Study on influence factors for the sustainability of individual safety behavior capability of employees in enterprises based on dematel-ism method

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Abstract: In order to get an accurate understanding of the sustainability of employees' safety behavior capability, based on the safety behavior influencing factors, 15 influencing factors were identified from the five aspects of safety environment, individual's basic qualities, individual safety quality, individual's behavioral abilities and individual's awareness. Using the decision making trial and evaluation laboratory (DEMATEL) and interpretive structural model (ISM), while studying the relationship between the influencing factors, the paper also analyzes the impact of each index on the sustainability of the individual's safety behavior, finding out the key influencing factors and analyzing the comprehensive influence relations among the factors and constructing a multi-level hierarchical structure model, and finally finding a new way and method to improve the sustainability of the employees' individual safety behaviors.

1. Introduction

Through the analysis of the accident cases, it is found that among all the direct causes of major accidents, the proportion of human factors is as high as 97%, the proportion of accidents caused by workers' violation accounts for 45% [1-3]. This paper argues that for the unsafe behavior, the lack of capacity is the root cause of the accident, so the study on the sustainability of individual safety behavior capability of employees ,Identify the key factors that can improve the sustainability of employee safety behavior capability, not only can reveal the deep-rooted causes of unsafe behavior, but also can understand the laws of individual employees behavior in-depth, and have great significance in preventing unsafe behavior.

The capacity of safety behavior is keep the production safety work more smoothly .The worker dealing with the safety duties related to their own jobs, make the right decisions and take appropriate actions by using and integrating the intrinsic qualities of knowledge, skills,

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awareness, personal value judgment and attitude , So as to avoid the personal injury and death, property damage, environmental damage, occupational diseases, The sustainability of safe behavioral ability refers to the state or process in which the safety behavior ability can be maintained for a long period of time within a certain period of time.

2. Literature Review

Combing the relevant literature at home and abroad, we found that scholars mainly based on cognitive psychology[4-5], psychometrics [6-7], economics theory[8-9], game theory[8-9], planned behavior theory[10] and catastrophe theory[11], the author used the structural equation modeling method[12-14], the system dynamics method to study the causes of unsafe behavior and the related control methods, and so on ,discussing the influence of the external regulations, the cognition ability, the values and the value judgments of the enterprise workers, the nature of the coal mine production tasks, the organizational characteristics and the relationship characteristics on the illegal behaviors, and reveals the law of the evolution of the unsafe behaviors.

Gene Earnest and Jim Palmer (1979) first proposed the concept of Behavior Based Safety (Behavior Safety), which developed into the method of behavioral safety management .Ryan Olson (2001) conducted ABC behavioral analysis of four drivers with more than 20 years of driving experience, and concluded that the effectiveness and retentiveness of the safety process can be increased over time by this method [15].Hickman (2003) supervised the safety behaviors of 15 miners. By comparing the safety behavior before and after the behavior management of miners, we found that the behavior safety management can effectively improve the safety behavior of miners [16].In the seventies and eighties of the last century, Chinese researchers started to pay attention to the research of behavioral science. As the degree of concern increased, the field of application of safety behavior became more and more widespread..Li Yuanxiu and Tian Wei (2009) Implemented behavioral safety management for the transportation department of metallurgical enterprises, described the implementation process and defined eight key unsafe behaviors [17]. Li Naiwen and Jidajiang (2011) Implemented a behavioral safety management (BBS) method in coal mines, and described the implementation process of the method and put forward the guarantee measures for the implementation of the process in detail[18]. Sun Jianhua and Huang Donghui et al. (2013) conducted blasting workers in coal mines with STOP safety behavior observation and developed corresponding observation cards to observe them regularly, noting that the proportion of unsafe workers decreased significantly [19].

Although the above study conducted a more in-depth study of unsafe behavior, it neglected the question of how to extend the sustainability of the safety behavior. If the sustainability of the safety behavior can be improved, it means the unsafe behavior Reduce the proportion of unsafe behavior [20].

At present, Decision Making Trial and Evaluation Laboratory has been widely used in many fields such as supply chain management, project investment and safety management.BaoLiPing used ISM method to construct the explanation structural model of the 4-level prevention system of military vehicle accident [21],FuruyaWimei and other scholars used DEMATEL method to identify the influencing factors of the Japanese fishery system and used the method of Interpretive Structural Model (ISM) to examine the relationship between factors [22],Wu & Lee (2007) made use of DEMATEL to make managerial competency decisions [23],Yager (2013) used DEMATEL to improve the information security risk control evaluation model for enterprise and organizational information security [24].

However, few studies have used this method for the sustainability of safety behaviors [25]. Therefore, I will combine DEMATEL and ISM method, study the interaction between the influencing factors and the extent of their impact on the unsafe behavior, to construct a

multi-level hierarchical structure model of influencing factors, revealing the importance of each factor, clarifying the reasons factors and result factors, in order to provide new ideas and new methods for the management and control of employees' safety behavior management.

