion assessment mechanism lies in early detection of crisis signs, assessing and judging the direction, scale, degree, and impact of possible real crises, and coordinating with all relevant functional departments as soon as possible to jointly prepare for the response to crises [11]-[13]. In addition, the corresponding laws and regulations for online public opinion management work are the action guide and legal basis for the online public opinion assessment system [14]. At the present stage, the lack of effective guidance and standardization of the assessment work has affected the efficiency of the practical operation of local governments at all levels [15]. Therefore, it is of great significance to construct and improve the legal system of network public opinion crisis early warning to safeguard the basic rights of citizens, social stability and national security.

This paper takes the W municipal government as the research object, analyzes its ability shown in online public opinion response, and combines with the existing research to initially propose the evaluation system of government online public opinion response ability. Then, the principal component factors in the secondary indicators are calculated, and the screening and modification of the indicators are carried out to determine the final structure of

the evaluation system of the government's ability to respond to online public opinion. Subsequently, the structure type and operation steps of hierarchical analysis method are discussed separately, and the AHP-entropy method is obtained by combining with the entropy value method, which is used to assign each index. Finally, a public safety online public opinion event in City W is used as an entry point to assess the online public opinion response capability of the City Government of W. The results of the assessment are summarized as follows. Combined with the evaluation results, the legal-oriented strategy of the government in public security public opinion response is proposed.

II. Evaluation Methods for Public Safety Public Opinion Incident Response

As a government department responds to public safety online public opinion events, the evaluation of its response effectiveness can be mapped to the evaluation of its performance in online public opinion response capability. Therefore, this chapter develops the construction of the evaluation system of the government's ability to respond to online public opinion, as well as the research and implementation of the indicator assignment, as an evaluation method for the response to public security public opinion events.

II. A. Screening and identification of indicators

On the basis of analyzing the composition of the online public opinion response capability of the W municipal government and referring to the existing literature, this study preliminarily constructs an evaluation index system, taking the online public opinion response capability of the W municipal government as the general target level, and (A) dynamic response capability, (B) channeling and coordination capability, and (C) overall control capability as the secondary target levels, and selecting (A1) response speed, (A2) response attitude, (A3) response level, (A4) number of responses, (B1) collaborative linkage, (B2) netizen participation, (B3) information disclosure, (B4) situational guidance, (B5) use of new media, (B6) netizen satisfaction, (C1) cycle of events, and (C2) accountability and recrimination. As an important subject of online public opinion, whether netizens can freely participate in the discussion of relevant events and express their own opinions also plays an important role in the government's effective channeling and coordination of online public opinion, and thus should be one of the evaluation indexes for measuring the government's ability to respond to online public opinion. The preliminary evaluation system of the government's ability to respond to online public opinion is shown in Table 1.

Table 1: Evaluation System for Online Public Opinion Response capabilities

Destination layer	Evaluation index layer
(A)Dynamic response capability	(A1)Response speed
	(A2)Response attitude
	(A3)Response level
	(A4)Frequency Response
(B)The ability to guide and coordinate	(B1)well-coordinated and inter-connected
	(B2)Civic Engagement
	(B3)disclose information
	(B4)Situation guidance
	(B5)The application of new media
	(B6)Netizen satisfaction
(C)Overall control ability	(C1)Accountability and pursuit of responsibility
	(C2)time of duration

The results of the principal component analysis of the 12 indicators are shown in Table 2, with (R1) total, (R2) percentage of variance, (R3) cumulative (%), and the rotated component matrix is shown in Table 3.

Table 2: Explanation of total variance

Initial eigenvalue			Extract the sum of the load squares			The sum of squared rotating loads		
R1	R2	R3	R1	R2	R3	R1	R2	R3
5.473	44.672	44.672	5.473	44.672	44.672	3.164	27.103	27.103
1.655	12.857	57.529	1.655	12.857	57.529	2.593	22.341	49.444
1.176	8.868	66.397	1.176	8.868	66.397	1.73	13.685	63.129
1.12	8.402	74.799	1.12	8.402	74.799	1.536	12.07	75.199
0.814	5.849	80.648						
0.671	4.659	85.307						
0.4	4.264	89.571						
0.244	2.968	92.539						
0.198	2.585	95.124						
0.176	2.396	97.52						
0.05	1.346	98.866						
0.024	1.134	100.00						

