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Research on the Intelligence of Correctional Facility Positioning System Based on ANP-Fuzzy

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***Abstract:** The intelligent prison represents an advanced stage in prison technology and information. The precision and sophistication of the personnel positioning system form a crucial foundation for the intelligent prison. This paper addresses the current lack of clear definition regarding the intelligence level of various elements in the public security prison positioning system. It tackles issues such as the complexity of interactions and the relatively simplistic evaluation methods. The proposed solution introduces a prison positioning system based on the ANP (network analysis method) - Fuzzy (fuzzy comprehensive evaluation) wisdom index system. Utilizing the network analysis method, the paper quantitatively analyzes the importance weights of each constraint positioning factor, providing an accurate reflection of mutual influences between different system levels. The fuzzy comprehensive evaluation method integrates qualitative and quantitative assessments to yield both intuitive and numerical results. The system advocates an operational approach to refine and quantify end-level indicators, offering an effective means to evaluate the intelligence level of the prison positioning system. This holds significant importance for intelligent prison construction, ensuring supervisory safety, and advancing the scientific and technological capabilities of law enforcement.*

***Keywords:** ANP, Fuzzy, Public Security Prison, Super Decision*

1. Introduction

Positioning systems are integral components of prison management systems, particularly within the context of intelligent prison construction. The demand for the development of prison positioning systems has significantly increased. The wisdom level of a positioning system varies based on different elements within the system. Scientifically and reasonably assessing the construction and application levels of a prison positioning system is crucial for providing informed decision-making support. This is an urgent problem that requires resolution.

From a technical research standpoint, despite numerous methods and algorithms available for evaluating positioning systems, there lacks a universally recognized evaluation standard. Currently, both domestic and international research institutions have primarily focused on exploring the evaluation of positioning system applications in specific scenarios. Due to varying areas of concern, different methods have distinct emphases, and existing indices may not be universally applicable to the system. Moreover, systematic research on evaluating the wisdom degree of the entire positioning system, its application level, and effectiveness is limited

At present, for and mainly use fuzzy theory, hierarchical analysis, system dynamics, entropy weight method and other methods. Such as Hua Sheng[1] uses AHP as a new weight allocation scheme, and its simulation results show that AHP effectively expands the influence of the index gap on the weights and improves the accuracy of the existing algorithm; Zhang Chenchen et al.[2] applied AHP to wireless positioning algorithms, combining the advantages of TDOA, PDOA, AOA positioning, etc. By comparing the three positioning algorithms to derive the weight matrix and then derive the weight coefficients, it has a certain corrective effect on the three algorithms' NLOS errors, and has a very good improvement on the positioning robustness; Zujun He Zujun He et al.[3] proposed a fuzzy evaluation and gray correlation based power positioning FMEA method to solve the limitations of the traditional FMEA method, which is unable to comprehensively assess the consequences of failures and lacks quantitative evaluation indexes; Hongwei Feng Feng Hong et al.[4] For the evaluation of power positioning system RAM, the AHP method is used to determine the weights of each index of the evaluation index system, and a fuzzy comprehensive judgment model is established to quantify the system RAM and to analyze and select the different evaluation conclusions that may ultimately occur. Previous research on the positioning system did not well take into account the interdependence of factors and the influence of subjective factors, and there are certain limitations in the evaluation of wisdom, how to consider the interconnection of factors at the same time as the combination of subjectivity and objectivity has become a new breakthrough point, so this paper proposes an ANP-Fuzzy-based evaluation method applicable to public security prisons with scientific, focused, qualitative analysis and quantitative computation, which has important advantages. Therefore, this paper proposes a scientific, focused, qualitative analysis and quantitative calculation evaluation method based on ANP-Fuzzy for public security prisons, which has important practical significance.

2. Network Analysis Method

2.1. Analysis of ANP

Analytical Network Process (ANP)[5]is a method that is based on the Analytic Hierarchy Process.ANP is a practical analytical decision-making method adapted to the non-independent hierarchical structure by considering the degree of mutual influence between the internal factors of the system on the basis of the Hierarchy Process (AHP), which is not limited to the simple independent hierarchical structure.[6][7]ANP represents the logical relationship of mutual influence and dependence among the elements at each level of the target criterion system in an intuitive and reasonable way, which is not limited to a simple and independent hierarchical structure, and is superior to solving the nonlinear evaluation problems of complex systems.