3. Identify the Influencing Factors

According to literature research, find out the influencing factors that can affect the continuity of employee safety capability, find 15 influencing factors in 5 main aspects ， construct the corresponding influencing factor system, as shown in Figure 3.1

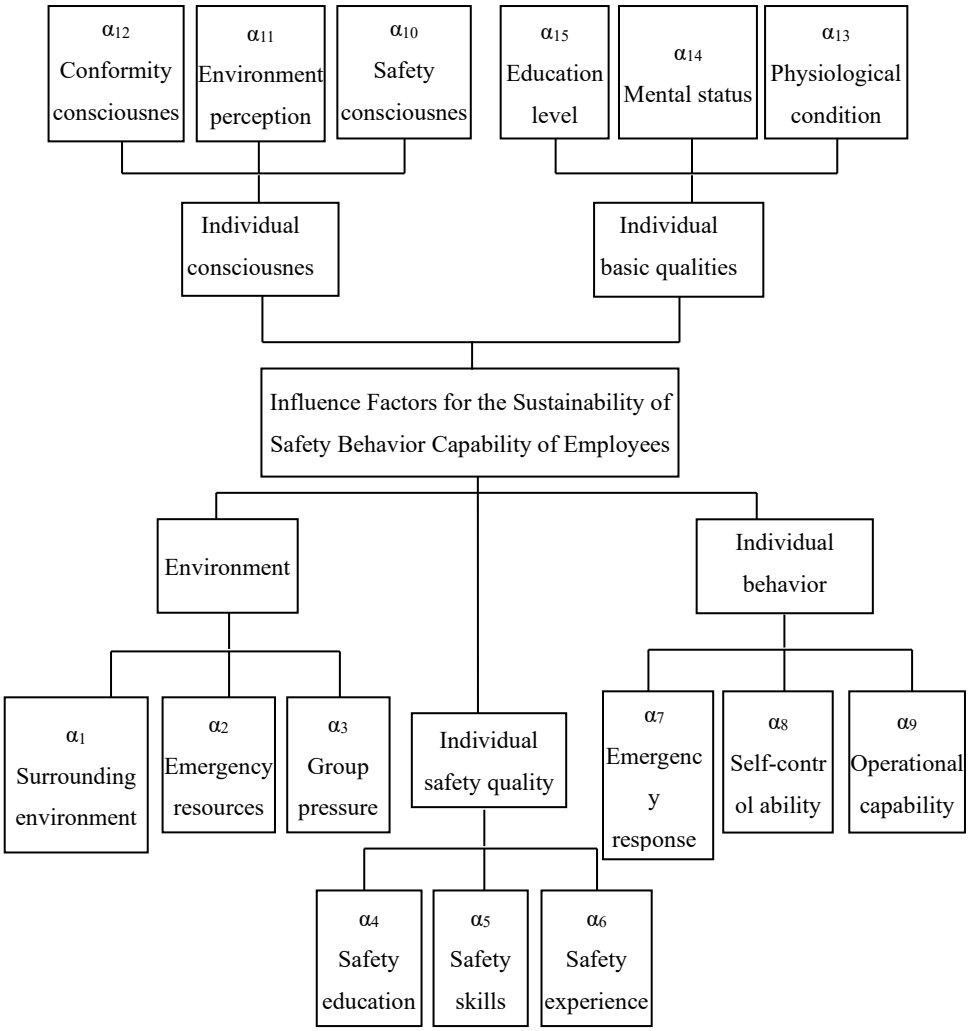


Fig. 3.1. Influencing factors system diagram

3.1. Environmental factors（A1）

Environmental factors that affect the sustainability of individual safety capacity of

employees include the surrounding environment, emergency resources, and population pressure. Environmental factors mainly refer to the impact of the external environment on the individual.

α_1 The surrounding environment, refer to the working environment and climatic conditions around the individual and so on.

α_2Emergency resources, refer to a series of emergency facilities that are equipped with relevant safety protection, emergency rescue equipment, surrounding escape routes and rescue guidelines to prevent emergencies in the individual working environment.

α_3Group pressure, refers to the individual work around the other groups of workers to the behavior guidelines caused by the individual, such as psychological implications.

3.2. The quality of individual security（A2）

The quality of individual safety refers to the level of safety skill possessed by individual employees during their safety work. Mainly includes three aspects: safety education, safety skills, safety experience.

α_4Safety education, refers job safety training and education that workers accepted.

α_5Safety skills ,refer to the occupational safety skills possessed by individual workers.

α_6Safety experience refers to the accumulation of new knowledge gained by workers in safety operations after working for a period of time.

3.3. Individual capacity (A3)

Individual behavior capacity refers to the individual workers in the event of sudden or behavioral ambivalence, the ability to deal with their own. Including emergency response capability, self-control ability, ability to act three factors.

α_7Emergency response capacity, refers to the individual workers in the event of an emergency situation, their own ability to respond to emergencies.

α_8Self-control ability ,refers to the ability of workers to maintain self-control under the temptation of outsiders.

α_9Mobility, refers to the ability of workers to respond to actions, including speed, weight, observation and so on.

3.4. Individual Consciousness (A4)

Individual consciousness refers to the state of psychological perception of the potential hazard source that the worker may be harming himself or others in the safety production .The impact of individual awareness status on the sustainability of security capabilities is reflected in three aspects: security awareness, environmental awareness and subordinate awareness.

α_{10}Safety awareness, refers to the consciousness of the individual in the mental state of danger.

α_{11}Environment awareness, refers to the degree of perception of the environment in which employees work.

α_{12}Conformity consciousness, refers to the choice of psychological behavior which is consistent with other groups under the influence of other employees.

3.5. Basic quality of the individual (A5)

The basic quality of an individual includes three aspects: physiological status,

psychological status and education level.