Table 3: The rotated component matrix

Index	Ingredient			
	1	2	3	4
(B5)	0.989	0.164	0.135	-0.16
(C2)	0.86	0.151	0.136	0.291
(B1)	0.819	0.172	0.122	0.303
(A3)	0.778	0.016	-0.089	0.405
(B2)	0.333	0.844	0.042	0.046
(B4)	0.134	0.772	0.12	0.435
(A4)	0.628	0.699	0.118	-0.013
(C1)	0.559	0.657	-0.063	-0.09
(A1)	0.308	0.132	0.752	0.248
(B3)	0.591	0.251	0.67	0.163
(A2)	0.299	-0.045	0.137	0.876

According to the analysis results, it can be seen that the cumulative contribution rate of the first, second, third and fourth principal components reaches 74.799%, so this study believes that the principal components with a cumulative contribution rate of 74.799% can basically cover the majority of the information of the original 12 indicators. Extracting the indicators that have a higher value of the components in the first four principal components as the final evaluation indicators. Through the rotated factor analysis, we can get the component matrix of each indicator after rotation, and make clear the value of the 12 indicators on each principal component, the higher the value of the component, the higher the contribution of the indicator to the principal component, and the more important it is for the evaluation results. Based on the consideration of screening strength and the amount of indicators, this study takes greater than 0.6 as the selection criterion, and finally determines (A3) number of responses, (C2) duration, (B1) departmental linkage, (B5) use of new media, (B3) disclosure of information, (B2) participation of netizens, (C1) accountability and pursuit of responsibility, (A3) response hierarchy, (B4) situational guidance, (A1) response speed, and (A2) response (A1) Response Speed and (A2) Response Attitude, a total of 11 indicators are the final evaluation indicators.

II. B. Methodology for the assignment of indicators

II. B. 1) Types of Hierarchical Analysis Structures

Based on the logical relationship of the elements of each level, the model of the hierarchical analysis method is usually divided into three levels. The goal is the highest level of the model, indicating the object that needs to be decided. Criteria are the influencing factors and judgment criteria to be considered, i.e., the intermediate links and constraints involved in choosing decision-making solutions in the actual problem. Scenarios are various comparison options for solving the target problem, etc.

In the hierarchical structure system, there are multiple elements in each level of the model schematic, and the logical relationships between the elements on the graph are connected by straight lines. When the individual

elements of the upper and lower levels are uniquely connected by a single line, and the individual elements of the same level have obvious differences and no logical relationship, the model of the independent structure system is usually used in Fig. 1; when the individual elements of the upper and lower levels are all connected, it means that each element is involved with the upstream and downstream, and the model of the correlation structure is usually used in Fig. 2; when the individual elements of the upper and lower levels are partially connected by the only single line, and partially connected, the features between the independent structure and the association structure, usually adopts the mixed structure model see Figure 3.

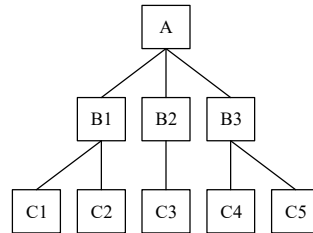


Figure 1: Independent structure model

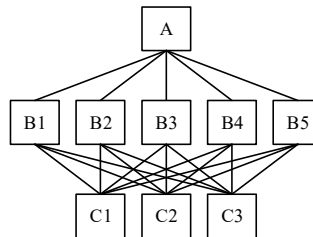


Figure 2: Associated structure model

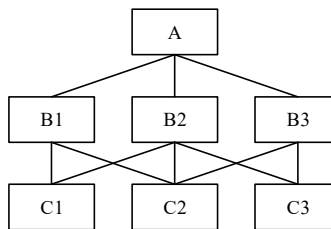


Figure 3: Hybrid structure model

II. B. 2) Hierarchical Analysis Main Steps

Hierarchical analysis method for program selection decision-making includes four steps.

- (1) Taking the problem to be solved and the decision-making goal as the guide, sorting out and analyzing the internal logic, defining the hierarchy and elements and constructing the model structure.
- (2) Compare individual elements with each other according to certain scales and rules to form a quantitative matrix.
- (3) Select a certain level, calculate the mathematical indexes of the elements in the matrix of the same level according to the logic rules of the upper and lower levels, and carry out tests.
- (4) Select the optimal solution by ranking the elements of the bottom level relative to the relevant parameters of the target problem according to the weights.

II. B. 3) Entropy method

Entropy value method is a method of analysis under objective conditions, which is now widely used in many fields such as social economy, science and technology and engineering practice. The entropy value method can minimize the subjective influence of the weights of the factors on the evaluation results and make them more in line with the objective reality.