2.2. Typical structure of network analysis method

A typical ANP hierarchy contains two main parts, the control layer and the network layer. The control layer consists of problem objectives and decision criteria, where each decision criterion is independent of the other and is influenced only by the problem objectives. The set of elements governed by these control layer criteria together form the network layer, and the set of elements in the network layer have a certain degree of influence and dependence on each other, thus constituting a network structure. The specific network hierarchical structure of the ANP is shown in Figure 1:

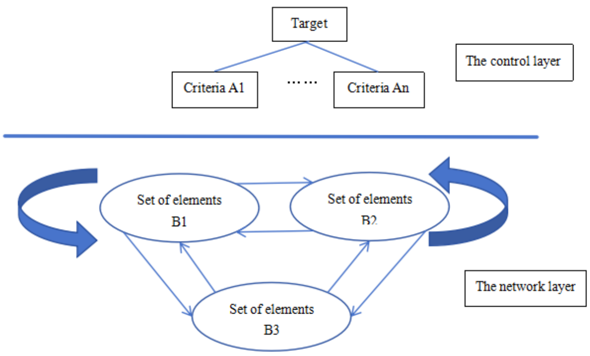

Figure 1: ANP structure diagram.

2.3. Algorithmic process

2.3.1. Analyzing the problem

By soliciting the opinions of experts in the field of industry, the target guidelines affecting the issue of the intelligence degree of the location system of the supervisory institution will be synthesized and analyzed, and the sub-criteria and element sets related to them will be derived accordingly. At the same time, the correlation relationship and the degree of influence between each element level and within the element set are analyzed.

2.3.2. Building structural models

After a comprehensive analysis of the decision-making object, the final goal of the system and the decision-making criteria are clarified, while the interdependence between the elements in the system is comprehensively assessed and the network structure model is established in this way.

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2.3.3. Constructing a judgment matrix

A two-by-two approach is used to compare the relative weights between the elements of each hierarchy. a_{ij} indicates the comparison of the importance of element i with that of element j, where $a_{ij} = \frac{1}{a_{ji}}$, the scale of the judgment matrix element a_{ij} ,as shown in Table 1:

Table 1: Meaning of judgment matrix scaling.

Number	A pair of comparison values	Meaning
1	1	Compared to each other, the two factors have equal importance
2	3	Compared to each other, the former is slightly more important than the latter
3	5	Compared to each other, the former is significantly more important than the latter
4	7	Compared to each other, the former is significantly more crucial than the latter
5	9	Compared to each other, the former is more extremely important than the latter
6	2, 4, 6, 8	The intermediate value of the aforementioned adjacent judgments

Assume that the control layer elements in the ANP areA_1 ,A_2 ,...,A_m , and the set of network layer elements areB_1 ,B_2 ,...,B_n,where the network layer element set contains the elementsb_{i2} ,.....bi_{n_i} , i=1,2,...,n.n_i is the number of elements in the element setB_i The number of elements in the set, i.e.n_i =1,2,.......,N. Putting the elements where the control layer is locatedA_s (s=1,2,...,m) as a criterion, take the network layer B_j The elements contained in b_{jl} (l=1,2,......,.... n_j) as sub-criteria, thus further constructing the set of elementsB_i of comparison matrix,as shown in Table 2:

Table 2: Judgment matrix scaling.

b_{jl}	b_{i1}	b_{i2}	...	bi_{n_i}	Normalized feature vector
B_{i1}					$f_{i1}^{(j1)}$
b_{i2}					$f_{i2}^{(j2)}$
...					...
bi_{n_i}					$f_{in_i}^{(jl)}$