α_{13}Physiological conditions, refers to the individual workers in the production of physiological functions, health conditions, such as whether sick, whether the work fatigue.

α_{14}Mental status, refers to the individual workers' ability to resist pressure, service character and so on.

α_{15}The level of education refers to the level of education received by employees, which is related to the ability and speed of learning safety knowledge and skills of employees in safety production.

4. The Analysis of Sustainability Factors Model for Individual Security Ability of Employees.

4.1. The theoretical basis for integrating the DEMATEL-ISM structured approach

DEMATEL method, the use of the principles of graph theory and matrix analysis of system factors, by determining the direct impact of the relationship between the various factors in the size of the system to calculate the various factors on the impact of other factors and the extent of the impact of the various factors to obtain the degree of centrality and the degree of reason, and then determine the cause and effect of factors.

The ISM method is a qualitative analysis-based method. The function is to decompose the complex system into several subsystems, and ultimately form a multi-level hierarchical interpretation structural model.

Based on the DEMATEL method, the ISM method can be used to further divide the hierarchy between accident factors .Although the DEMATEL method can identify the key factors, it is impossible to determine the complex correlation between the various factors and lack of consideration of the influencing factors themselves .Therefore, based on the comprehensive influence matrix in DEMATEL method, considering the influence of the factors and the unit matrix, the overall influence matrix is constructed. Through the given threshold, the global influence matrix is standardized and reachable, that is, the reachable matrix .If the matrix element is 1, then there is an impact relationship between the two factors, otherwise there is no mutual influence.

On the one hand, the integrated DEMATEL-ISM method includes that the comprehensive influence matrix in the DEMATEL method includes both the direct influence of each factor and the gradual influence of the factors themselves. On the other hand, the matrix of reachability matrix in ISM more information while avoiding the large and complex matrix calculations in ISM methods.Based on the comprehensive influence matrix of DEMATEL method, the reachability matrix of ISM method is constructed considering the influence of factors on itself. The correlation and logical structure of factors can be further analyzed to realize the structural and hierarchy of accident factors.Therefore, DEMATEL method and ISM method achieve effective complementarity, which is a new way to construct the hierarchy of factors[26].

The steps to build an integrated DEMATEL-ISM model are shown in Figure 4.1

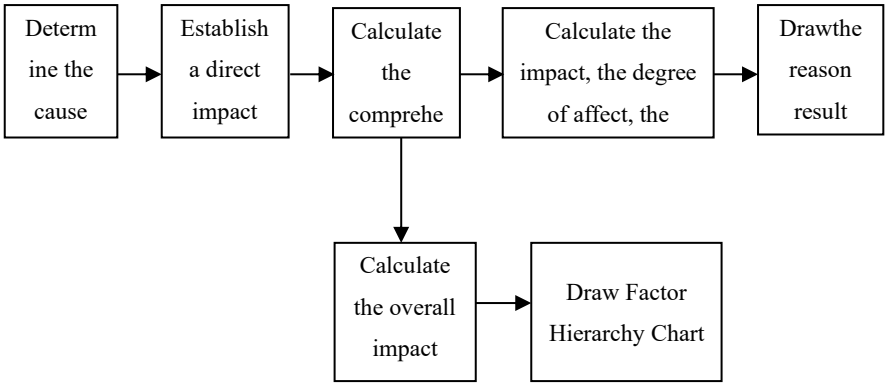


Fig. 4. 1. Integrated DEMATEL-ISM method steps

4.2. Empirical Analysis of Influential Factors

4.2.1. Establish a direct impact matrix

Five experts were invited to judge respectively the 15 influencing factors ofα_1~α_{15}in Section 2.1 according to the interaction among factors of very strong, strong, general, weak, none and five levels, and set five levels of assignment 4,3,2,1,0, and then summarize the results of a number of expert judgments,using the average method to eliminate differences in individual knowledge among experts in order to obtain the initial direct impact matrix.The specific formula is:

$$B = \begin{bmatrix} 0 & \beta_{12} & \cdots & \beta_{1n} \\ \beta_{21} & 0 & \cdots & \beta_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \beta_{n1} & \beta_{n2} & \cdots & 0 \end{bmatrix} \quad (1)$$

Where, $\beta_{ij}$is the average direct influence strength of accident factor $\alpha_i$on α_j, and $\beta_{ij} \neq \beta_{ji}$, when i=j, take $\beta_{ij}=0$. The initial direct impact matrix is normalized,

$$C = \frac{1}{\max\limits_{1 \le i \le n} \sum\limits_{j=1}^{n} \beta_{ij}} B \quad (2)$$

The normalization directly affects the matrix C, $C = \left[c_{ij} \right]_{n \times n}$, $\max\limits_{1 \le i \le n} \sum\limits_{j=1}^{n} \beta_{ij}$ which is the maximum value of the row and the row. At this point, the normalized direct influence matrix C is still 0 on the diagonal.

The initial direct impact matrix B is shown in Table 4.1.