- (1) Construct judgment matrix

Based on the information data provided, the judgment matrix of m programs n evaluation indicators is constructed as equation (1).

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1m} \\ \vdots & & \vdots \\ x_{n1} & \cdots & x_{nm} \end{bmatrix} \quad (1)$$

(2) Data standardization

The polar value method is used to standardize the original data. Among them, equation (2) is used to deal with positive indicators, and equation (3) is used to deal with negative indicators, and finally get the standardized matrix that has eliminated the differences in the unit of measurement of each indicator.

$$r_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \quad (2)$$

$$r_{ij} = \frac{\max(x_{ij}) - x_{ij}}{\max(x_{ij}) - \min(x_{ij})} \quad (3)$$

where, x_{ij} represents the first j indicator value of the first i sample ($i=1,2,\dots,m; j=1,2,\dots,n$), r_{ij} is the standardized data. In order to avoid the existence of lower values or even negative values of some of the data after the standardization process, and thus the uniform translation of its processing as in equation.

$$r'_{ij} = r_{ij} + H \quad (4)$$

where H is the magnitude of the indicator panning, generally taken as 0.01.

(3) Determine the entropy value of the evaluation indicators

a) The normalization matrix is normalized as in equation

$$p_{ij} = \frac{r'_{ij}}{\sum_{i=1}^m r'_{ij}} \quad (5)$$

b) Calculate the information entropy value e_j of the j th evaluation index as in equation.

$$e_j = -\frac{\sum_{i=1}^m p_{ij} \ln(p_{ij})}{\ln m} \quad (6)$$

c) Calculate the coefficient of variation g_j for indicator j as in equation

$$g_j = 1 - e_j \quad (7)$$

d) Calculate the weight of the j th indicator as v_j as in equation

$$v_j = \frac{g_j}{\sum_{j=1}^n g_j} \quad (8)$$

II. B. 4) AHP-entropy method

AHP-entropy value method refers to the use of hierarchical analysis and entropy value method to assign subjective and objective weights to the indicators, and combine the two weights to get more reasonable and objective indicator weights. This method can not only weaken the influence of some subjective factors on the assignment of hierarchical analysis, but also weaken the bias of objective assignment caused by the large differences in the original data information. In order to make the weights of indicators more accurate and scientific, formula (9) is used to calculate the combined weights of evaluation indicators.

$$w_j^* = \frac{w_j v_j}{\sum w_j v_j} \quad (9)$$

where w_j is the weight of the hierarchical analysis method and v_j is the weight of the entropy method.

II. C. Assignment of weights to indicators

After processing the data of the urban areas of the W municipal government through the AHP-entropy method, the weights of the indicators are shown in Table 4.

Table 4: Evaluate the index weights of the system

Index	Comprehensive weight value	Sort	Index	Comprehensive weight value	Sort
(A)	41.25%	1	(A1)	5.224%	10
			(A2)	8.518%	6
			(A3)	5.653%	9
			(A4)	1.515%	11
(B)	36.45%	2	(B1)	9.531%	4
			(B2)	15.981%	1
			(B3)	9.474%	5
			(B4)	8.502%	7
			(B5)	6.989%	8
(C)	22.30%	3	(C1)	14.036%	3
			(C2)	14.577%	2

III. Example Analysis of Government's Online Public Opinion Response Capability

This chapter takes the viaduct collapse incident in City W as a study case, and adopts the evaluation system of governmental online public opinion response capability proposed above to assess the response performance of the City Government of W on online public opinion. Combined with the evaluation results, suggestions for coping strategies are made from the perspective of laws and regulations.

III. A. Analysis of Online Public Opinion on the Viaduct Collapse Incident in W City

On December 12, 2022, at about 5:55 p.m., a bridge spanning a district in W City suddenly collapsed, and five small cars under the bridge were instantly crushed. By the time search and rescue teams arrived to rescue them, the accident had already resulted in three deaths and four injuries.