2.3.4. Consistency test

longitude normalized Processing judgment matrix maximum eigenroot of the matrix λ_{max} Corresponding to the composition of elements in F, which represents the set of relative importance ranking weights between elements of different levels, there is one and only one non-zero eigenroot of the nth-order identity matrix for n, which is n; and assuming that the nth-order positive mutual inverse the largest characteristic root of matrix B$\lambda \geqq n$ B is consistent when and only when the matrix B satisfies$\lambda = n$ B is a consistent matrix.

where the consistency indicator CI is introduced:

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (1)$$

When the value of CI is close to 0, the higher matrix consistency it reflects, and when CI is 0, it has the best consistency. Meanwhile, the stochastic consistency index RI is introduced to measure the size of CI:

$$RI = \frac{CI_1 + CI_2 + \cdots + CI_n}{n} \quad (2)$$

RI is related to the order of the matrix and the correspondence is shown in Table 3[11] :

Table 3: Average Random Consistency Index.

ordinal number	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46	1.49	1.52

To further eliminate the problem of consistency deviation due to random causes, the test coefficient CR is introduced as:

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$$CR = \frac{CI}{RI} \tag{3}$$

This judgment matrix is considered to pass the consistency test if and only if the calculated value $CR < 0.1$, the judgment matrix is considered to pass the consistency test.

2.3.5. Calculate the super matrix

Assume that the control layer elements in the ANP areA_1 ,A_2 ,...,A_m , and the set of network layer elements isB_1 ,B_2 ,...,B_n , where the network layer element set contains the elementsb_{i2} ,...,b_{in_i} , i=1,2,...,n.n_i is the number of elements in the element setB_i The number of elements in the set , i.e.n_i =1,2,...,N. Taking A_s As a control criterion for the objective, the set of elements$B_j$as the control criterion for the objective, and the individual elements in the element setb_{jl} as the sub-criteria, and further construct the element setB_i.[8]

$$F_{ij} = \begin{bmatrix} f_{i1}^{(j1)} & f_{i1}^{(j2)} & \cdots & f_{i1}^{(jn_j)} \\ f_{i2}^{(j1)} & f_{i2}^{(j2)} & \cdots & f_{i2}^{(jn_j)} \\ \vdots & \vdots & \ddots & \vdots \\ f_{in_i}^{(j1)} & f_{in_i}^{(j2)} & \cdots & f_{in_i}^{(jn_j)} \end{bmatrix} \tag{4}$$

In the weight matrixF_{ij} In the weight matrix, the elementb_{jl} as the sub-criterion for the group of elementsB_i The two-by-two comparison of two elements in the matrix further yields the normalized eigenvector, denoted as $\left[f_{i1}^{(j1)}, f_{i2}^{(j1)}, \cdots, f_{in_i}^{(j1)}\right]^T$,which is the$B_i$in the elementb_{i1} ,...,..b_{i2} ,.....b_{in_i} The normalized eigenvector forB_j element in , , ..., for the element inb_{j1} , , ...b_{j2} ,.....b_{jn_i} Vector ordering of the degree of influence. When the elements are unaffected by each other, let$F_{ij} = 0$, the super matrix[9]F_s be:

$$F_S = \begin{bmatrix} F_{11} & F_{12} & \cdots & F_{1n} \\ F_{21} & F_{22} & \cdots & F_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ F_{n1} & F_{n2} & \cdots & F_{nn} \end{bmatrix} \tag{5}$$

2.3.6. Construction of weighted super matrix

The normalized sorting vector is obtained by taking theA_s control criterion, the share corresponding to the two-by-two each group element elements that are unrelated and interact with each other is taken to be 0, resulting in a normalized ranking vector, which further constitutes a weighting matrixR_s :

$$R_S = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{n1} & r_{n2} & \cdots & r_{nn} \end{bmatrix} \tag{6}$$

The weighting of theR_s Weighting the hyper matrix elements yields the weighted hyper matrix $\overline{F_s}$, denoted as follows:

$$\overline{F_S} = r_{ij}(F_{ij}), i = 1,2,\cdots,n, j = 1,2,\cdots,n \tag{7}$$

2.3.7. Calculate the stabilized weighted super matrix

$\overline{F_s}$ The element $\overline{f_{ij}}$ indicates the degree of dominance of element i over element j. However, it cannot reflect the interactions among elements across hierarchical levels, so the optimization process of

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$\overline{F_s}$ results in a stabilized weighted super matrix[9] which is expressed as follows:

$$\overline{F}_s^{\infty} = \lim_{i\to\infty} \frac{1}{n} \sum_{i=1}^{n} \overline{F}_s^{i} \tag{8}$$

When there are limit values in the processed matrix, the column vector of $\overline{F}_s^{\infty}$ is the limit sorting vector, the elements of each row are equal respectively, and the value is the weight of the corresponding element indicator, which is the global weight of each assessment indicator.