Table 4. 1. Initial direct impact matrix

B	α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8	α_9	α_{10}	α_{11}	α_{12}	α_{13}	α_{14}	α_{15}
α_1	0	3.2	2.2	2	1.8	1.6	2.2	1.2	1.8	1.8	2.4	1.8	1	1.2	1

α_2	2.4	0	2	1.4	1.4	1.2	2.4	1.8	1.4	1.6	1.6	0.6	0.4	1	0.4
α_3	2	2.6	0	2.4	2.2	2.4	2.4	2.6	2.6	2.2	1.8	3	1	2.8	1
α_4	2	2.2	2	0	3.6	2.4	3	2.4	3	3.6	3	1.6	0.6	1.8	2.2
α_5	1.2	1.8	2	3.2	0	3.2	3.2	2.4	3	3.2	1.8	2	1.8	2.2	2
α_6	2.2	2	2	3.2	3.4	0	3.4	2.8	2.8	2.4	1.8	1.6	1	2	2.2
α_7	1.8	3	1.6	3	2.8	2.8	0	2.8	2.4	2.4	2.6	1.2	1.8	2.8	1.6
α_8	1.6	1.6	2.4	2.8	2.6	2.6	2.8	0	3.2	2.2	1.8	2.2	1.2	1.8	1.8
α_9	1.6	2.2	2.4	2.8	3.2	3	3.2	3.6	0	2	1.6	1.8	1.6	2.2	1.4
α_{10}	1.8	1.6	2.6	4	3	3.4	3	3	2.8	0	2.4	1.6	0.6	2.8	2
α_{11}	2.6	1.6	2	2.8	2	2.2	2.4	2.6	2.2	2	0	1	0.2	1.8	1.4
α_{12}	2	1.6	2.8	2.2	1.6	1.6	2	2	1.6	1.6	1.8	0	0.4	1.4	1.6
α_{13}	1.4	1.2	1.6	1.2	1.4	1	1.8	1.8	1.8	0.8	1	1	0	2.8	1.8
α_{14}	1.4	1.6	2.8	2.4	2.2	2	2.6	2.6	2	2.4	2	1.8	2.2	0	2.4
α_{15}	1.4	0.8	1.5	3	2.4	2.4	2.2	1.8	1.2	2.2	1.8	1	1.2	2	0

The initial direct impact matrix is normalized according to formula (2), and the normalized direct impact matrix C is obtained, as shown in Table 4.2.

Table 4. 2. Normalization directly affects the matrix

C	α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8	α_9	α_{10}	α_{11}	α_{12}	α_{13}	α_{14}	α_{15}
α_1	0	0.09	0.06	0.06	0.05	0.05	0.06	0.03	0.05	0.05	0.07	0.05	0.03	0.03	0.03
α_2	0.07	0	0.06	0.04	0.04	0.03	0.07	0.05	0.04	0.05	0.05	0.02	0.01	0.03	0.01
α_3	0.06	0.08	0	0.07	0.06	0.07	0.07	0.08	0.08	0.06	0.05	0.09	0.03	0.08	0.03
α_4	0.06	0.06	0.06	0	0.10	0.07	0.09	0.07	0.09	0.10	0.09	0.05	0.02	0.05	0.06
α_5	0.03	0.05	0.06	0.09	0	0.09	0.09	0.07	0.09	0.09	0.05	0.06	0.05	0.06	0.06
α_6	0.06	0.06	0.06	0.09	0.10	0	0.10	0.08	0.08	0.07	0.05	0.05	0.03	0.06	0.06
α_7	0.05	0.09	0.05	0.09	0.08	0.08	0	0.08	0.07	0.07	0.08	0.03	0.05	0.08	0.05
α_8	0.05	0.05	0.07	0.08	0.08	0.08	0.08	0	0.09	0.06	0.05	0.06	0.03	0.05	0.05
α_9	0.05	0.06	0.07	0.08	0.09	0.09	0.09	0.10	0	0.06	0.05	0.05	0.05	0.06	0.04
α_{10}	0.05	0.05	0.08	0.12	0.09	0.10	0.09	0.09	0.08	0	0.07	0.05	0.02	0.08	0.06
α_{11}	0.08	0.05	0.06	0.08	0.06	0.06	0.07	0.08	0.06	0.06	0	0.03	0.01	0.05	0.04
α_{12}	0.06	0.05	0.08	0.06	0.05	0.05	0.06	0.06	0.05	0.05	0.05	0	0.01	0.04	0.05
α_{13}	0.04	0.03	0.05	0.03	0.04	0.03	0.05	0.05	0.05	0.02	0.03	0.03	0	0.08	0.05
α_{14}	0.04	0.05	0.08	0.07	0.06	0.06	0.08	0.08	0.06	0.07	0.06	0.05	0.06	0	0.07
α_{15}	0.04	0.02	0.04	0.09	0.07	0.07	0.06	0.05	0.03	0.06	0.05	0.03	0.03	0.06	0

4.2.2. Calculate the comprehensive impact matrix

Normalization directly affects the index C of the matrix is a direct impact between the various factors, but the reality also need to consider the indirect impact between the various factors, at the same time, due to a factor change caused by the effects also belong to the consideration.The comprehensive impact matrix represents the cumulative sum of the direct and indirect effects of the factors to determine the ultimate impact of each factor relative to the highest level in the overall system,expressed as:

$$T = C + C^2 + \ldots\ldots + C^n = \sum_{i=1}^{n} C^i \qquad (3)$$

The approximate calculation method $T = C(I - C)^{-1}$ used in many literature, however, this method is suitable for the case of n→∞.But under normal circumstances, n is difficult to approach infinity,so still use (3) formula., For the direct influence matrix in the table, according to the formula (3), through MATLAB software, calculate the comprehensive influence matrix as:

Table 4. 3. Comprehensive impact matrix

T	α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8	α_9	α_{10}	α_{11}	α_{12}	α_{13}	α_{14}	α_{15}
α_1	0.32	0.37	0.34	0.32	0.37	0.32	0.33	0.32	0.31	0.24	0.16	0.28	0.23	0.32	0.37
α_2	0.26	0.29	0.28	0.26	0.32	0.28	0.27	0.26	0.24	0.18	0.12	0.23	0.17	0.26	0.29
α_3	0.32	0.45	0.42	0.41	0.46	0.43	0.42	0.39	0.35	0.32	0.19	0.38	0.27	0.32	0.45
α_4	0.40	0.43	0.49	0.45	0.51	0.46	0.46	0.46	0.41	0.31	0.20	0.38	0.33	0.40	0.43
α_5	0.39	0.51	0.40	0.46	0.51	0.45	0.45	0.45	0.37	0.32	0.23	0.39	0.32	0.39	0.51
α_6	0.39	0.50	0.48	0.37	0.51	0.46	0.45	0.42	0.37	0.30	0.21	0.38	0.32	0.39	0.50
α_7	0.38	0.49	0.46	0.44	0.41	0.45	0.43	0.41	0.38	0.29	0.22	0.39	0.30	0.38	0.49
α_8	0.38	0.47	0.44	0.42	0.47	0.36	0.43	0.39	0.35	0.30	0.20	0.35	0.30	0.38	0.47
α_9	0.40	0.49	0.47	0.45	0.50	0.48	0.37	0.41	0.36	0.31	0.22	0.38	0.30	0.40	0.49
α_{10}	0.43	0.55	0.50	0.49	0.53	0.49	0.47	0.38	0.40	0.32	0.21	0.42	0.34	0.43	0.55
α_{11}	0.34	0.42	0.38	0.37	0.41	0.39	0.37	0.35	0.27	0.24	0.15	0.32	0.26	0.34	0.42
α_{12}	0.33	0.37	0.33	0.32	0.36	0.34	0.32	0.31	0.29	0.19	0.14	0.28	0.24	0.33	0.37
α_{13}	0.26	0.29	0.28	0.26	0.31	0.29	0.28	0.25	0.23	0.19	0.11	0.28	0.22	0.26	0.29
α_{14}	0.38	0.45	0.42	0.40	0.45	0.42	0.39	0.39	0.35	0.29	0.22	0.30	0.31	0.38	0.45
α_{15}	0.30	0.41	0.37	0.35	0.38	0.35	0.32	0.34	0.30	0.23	0.17	0.31	0.21	0.30	0.41

4.2.3. Calculate the degree ofaffect, the degree of influence, degree of reason and the degree of centrality

Through the comprehensive influence matrix T, the elements are summed in order of rows to obtain the factor influence fi, and the influence fi represents the comprehensive influence of element i on all other elements. The comprehensive influence is all direct and indirect. The formula is:

$$f_i = \sum_{i=1}^{n} t_{ij} \left(i = 1, 2, \ldots, n \right) \tag{4}$$

Similarly, the elements in the matrix T are summed in order to obtain the factor influence degree ei, the influence degree ei means the element i is affected by the comprehensive influence degree of all the other elements, and the formula is:

$$e_i = \sum_{j=1}^{n} t_{ji} \left(i = 1, 2, \ldots, n\right) \quad (5)$$

Reason Ni represents the pure effect of this factor i on all other factors and can also be considered as a causal logical relationship between this factor and other factors. If it is a positive number, it means that it has a great influence on other factors and belongs to the factor of reason; If it is negative, itmeans that the factor will be greatly influenced by other factors, which is the result factor, It's expression is:

$$N_i = f_i - e_i \left(i = 1, 2, \ldots, n\right) \quad (6)$$

The degree of central Miindicates the influence of this factor i on all the factors and the influence of other factors on this factor. Therefore, the degree of centrality M_i represents the medium importance of all factors among the factors. The greater the degree of centrality, the higher the importance of this factor,It's expression is:

$$N_i = f_i + e_i \left(i = 1, 2, \ldots, n\right) \quad (7)$$

According to the matrix of combined effects in Table 4.3, the degree of affect, the degree of influence, the degree of centrality and the degree of reason are respectively calculated according to formula (4) (5) (6) (7).

Table 4. 4. Calculation Results Table

Factors		Impact	Degree of	Centrality	Reason of	Center of the	Factor attributes
α_1	Surroundings	4.45	4.52	8.97	-0.07	11	Results factors
α_2	Emergency resources	3.59	4.88	8.47	-1.29	13	Results factors
α_3	Group pressure	5.50	5.27	10.77	0.23	8	Reason factors
α_4	Safe education	6.01	6.49	12.50	-0.48	1	Results factors
α_5	Safety skills	5.93	6.07	12.00	-0.14	3	Results factors
α_6	Safety experience	5.89	5.76	11.65	0.13	5	Reason factors
α_7	Emergency response	5.78	6.50	12.28	-0.72	2	Results factors
α_8	Self-control ability	5.51	5.97	11.48	-0.46	7	Results factors
α_9	Operational capability	5.84	5.75	11.59	0.09	6	Reason factors
α_{10}	Safety consciousness	6.26	5.54	11.80	0.72	4	Reason factors
α_{11}	Environment awareness	4.88	4.95	9.83	-0.07	10	Results factors
α_{12}	Conformity consciousness	4.37	4.04	8.41	0.33	14	Reason factors
α_{13}	Physiological condition	3.70	2.77	6.47	0.93	15	Reason factors
α_{14}	Mental status	5.40	5.06	10.46	0.34	9	Reason factors
α_{15}	Education level	4.57	4.11	8.68	0.46	12	Reason factors