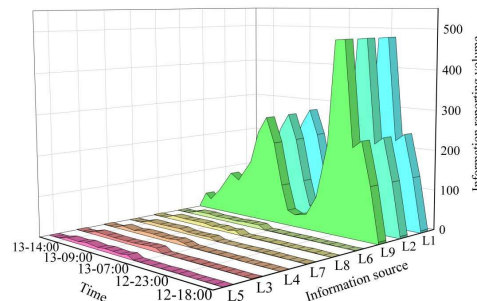


Figure 4: The trend of overall information reporting volume

The incident was then labeled as “W City Viaduct Collapse”, and the online public opinion rapidly heated up across the Internet, peaking at 20:00~24:00 on the evening of the 12th, and then showing a downward trend. Public opinion heated up again at 7:00-9:00 p.m. on the 13th, when the official microblog of the city of W reported the status of the accident for the first time. The trend of the amount of information coverage about this incident is shown in Figure 4, and the selected sources of information are (L1) microblogs, (L2) WeChat, (L3) forums, (L4) blogs, (L5) newspapers and magazines, (L6) clients, (L7) government affairs, (L8) websites, and (L9) videos.

In this public opinion event, (L1) microblogging became the largest public opinion forum for the media and the public to pay attention to and discuss the truth of the event, and it can be found that its information source accounted for as high as 90.41%. The percentage of major information sources is shown in Figure 5.

III. B. Fuzzy Comprehensive Assessment Process of Government's Online Public Opinion Response Capability

Based on the evaluation system of the government's online public opinion response capacity proposed above, questionnaires on the evaluation of the government's online public opinion response capacity in W city government

are designed. The content of these questionnaires mainly evaluates the situation of 11 secondary indicators, and the evaluation options include five levels: (Y5) very poor performance, (Y5) poor performance, (Y5) average performance, (Y5) good performance and (Y5) very good performance. A total of 324 questionnaires were distributed to the Internet users in W city through online, and 300 valid questionnaires were recovered, with a validity rate of 92.59%. The number of comments for each level of indicators was meticulously categorized and summarized, thus obtaining the distribution of comments for the second-level indicators as shown in Table 5.

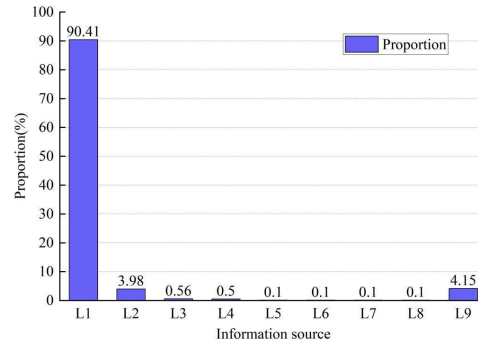


Figure 5: Proportion of information sources

Table 5: Summary of the number of comments for secondary indicators

Index	S5	S4	S3	S2	S1
(A1)	9	22	76	139	54
(A2)	6	22	128	121	23
(A3)	9	26	99	123	43
(A4)	12	20	91	125	52
(B1)	9	16	90	134	51
(B2)	5	16	107	135	37
(B3)	23	16	88	121	52
(B4)	11	28	98	137	26
(B5)	8	29	89	118	56
(C1)	2	18	105	143	32
(C2)	7	84	101	58	50

Organize the questionnaire data to get the total number of respondents' comments on the secondary indicators, and normalize them on this basis. Normalization is to divide the number of comments obtained for each indicator by the total number of valid questionnaires, and the result obtained after calculation is the affiliation data of the secondary indicators. After integration, the results of the affiliation degree of the second-level indicators are shown in Table 6.

Table 6: Secondary indicator membership degree

Index	S5	S4	S3	S2	S1
(A1)	0.0300	0.0733	0.2533	0.4633	0.1800
(A2)	0.0200	0.0733	0.4267	0.4033	0.0767
(A3)	0.0300	0.0867	0.3300	0.4100	0.1433
(A4)	0.0400	0.0667	0.3033	0.4167	0.1733
(B1)	0.0300	0.0533	0.3000	0.4467	0.1700
(B2)	0.0167	0.0533	0.3567	0.4500	0.1233
(B3)	0.0767	0.0533	0.2933	0.4033	0.1733
(B4)	0.0367	0.0933	0.3267	0.4567	0.0867
(B5)	0.0267	0.0967	0.2967	0.3933	0.1867
(C1)	0.0067	0.0600	0.3500	0.4767	0.1067
(C2)	0.0233	0.2800	0.3367	0.1933	0.1667

The fuzzy comprehensive evaluation of the second-level indicators needs to be based on the principle of maximum affiliation, the so-called principle of maximum affiliation is that among the affiliations of the evaluation indicators, the one with the largest value is the evaluation grade of the indicator. In this way, the evaluation of the government's ability to respond to online public opinion in the second-level indicators can be obtained. Then, formula (10) is applied to calculate the corresponding specific rating of each indicator.

$$S = T \times N^T \quad (10)$$

After calculating the scores for each evaluation indicator, it can be noticed that the differences in scores between these indicators are not significant. If the scoring results are categorized according to the scoring results, then all the scoring results can be described as general. In order to better distinguish between different evaluation results, this paper gives the corresponding score standard and uses it as a criterion for judging. The results of scoring from 0-3 are described as biased towards poor (Z1), 3-5 as general performance (Z2), and 5-8 as biased towards good (Z3). The evaluation results of the secondary indicators of W municipal government are shown in Table 7.