3. Fuzzy Integrated Evaluation Method

3.1. Overview

Fuzzy comprehensive evaluation method is a kind of scientific evaluation method with both composite and comprehensive nature based on the premise of fuzzy mathematics theory research, which is widely used in decision-making and evaluation problems facing uncertainty and fuzzy information. Its core idea lies in transforming vague and difficult-to-quantify qualitative information into clear and quantifiable quantitative evaluation results by means of fuzzy set, affiliation function, fuzzy rule establishment and fuzzy reasoning.

3.2. Algorithmic process

3.2.1. Constructing a collection of target guidelines

For the first-level indicators affecting the intelligence of the jail location system, it is assumed that they belong to the same set of elements U, denoted as follows:

$$\mathrm{U} = \{\mathrm{u}_1, \mathrm{u}_2, \dots, \mathrm{u}_\mathrm{n}\} \tag{9}$$

3.2.2. Allocation of weights of evaluation indicators

Let the weight matrix of the element set U be W. The set of weights can be obtained from ANP, expressed as follows:

$$\mathrm{W} = \{\mathrm{w}_1, \mathrm{w}_2, \dots, \mathrm{w}_\mathrm{n}\} \tag{10}$$

3.2.3. Establishment of fuzzy affiliation matrix

The fuzzy affiliation matrix can be functionally represented by a series of affiliation functions. With m evaluation indicators, each with n evaluation levels, the fuzzy affiliation matrix M can be expressed as an m*n matrix, where each element M_{ij} .denotes the degree of affiliation of indicator i on indicator j.

3.2.4. Setting up an option set

The device selection set V is the set of elevator's judgment results for each element, which is expressed as follows:

$$\mathrm{V} = \{\mathrm{v}_1, \mathrm{v}_2, \dots, \mathrm{v}_\mathrm{m}\} \tag{11}$$

3.2.5. Fuzzy judging of single elements

The Evaluating individual factors in the set of elements U yields the degree of affiliation of the evaluation target to the elements in the alternative set.[10] The degree of affiliation of the target to the elements of the alternative set is determined. Assuming that for an element u_i in the element set U, the degree of affiliation of this element to an element v_j in the alternative set V is denoted as r_{ij}, and so on, expressed as follows:

$$\mathrm{R_i} = \frac{\mathrm{r_{i1}}}{\mathrm{v_1}} + \frac{\mathrm{r_{i2}}}{\mathrm{v_2}} + \dots + \frac{\mathrm{r_{im}}}{\mathrm{v_m}} \tag{12}$$

At this point R_i constitutes a single-element evaluation set, expressed as follows.

$$\mathrm{R_i} = \{\mathrm{r_{i1}}, \mathrm{r_{i2}}, \dots, \mathrm{r_{im}}\} \tag{13}$$

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3.2.6. Obtaining Fuzzy Comprehensive Evaluations.

The weight matrix W and the single-element evaluation matrix R are subjected to a fuzzy transformation process, which further constitutes a fuzzy comprehensive evaluation set B, where the elements b_j in set B are the corresponding impact indicators.

$$B = W \cdot R = (\omega_1, \omega_2, \ldots, \omega_n) \cdot \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix} = b_1, b_2, \ldots, b_m \tag{14}$$

3.2.7. Optimization of indicators.

With b_j as weights, the elements of the alternative set v_j are weighted and averaged to obtain the optimized result, which is expressed as follows:

$$v = \sum_{j=1}^{m} b_j v_j \div \sum_{j=1}^{m} b_j \tag{15}$$

Where, V is the fuzzy comprehensive evaluation result.