4.2.4. Draw the reason result chart

In Table 4.4 the center of each factor as the abscissa, the degree of ordinate for the reason, draw the factors that affect the sustainability of safety behavior results of the results. As shown in Figure 4.2:

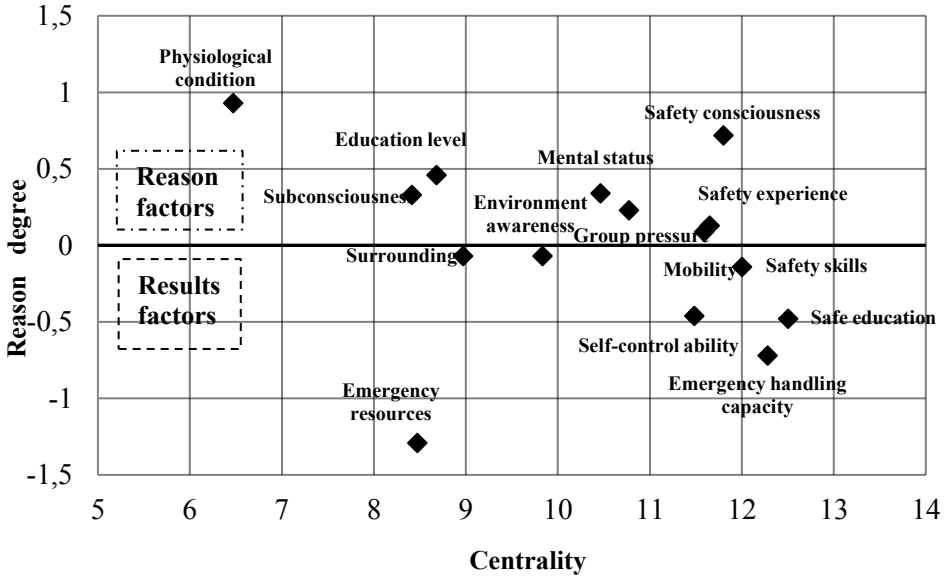


Fig. 4. 2. The reason and the results figure

4.2.5. Calculate the overall impact matrix and reachable matrix

Taking into account the impact of factors on itself, according to the comprehensive impact matrix, calculate the overall impact matrix H:

$$H = T + I \qquad (8)$$

Where, I is the identity matrix, when the factor i and the factor j are related, hij> 0, when the factor i and the factor j are not related, hij<0.

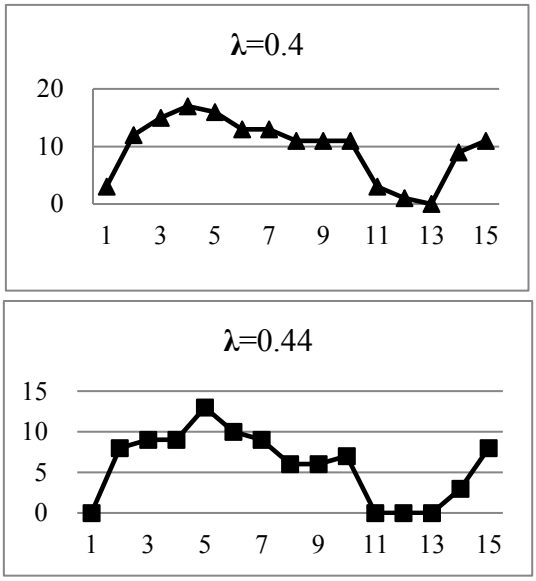
From the overall impact matrix, the numerical size there is influence between factors determines the influence degree between various factors. The sum of the elements of the element αi in the matrix is the node degree of the factor. Take the different threshold λ, the resulting accident factor node degrees are different, so the value of λ to be done when the number of nodes to be moderate, too much or too little both cannot. At the same time, the larger number of nodes should be in line with the DEMATEL method to determine the center of the front relatively close factor. Therefore, taking λ = 0.4, 0.44, 0.47, 0.5 respectively, we get four different reachable matrices. The resulting node degree

distribution table is shown in Table 4.5:

Table 4. 5. factors under different λ node degree distribution table

λ	0.40	0.44	0.47	0.50
α_1	3	0	0	0
α_2	12	8	6	4
α_3	15	9	4	2
α_4	17	9	3	1
α_5	16	13	7	6
α_6	13	10	6	3
α_7	13	9	3	0
α_8	11	6	3	0
α_9	11	6	5	1
α_{10}	11	7	7	4
α_{11}	3	0	0	0
α_{12}	1	0	0	0
α_{13}	0	0	0	0
α_{14}	9	3	0	0
α_{15}	11	8	6	3