Table 7: Evaluation results of secondary indicators

Index	Evaluation result	Score	Index	Evaluation result	Score
(A1)	Z3	6.5090	(B3)	Z2	4.0239
(A2)	Z2	4.8653	(B4)	Z3	6.1792
(A3)	Z2	4.2501	(B5)	Z2	3.7066
(A4)	Z2	4.4879	(C1)	Z3	7.2292
(B1)	Z3	5.7088	(C2)	Z1	2.2970
(B2)	Z3	5.8603			

According to the results of the secondary indicators, it can be found that the number of indicators with a score of "favor" is consistent with the number of indicators with "average performance", with a total of 5. Among them, there are five indicators of "good bias", including (A1) response speed, (B1), departmental linkage, (B2) netizen participation, (B4) situation guidance and (C1) netizen satisfaction, and the indicators of "average performance" include (A2) response attitude, (A3) response level, (A4) response frequency, (B3) information disclosure and (B5) new media use. The only indicator of "poor bias" is (C2) accountability. In general, the evaluation results of the secondary indicators are relatively positive, indicating that the government's response has been recognized in the governance of online public opinion.

III. C. Legal Orientation Strategies for Public Security Public Opinion Response

The continuous expansion and growth of network scale makes its influence on social governance cannot be underestimated. Therefore, the management of public security incidents on the Internet has become a topic and task that needs to be actively dealt with by local government departments. Combined with the above analysis, this section puts forward the following three suggestions for local government departments to deal with public security public opinion from the perspective of legal strategy:

(1) Actively carry out publicity activities to guide netizens to surf the Internet correctly. Local government departments can publicize the idea that "the Internet is not a place outside the law" through activities such as "Internet Safety Publicity Month" and "Initiative for Proper Use of the Internet". Make clear the responsibility and consequences of false speech and other illegal acts, so that people deeply realize that even political activities in the virtual space can not harm the interests of the state and society, and must be responsible for their own words and deeds.

(2) Strengthening the regulation of the self-media industry and guiding its standardized, orderly and healthy development. In terms of policies and regulations, further refine the introduction of laws and regulations for the healthy development of the self-media industry, administrative guidance, etc., so that the development of self-media have rules to follow. At the same time, in the market management, strengthen the management constraints on the self-media platform companies, strengthen the content audit of media platforms, and urge them to control the negative information in a timely manner. In law enforcement management, crack down on the dissemination of false content and harmful information for personal gain.

(3) Create a positive legal environment. Incorporate the emergency management of online public opinion in public security incidents into emergency laws and regulations, and upgrade the legal level of online public opinion management. Define relevant concepts scientifically and refine the legal guidelines to create an excellent legal environment for the management of online public opinion in public security incidents.

IV. Conclusion

Based on the actual performance of the government in responding to public security public opinion, this paper constructs a set of evaluation system for the government's ability to respond to online public opinion in accordance with the actual performance of the government in responding to public security public opinion, from the three levels of dynamic response ability, channeling and coordinating ability, and overall control ability. By integrating the hierarchical analysis method and the entropy value method, the weights of each index of the evaluation system are determined objectively and reasonably.

Taking the viaduct collapse incident in City W as a case study, based on the designed evaluation system of government's online public opinion response capability, the fuzzy comprehensive evaluation method is used to analyze the response performance of City W's public security public opinion incident. Its scores in multiple dimensions of the evaluation system are all 5.00 and above, and its performance is only slightly worse in "accountability". This indicates that Municipality W has performed well in managing the online public opinion of this public safety incident, and has been recognized by the general public. Combining the research content and case study results, it is recommended that local government departments take measures to actively conduct publicity campaigns, strengthen the regulation of the self-media industry, and create a positive legal environment. Through these measures, a legal compliance framework for online public opinion is constructed to promote effective governance of online public opinion on public safety incidents.

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