4. Super Decision software

Super Decision is a state-of-the-art software tool designed for multi-criteria decision analysis (MCDA), further developed by Prof. Rozann W. Satty in collaboration with William Adams on the basis of ANP. It follows the core concepts of AHP and ANP, especially the ideas of hierarchical structure and two-by-two comparison. When using Super Decision for decision analysis, users can take more factors and interrelationships into consideration, further realizing the digitization, proceduralization, and modeling of ANP theory and process.In this paper, Super Decision software is used to operate and process the data derived through ANP.

5. Constructing the Wisdom Degree Indicator System of Public Security Prison Positioning System

Table 4: The referential relationship between symbols and constituents in a localization system.

Objective	Primary indicators	Secondary indicators
Correctional Facility Positioning System Intelligence Index System A	Basic Function C1	Real-time position tracking C11
		Historical trajectory querying C12
		Control center management C13
	Linkage Capacity C2	Linked Video Surveillance System C21
		Linked Access Control System for Entrances and Exits C22
		Linked Electronic Fence System C23
		Linked Alarm System C24
		Linked Maintenance and Operation Support System C25
	Anomalous Event Analysis C3	Outlier Monitoring C31
		Crowd Overloading C32
		Prolonged Stay Timeout C33
		Unaccompanied Individuals C34
		Event Situation Assessment C35

The factors affecting the intelligence of the public security prison positioning system involve many aspects, and it is necessary to meet the requirements of comprehensiveness and pertinence in the identification of indicators. By analyzing the research results of related literature and interviews and surveys to obtain evaluation indicators, and through the analysis of industry experts, the intelligence of the public security prison positioning system is finally evaluated based on the network hierarchy method of dependence and feedback (ANP), and two levels of indicators have been derived. That is, the basic function C1, the linkage ability C2, and the dissimilarity analysis C3 are three first-level indexes, and the corresponding 13 second-level indexes with interdependence, which are as follows:

Basic functions: real-time location positioning, historical track query, control center management.

Linkage capability: linkage video surveillance system, linkage entrance/exit control system, linkage electronic fence system, linkage alarm system, linkage security operation and maintenance system.

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Alteration analysis: outlier monitoring, crowd overcrowding, overstaying, unaccompanied, state of affairs analysis.

After completing the construction of secondary and tertiary indicators, the finalization of the intelligence degree indicator system of the prison location system is shown in Table 4.

6. Example based on X City Supervisor's Office

This paper chooses the wisdom of X city public security prison positioning system as the evaluation target, and on the basis of exhaustive preliminary research and fieldwork, integrates the adaptive data such as the actual situation of the elements affecting the evaluation target and the parameter situation, to provide support for the subsequent analysis work.

6.1. Constructing an indicator set of impact elements

$$A = \{C_1, C_2, C_3\} \tag{16}$$

$$C_1 = \{C_{11}, C_{12}, C_{13}\} \tag{17}$$

$$C_2 = \{C_{21}, C_{22}, C_{23}, C_{24}, C_{25}\} \tag{18}$$

$$C_3 = \{C_{31}, C_{32}, C_{33}, C_{34}, C_{35}\} \tag{19}$$

A table of influences and correlations between the elements was constructed by means of a survey of domain experts, the form of which is shown in Table 5:

Table 5: Index Influence correlation.

		C1			C2					C3				
		C11	C12	C13	C21	C22	C23	C24	C25	C31	C32	C33	C34	C35
C1	C11		√	√	√	√	√	√	√	√	√		√	
	C12			√	√	√	√	√	√	√				√
	C13	√	√		√	√	√	√	√	√	√	√	√	√
C2	C21							√		√	√	√	√	√
	C22						√	√		√				√
	C23					√		√		√				√
	C24				√	√	√		√	√	√	√	√	√
	C25	√	√	√	√	√	√	√		√	√	√	√	√
C3	C31				√	√	√	√					√	√
	C32				√	√	√	√						√
	C33				√	√	√	√						√
	C34				√	√	√	√						√
	C35				√	√	√	√	√					

Based on the dependencies between the indicators and the influencing elements at each level, the corresponding network hierarchy is derived, while the two-by-two comparison matrix and the three-level indicator supermatrix are further derived from the table of interactions between the elements. As shown in Figure 2.