The corresponding node scatter plot is shown in Figure 4.3



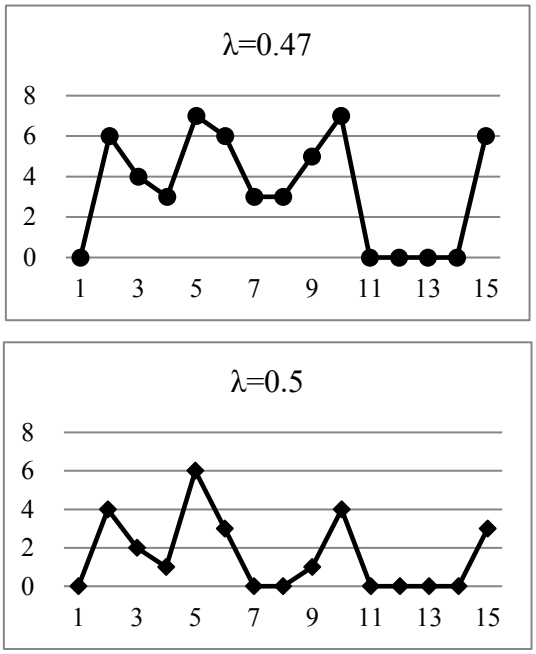


Fig. 4. 3. Factor λ scatter plot at different λ

As can be seen from the scatter plot, when λ = 0.47, the node degree curve is in good agreement with the top-ranked factors in Table 4.4.

4.2.6. Draw Factor Hierarchy Chart

Before drawing the hierarchy diagram of factors, we first need to classify the reachable matrix when λ = 0.47, and divide the different factors into different levels. When λ is 0.47, the corresponding reachable matrix is:

Table 4. 6. Reachability matrix with λ = 0.47

K	α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8	α_9	α_{10}	α_{11}	α_{12}	α_{13}	α_{14}	α_{15}
α_1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
α_2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
α_3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
α_4	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
α_5	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1
α_6	0	1	1	0	1	1	0	0	0	0	0	0	0	0	1
α_7	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1
α_8	0	1	0	0	1	0	0	1	0	0	0	0	0	0	1
α_9	0	1	1	0	1	1	0	0	1	0	0	0	0	0	1
α_{10}	0	1	1	1	1	1	1	0	0	1	0	0	0	0	1
α_{11}	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
α_{12}	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
α_{13}	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
α_{14}	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
α_{15}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

On the basis of reachability matrix K, it is judged whether to set up the factors of all levels according to the conditional formula.

$R_i \cap S_i = R_i$，（i = 1，2，…，n) （9）

R_i is a reachable set, which is a set consisting of all the elements in the i line in the matrix K as 1. S_i is a set of factors, which is a set of factors that make all the elements in the column i in the matrix K be 1. According to the result, the multi-level hierarchical structure model is obtained.

If formula (9) holds, it means the element $\alpha_i$is the first layer element and then i line and column i are removed from the matrix K. If the formula is not true, the remaining matrix needs to be re-verified to find the corresponding second layer or other layers.

The hierarchy of matrix K is divided into hierarchy, which is the first layer:α_1、α_2、α_3、α_{11}、α_{12}、α_{13}、α_{14}、α_{15}; Level 2: α_5、α_7; The third layer; α_4、α_6、α_8; Level 4: α_9、α_{10}. Draw the corresponding factor recursion substructure diagram, as shown in figure 4.4.

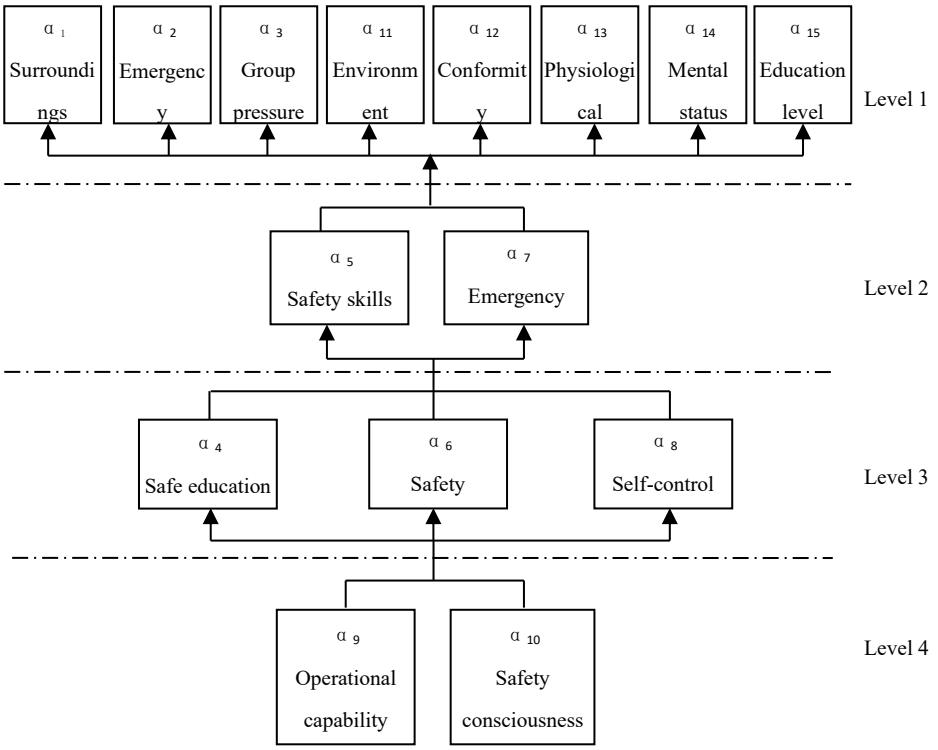


Fig. 4.4. Hierarchical organization chart

4.3. Results analysis

As can be drawn from Figure 4.4, the staff's operational capacity and safety awareness are the lowest factors that affect the sustainability of employees' safety behaviors. They are also considered as the least significant factor in the individual safety management of employees. These two factors are also considered to be the most essential factors in accidents caused by safety behaviors. Safety education, safety experience and staff self-control ability are located at the third level of the hierarchical structure of factors and are the over-factors affecting the final accident result. Directly affected by the fourth level, and thus related to the second-level safety skills and Emergency response capacity of workers. The eight factors surrounding the environment, emergency resources, group pressure, environmental awareness, public awareness, physiological status, mental status and education level are located in the first level. In the daily employee safety management, these eight factors are also considered as Surface factors are the most noticed or discovered influencing factors in human accidents.

