RESEARCH-ARTICLE

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Research on the Influencing Factors of Online Public Opinion Information Dissemination in the Era of Artificial Intelligence

Lei Ye*
School of Business Administration
Wuhan Business University
Wuhan, Hubei Province, China
lingfeiyu-816@wbu.edu.cn

Yuqing Hu
School of Business Administration
Wuhan Business University
Wuhan, Hubei Province, China
960306122@qq.com

Siyu An*
School of Economics and Management
North China University of Water Resources and Electric Power
Zhengzhou, Henan Province, China
Z20251070694@stu.ncwu.edu.cn

Abstract

In the era of artificial intelligence, the occurrence and governance of online public opinion events are closely related to artificial intelligence technology. Firstly, this paper comprehensively and effectively identifies the influencing factors of online public opinion dissemination in the artificial intelligence environment from four aspects which contain audience, relevant management departments, online public opinion information platforms, and online public opinion events, and establishes a system of 17 influencing factor indicators. Secondly, the Decision Laboratory Method (DEMATEL) is used to analyze the relationship between the influencing factors of online public opinion dissemination and identify the important factors that affect online public opinion events. On the basis of DEMATEL, the Interpretative Structural Modeling (ISM) is introduced to analyze the influence relationships among the influencing factors at different levels. Finally, based on the research results, it is proposed to focus on the root-level factors and put forward optimization strategies, that is, relevant management departments need to use artificial intelligence technology to efficiently govern online public opinion, increase the public's knowledge accumulation of artificial intelligence technology, and actively play the positive role of online public opinion information platforms.

CCS Concepts

• **Information systems**; • **Information systems applications**; • **Computing platforms**;

Keywords

Artificial Intelligence, Online Public Opinion, DEMATEL, ISM

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*Corresponding author.

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1 Introduction

In the era of artificial intelligence, incidents such as the fabrication of false statements using AI technology have emerged one after another, leading to the occurrence of online public opinion events and drawing extensive attention and discussion from all sectors of society. In the process of handling online public opinion incidents, it is very important to guide online public opinion correctly. Online public opinion may have a significant negative impact on society. If public opinion governance does not achieve good results, it may cause social public opinion to spiral out of control, thereby affecting social stability. Uncontrolled public opinion can exacerbate social conflicts and even trigger mass incidents. Therefore, it is of great significance to conduct in-depth research on the factors that affect the dissemination of public opinion information in network public opinion events under the environment of artificial intelligence, analyze the interaction between various influencing factors, and find scientific methods for network public opinion governance.

2 Screening of factors influencing the dissemination of online public opinion information

In order to screen the influencing factors of online public opinion information dissemination, the author sorted out relevant literature on online public opinion. Zhao Lexin divides the influencing factors of online public opinion into four categories which include netizens, media, government, and events[1]. Zhang Yiting believes that the evolution of online public opinion is mainly influenced by the subject, object, trigger, and carrier of public opinion[2]. Chen Ting explores the impact of different entities on the dissemination of online public opinion from three aspects which include netizens, media, and government[3]. Therefore, 17 factors affecting the dissemination of online public opinion information have been summarized and divided into four dimensions which contain audience, relevant management departments, online public opinion information platforms, and online public opinion events. The specific situation is shown in Table 1.

3 Construction of DEMATEL-ISM analysis model

The DEMATEL-ISM method consists of two parts which contain the decision laboratory method and the explanatory structural model. The decision laboratory method is used to study the interactions

Table 1: Factors Affecting the Dissemination of Online Public Opinion Information

Dimension	Factor	Symbol	Definition of factor
Netizen	attention of netizens	A1	attention of netizens to online public opinion events
	discussion among netizens	A2	discussion among netizens on online public opinion events
	the amount of public opinion information released by netizens	A3	the amount of netizens forwarding and commenting on public opinion information
	the skeptical attitude of netizens	A4	the skeptical attitude of netizens towards the handling results of online public opinion events
	the opposition of viewpoints	A5	the opposing attitudes of netizens towards the discussion of online public opinion events
Related management departments	the attention of relevant management departments	A6	the attention of relevant management departments to online public opinion events
	the amount of public opinion information released by relevant administrative departments	A7	the amount of relevant reports and comments on online public opinion events by online public opinion information platforms
	the response speed of relevant administrative departments to online public opinion events	A8	the speed at which relevant management departments utilize artificial intelligence technology to handle online public opinion events
	the ability of relevant management departments to respond to public opinion events	A9	the ability of relevant management departments to use artificial intelligence technology to handle online public opinion events
	credibility of relevant management departments	A10	the trust of netizens in the handling results of relevant management departments
	disclosure of public opinion information by relevant management departments	A11	the information disclosure of the results of handling online public opinion events by relevant administrative departments
Online public opinion information platform	attention of online public opinion information platform	A12	the attention of online public opinion information platforms to online public opinion events
	the quantity of information released by online public opinion information platforms	A13	the number of relevant reports and comments on online public opinion events by online public opinion information platforms
	the attitude tendency of online public opinion information platforms	A14	the emotional attitude held by online public opinion information platforms towards online public opinion events
	the influence of the online public opinion information platform	A15	the quantity of audiences owned by the online public opinion information platform
Online public opinion events	the destructive power of online public opinion events	A16	the degree of harm caused by online public opinion events
	duration of exposure of online public opinion events	A17	duration of popularity of online public opinion events