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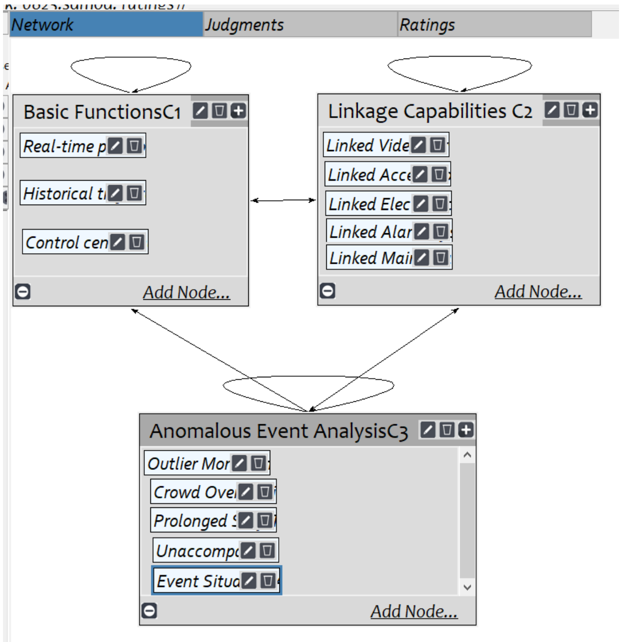

Figure 2: Network structure diagram.

6.2. Constructing the super matrix

The expert scores are sequentially inputted into the constructed ANP network model of the intelligence of the jail positioning system through Super Decision. As shown in Figure 3 and Figure 4.

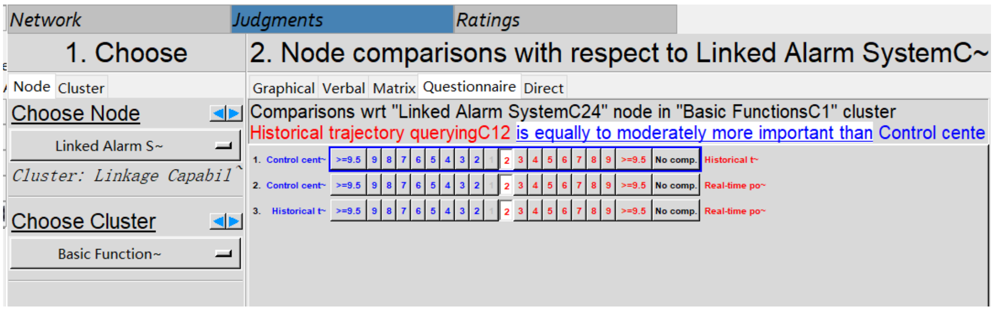

Figure 3: Super Decision Data Entry Chart.

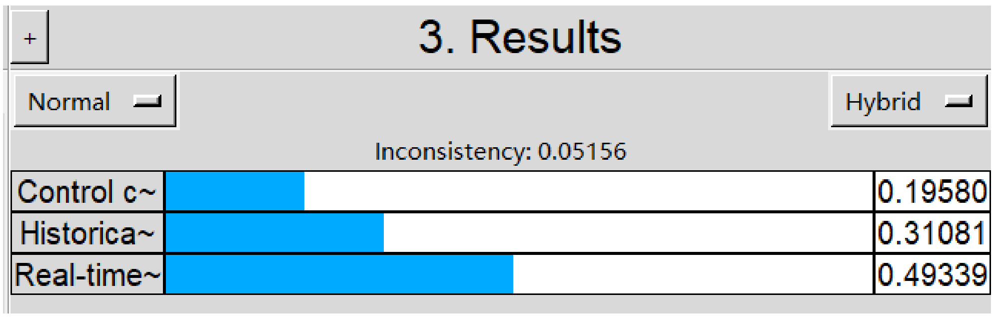

Figure 4: Output numerical results.