Combining DEMATEL method to get the center of the various factors in table 4.4 degrees, found that the center degree before six factors: safety education, safety skills, experience, emergency disposal ability, operation ability, safety consciousness, located in three level of 2, 3, 4.

In the all factors that affect worker safety behavior ability sustainable, safety education, safety skills, experience, emergency disposal ability, operation ability, safety consciousness the six factors from the worker is itself a human perspective, is individual impact on the

sustainability of overall safety behavior ability. At the same time, the six factors belongs to the transitional nature and the influencing factors, and can be important influence factors of the surface, also can decide the surface influence factors on the overall staff the size of the safe behavior ability the influence degree of the persistence.

5. Recommendations and conclusions

5.1. Suggestions and measures

Through the above analysis, we can clearly understand the various influence factors of worker individual safety behavior ability sustainable relationships between, and then from two aspects of shallow and deep consideration, a series of corresponding measures, to improve worker safety behavior ability of sustainable.

The main measures of the shallow layer are based on the factors in the hierarchy, which are embodied in:

(1) Currently, there are penalties for unsafe conduct of business management measures for employees ,The consequences of doing so are that one does not take into account the passive situation of the workers themselves and cannot reflect the "humane" side of managers; The second is that they are too inefficient in mobilizing the enthusiasm of workers. Therefore, we need to gradually adopt measures to punish the traditional unsafe behavior based safety management measures, turned to foster and encourage employees have the correct safety behavior and habits to give priority to, to punish is complementary method of safety management to increase employee concentration and enthusiasm.

(2) Strengthen the behavior information statistics and processing, the statistical results, data analysis reports timely feedback to employees, thus promoting staff participation in behavioral safety management initiative. At the same time, workers should report the behavior problems encountered in their work in order to form a two-way flow of information and increase the accuracy of information.

(3) Optimize the interpersonal relationships between the individual employees and the workers' groups, and the managers, and create a good group atmosphere. Reduce the ideological stress and mental stress caused by interpersonal relationships, improve work efficiency and increase the duration of workers' safety behavior [28].

(4) Pay attention to the reasonable disposition of the surrounding environment and emergency resources and minimize the loss of human lives when the accident occurs [29].

The main measures proposed are based on the second, third and fourth levels of the various influencing factors, which are reflected in:

(1) For the individual worker, the formation or change of his work habits is closely related to his or her own situation and the environment in which the habit is often consciously deciding on a person's decision or action The consequences of the overall security status have a significant impact on the quality. Therefore, appropriate safety education and training and safety skill assessment exercises can lead to preferences that are more likely to be "good outcomes", thereby enhancing the sustainability of employees' safety behavior.

(2) Enhance employees' understanding of behavioral concepts, classification, characteristics and other aspects in a deeper level, and enhance employee awareness and perception of behavioral safety. Summarize and transfer off-the-shelf safety experience to new workers, arouse regular summary of new safety experiences. In this way, employees can independently identify and judge behavioral risks in different working environments and form the overall picture of their own safety. Contain the unsafe behavior as soon as it occurs, thereby reducing the possibility of an unsafe behavior causing an accident.

(3) Establish enterprise safety culture, create a good safety atmosphere, and realize the

promotion of employee safety values. Safety culture itself is to highlight the essential characteristics of people-oriented, which focuses on employees to play their psychological, physical or technical experience advantages, so that workers from a passive "need me to be safe" state of compliance management a conscious "I want security" initiative security state.

5.2. Conclusion

(1) To understand accurately the sustainability of employees' safety behavior, based on safety behavior influence factor, from environmental factors, individual basic quality and individual safety quality, individual behavior and individual consciousness in find article 15 influencing factors in five aspects, the influence factors of build corresponding system.
(2) Using decision laboratory analysis (DEMATEL), it is concluded that affect worker safety conduct ongoing center are the six degrees sorting: safety education, emergency disposal ability, safety skills, safety consciousness, safety experience, ability to act.
(3) Using the ISM method, the eight factors that influence the sustainability of employees' safety behavior are: the surrounding environment, emergency resources, group pressure, environmental awareness, subordinate awareness, physiological status, psychological status and education level; Seven deep-seated: safety education, safety skills, safety experience, emergency response capabilities, mobility, safety awareness.
(4) The results of integrated decision-making laboratory analysis (DEMATEL) and Interpretation Structural Modeling (ISM) agree well with the threshold curve at $\lambda = 0.47$.
(5) According to the hierarchical organization chart of factors, corresponding countermeasures to improve the sustainability of employees' safety behavior are formulated, so as to provide new ideas and theoretical references for preventing unsafe behaviors and improving the level of behavioral safety management.

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