between various factors in a system, in order to solve complex real-world problems. Explanatory structural modeling is an effective method for modeling complex problems, which can represent the relationships and influence relationships between various elements in a system described by a directed graph based on graph theory.

Based on 17 factors affecting the dissemination of online public opinion information, the author constructs a DEMATEL-ISM model of the influencing factors. Firstly, distribute survey questionnaires to experts to determine the direct impact matrix. Secondly, using the DEMATEL method to analyze the importance of factors influencing the dissemination of online public opinion. Furthermore, using the ISM method to construct a multi-layer hierarchical structure model. Finally, a comprehensive analysis of the DEMATEL-ISM model is conducted.

3.1 DEMATEL-ISM analysis model construction

The steps for establishing the DEMATEL-ISM model constructed in this article are as follows.

The first step is to determine the influencing factor indicators for the study and obtain a direct impact matrix. Firstly, the 17 factors influencing the dissemination of online public opinion information are grouped into a set of influencing factors, namely. Secondly,

Table 2: Criteria for Experts to Evaluate the Influencing Factors of Public Opinion Information

impact level	no effect	weak	general	strong	very strong
corresponding score	0	1	2	3	4

invite experts to compare the degree of influence between factors pairwise, and the criteria for experts to evaluate the degree of influence between factors are shown in Table 2.

Based on the initial data scored by experts, the author calculated an n × n direct impact matrix, called X. Among them, a_{ij} represents the impact of element i on element j.

$$X = \begin{bmatrix} a_{11} & \cdots & a_{1j} & \cdots & a_{1n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{1i} & \cdots & a_{ij} & \cdots & a_{in} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{1n} & \cdots & a_{nj} & \cdots & a_{nn} \end{bmatrix} \tag{1}$$

The second step is to normalize the direct impact matrix X, and the author calculates the standard direct impact matrix Y. The calculation formula for the standard direct impact matrix Y is as follows.

$$Y = \left(\frac{a_{ij}}{max\left(\sum_{j=1}^{n} a_{ij}\right)} \right)_{n \times n} \tag{2}$$

The third step is to process the standard direct impact matrix Y, and the author calculates the comprehensive impact matrix Z. The calculation formula for the comprehensive impact matrix Z is as follows.

$$Z = Y(I - Y)^{-1} \tag{3}$$

Among them, I is the identity matrix.

The fourth step is to calculate the influence degree B, affected degreeC, centrality degree D, and causality degree E of each influencing factor based on the previous calculation results. Among them, the influence degree B of the influencing factor refers to the sum of the values of each row element in the comprehensive influence matrix Z of the influencing factor, representing the comprehensive influence value of each influencing factor on other influencing factors. The calculation formula for the degree of influence B of influencing factors is as follows.

$$B_i = \sum_{j=1}^{n} z_{ij} \ (i = 1, 2, 3, \ldots, n) \tag{4}$$

The degree of influence C of the influencing factors refers to the sum of the values of each column element in the comprehensive influence matrix Z of the influencing factors, representing the comprehensive value of each influencing factor influenced by other influencing factors. The calculation formula for the degree of influence C of the influencing factors is as follows.

$$C_i = \sum_{j=1}^{n} z_{ji} \ (i = 1, 2, 3 \ldots n) \tag{5}$$

The centrality D_i of influencing factor i refers to the result obtained by subtracting the value of the affected degree of each influencing factor from the value of the affected degree of each influencing factor. The centrality D_i of influencing factor i represents its important position in the entire concentration of influencing factors. The calculation formula for the centrality D_i of influencing factor i is as follows.

$$D_i = B_i + C_i \tag{6}$$

The causal degree E_i of influencing factor i refers to the value obtained by subtracting the degree of influence of influencing factor i from the degree of influence of influencing factor i . The calculation formula for the causal degree E_i of influencing factor i is as follows.

$$E_i = B_i - C_i \tag{7}$$

The fifth step is to calculate the overall impact matrix M, and the calculation formula is as follows.

$$M = I + Z \tag{8}$$

Among them, I is the identity matrix.

The sixth step is to calculate the reachable matrix N of the influencing factors. In the reachable matrix N of the influencing factors, N_{ij} represents the numerical value of the degree of influence of the influencing factor i on the influencing factor j. When N=1, it indicates that there is a direct relationship between the influencing factor i and the influencing factor j. When N=0, it indicates that the influencing factor i has no direct impact on the influencing factor j. The calculation formula for the reachable matrix N of influencing factors is as follows.

$$N_{ij} = \begin{cases} 1, M_{ij} \geq \lambda \\ 0, M_{ij} < \lambda \end{cases} \tag{9}$$

Among them, M_{ij} represents the factor values in the overall impact matrix. The threshold λ in this paper is the sum of the average and variance of all items in the composite matrix Z.

The seventh step is to divide the hierarchical structure of influencing factors and construct a multi-level explanatory structure model.

3.2 Results and Analysis of DEMATEL-ISM

Create a survey questionnaire on the influencing factors of online public opinion information dissemination according to step one, and invite 9 experts to fill out the questionnaire. By using the averaging method, establish a direct impact matrix X. Normalize the direct impact matrix X of the influencing factors of online public opinion information dissemination to obtain the standardized direct impact matrix Y of the influencing factors.

Calculate the comprehensive impact matrix Z according to formula (3).

According to formulas (4), (5), (6), and (7), the values of the influence degree B, affected degree C, centrality degree D, and

Table 3: DEMATEL Analysis of Factors Influencing the Dissemination of Online Public Opinion Information

	the degree of influence	the degree of affected influence	the degree of centrality	the degree of cause
A1	8.72	9.16	17.88	-0.45
A2	8.59	9.19	17.78	-0.60
A3	8.79	8.81	17.60	-0.02
A4	6.11	6.68	12.79	-0.57
A5	5.17	4.97	10.13	0.20
A6	8.62	8.94	17.56	-0.31
A7	8.04	8.01	16.04	0.03
A8	8.25	8.00	16.24	0.25
A9	7.79	6.79	14.58	1.00
A10	7.47	6.56	14.03	0.90
A11	8.24	6.64	14.87	1.60
A12	8.50	8.88	17.38	-0.37
A13	8.40	8.66	17.06	-0.26
A14	5.46	5.82	11.28	-0.36
A15	5.35	5.43	10.78	-0.09
A16	7.74	8.14	15.88	-0.40
A17	8.03	8.58	16.60	-0.55

According to Table 3, the importance of factors affecting the dissemination of online public opinion information, in descending order, includes A1, A2, A3, A6, A12, A13, A17, A8, A7, A16, A11, A9, A10, A4, A14, A15, and A5. The causal elements in the indicator system of factors affecting the dissemination of online public opinion information include A11, A9, A10, A8, A5, and A7. The result elements in the indicator system of factors affecting the dissemination of online public opinion information include A3, A15, A13, A6, A14, A12, A16, A1, A17, A4, and A2.

According to formulas (8) and (9), calculate the threshold λ=0.55, and convert the comprehensive impact matrix into a reachable matrix.

The reachability matrix is processed hierarchically to obtain the results of the first-level element division, the second-level element division, and the third-level element division successively, as shown in Tables 4, 5, and 6

Table 4: Division of First Layer Elements

	reachable set	antecedent set	intersection
1	[1–3,6,12,13,16,17]	[1–3,6,7,8,9,11,12,13,17]	[1–3,6,12,13,17]
2	[1–3,6,12,13,16,17]	[1–3,6,7,8,9,11,12,13,17]	[1–3,6,12,13,17]
3	[1–3,6,8,12,13,16,17]	[1–3,6,8,11,12,13,17]	[1–3,6,8,12,13,17]
4	[4]	[4]	[4]
5	[5]	[5]	[5]
6	[1–3,6,7,12,13,16,17]	[1–3,6,7,8,11,12,13,17]	[1–3,6,7,12,13,17]
7	[1, 2,6,7,12]	[6,7]	[6,7]
8	[1–3,6,8,12,13,17]	[3,8]	[3,8]
9	[1, 2,9]	[9]	[9]
10	[10]	[10]	[10]
11	[1–3,6,11,12,17]	[11]	[11]
12	[1–3,6,12,13,17]	[1–3,6,7,8,11,12,13,17]	[1–3,6,12,13,17]
13	[1–3,6,12,13,17]	[1–3,6,8,12,13]	[1–3,6,12,13]
14	[14]	[14]	[14]
15	[15]	[15]	[15]
16	[16]	[1–3,6,16]	[16]
17	[1–3,6,12,17]	[1–3,6,8,11,12,13,17]	[1–3,6,12,17]

cause degree E of the factors affecting the dissemination of online public opinion information can be calculated, as shown in Table 3.

The author divides the reachable matrix into levels and constructed a multi-layer hierarchical structure model. This model divides 17

Table 5: Division of Second Layer Elements

	reachable set	antecedent set	intersection
1	[1–3,6,13]	[1–3,6,7,8,9,11,13]	[1–3,6,13]
2	[1–3,6,13]	[1–3,6,7,8,9,11,13]	[1–3,6,13]
3	[1–3,6,8,13]	[1–3,6,8,11,13]	[1–3,6,8,13]
6	[1–3,6,7,13]	[1–3,6,7,8,11,13]	[1–3,6,7,13]
7	[1, 2,6,7]	[6,7]	[6,7]
8	[1–3,6,8,13]	[3,8]	[3,8]
9	[1, 2,9]	[9]	[9]
11	[1–3,6,11]	[11]	[11]
13	[1–3,6,13,]	[1–3,6,8,13]	[1–3,6,13]

Table 6: Division of Third Layer Elements

	reachable set	antecedent set	intersection
7	[6,7]	[6,7]	[6,7]
8	[8]	[3,8]	[8]
9	[9]	[9]	[9]
11	[11]	[11]	[11]

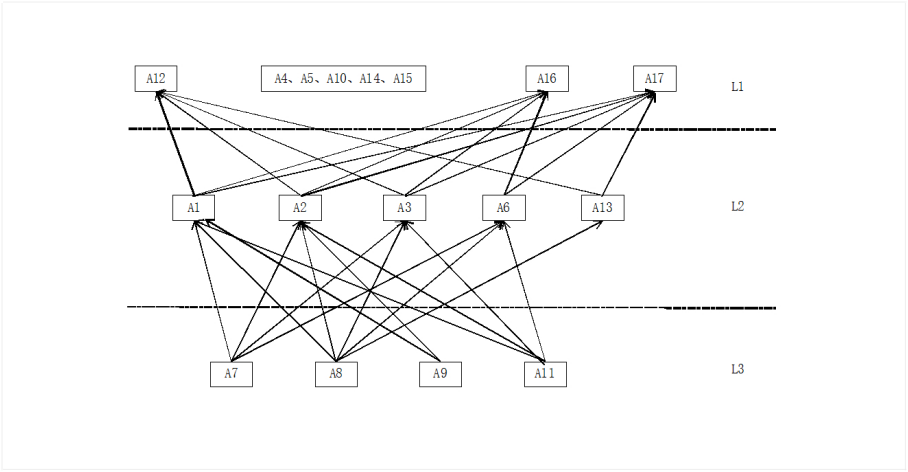

Figure 1: Multi Layer Explanatory Structure Model

factors affecting the dissemination of online public opinion information into three levels, as shown in Figure 1.

From Figure 1, the factors at the first level of the influencing factor system hierarchy are A4, A5, A10, A12, A14, A15, A16, and A17 respectively. The factors at the second level of the influencing factor system are A1, A2, A3, A6, and A13. The factors at the third level of the influencing factor system are A7, A8, A9, and A11.

4 Suggestions

Firstly, relevant administrative departments need to leverage artificial intelligence technology to efficiently manage online public opinion. A7, A8, A9, and A11 are the root causes of the spread of online public opinion information. Therefore, the active guidance of relevant administrative departments plays a crucial role in the development trend of online events. Relevant administrative departments need to utilize artificial intelligence technology to establish and improve a rapid response mechanism to ensure prompt and effective intervention and handling in the event of a public opinion crisis. Relevant administrative departments should strengthen the training of managers in the application of artificial intelligence technology to enhance their professional capabilities in dealing with online public opinion.

Secondly, to enhance the public's knowledge accumulation of artificial intelligence technology. A1, A2, and A3 are the top three intermediate factors in importance ranking and should be given special attention. To carry out education on artificial intelligence technology and cultivate the ability of netizens to distinguish the

authenticity of information, such as identifying false statements fabricated by AI.

Thirdly, actively leverage the positive role of online public opinion information platforms. A12, A13, and A17 are the top three direct factors in importance ranking and should be given sufficient attention. The online public opinion information platform should play a supervisory role, expose online rumors and false information, and help the public identify and resist the spread of false news and harmful information. The online public opinion information platform utilizes its interactive function to promptly respond to public concerns.

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