Inconsistency has a value less than 0.1 indicating consistency and indicates the proportionate weight of all elements present in the given community, the magnitude of which can be obtained from the bar table.

Based on the first-level indicators, the interrelationships between the second-level indicators were analyzed under different conditions of influence factors, and the unweighted super matrix, weighted super matrix, and limit super matrix were obtained by using SD software, as shown in Fig.As shown in Table 6-8:

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Table 6: Unweighted super matrix.

Main Network: 0825.sdmod: ratings: Unweighted S...

Clusters	Nodes	Crowd ...	Event Sit...	Outlier ...	Prolong...	Unaccom...	Control ...	Historica...	Real-ti...	Linked A...	Linked A...	Linked ...	Linked ...	Linked Vi...
Anomalous Event AnalysisC3	Crowd OverloadingC32	0.000000	0.194799	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.191513	0.140512	0.120999	0.000000	0.141291
	Event Situation AssessmentC35	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.372270	0.421537	0.416972	1.000000	0.423874
	Outlier MonitoringC31	0.000000	0.433577	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.203583	0.212110	0.210671	0.000000	0.162803
	Prolonged Stay TimeoutC33	0.000000	0.176826	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.094378	0.119786	0.091700	0.000000	0.109228
	Unaccompanied IndividualsC34	0.000000	0.194799	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.138256	0.106055	0.159659	0.000000	0.162803
Basic FunctionsC1	Control center managementC13	0.250000	0.666667	0.195800	1.000000	0.250000	0.000000	0.666667	1.000000	0.493386	0.195800	0.493386	0.195800	0.493386
	Historical trajectory queryingC12	0.000000	0.333333	0.310814	0.000000	0.000000	0.333333	0.000000	0.000000	0.195800	0.310814	0.195800	0.310814	0.195800
	Real-time position trackingC11	0.750000	0.000000	0.493386	0.000000	0.750000	0.666667	0.333333	0.000000	0.310814	0.493386	0.310814	0.493386	0.310814
Linkage Capabilities C2	Linked Access Control System for Entrances and Exits C22	0.000000	0.134990	0.111434	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.245562	0.249311	0.000000	0.000000
	Linked Alarm SystemC24	0.660761	0.400035	0.194464	0.527836	0.614411	0.000000	0.000000	0.000000	0.527836	0.000000	0.593634	1.000000	0.800000
	Linked Electronic Fence System C23	0.000000	0.149399	0.227840	0.000000	0.000000	0.000000	0.000000	0.000000	0.332516	0.245562	0.000000	0.000000	0.000000
	Linked Maintenance and Operation Support SystemC25	0.131112	0.073137	0.084760	0.139648	0.117221	1.000000	1.000000	1.000000	0.139648	0.069571	0.157056	0.000000	0.200000
	Linked Video Surveillance SystemC21	0.208127	0.242438	0.381501	0.332516	0.268369	0.000000	0.000000	0.000000	0.000000	0.439305	0.000000	0.000000	0.000000

Table 7: Weighted super matrix.

Main Network: 0825.sdmod: ratings: Weighted Sup...

Clusters	Nodes	Crowd ...	Event Si...	Outlier ...	Prolong...	Unacco...	Control ...	Historica...	Real-tim...	Linked A...	Linked ...	Linked E...	Linked M...	Linked Vi...
Anomalous Event AnalysisC3	Crowd OverloadingC32	0.000000	0.138084	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.132327	0.097088	0.083605	0.000000	0.097627
	Event Situation AssessmentC35	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.257223	0.291265	0.288111	0.690959	0.292880
	Outlier MonitoringC31	0.000000	0.307344	0.000000	0.000000	0.708856	0.000000	0.000000	0.000000	0.140667	0.146559	0.145565	0.000000	0.112490
	Prolonged Stay TimeoutC33	0.000000	0.125344	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.065212	0.082767	0.063361	0.000000	0.075472
	Unaccompanied IndividualsC34	0.000000	0.138084	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.095530	0.073280	0.110318	0.000000	0.112490
Basic FunctionsC1	Control center managementC13	0.096622	0.075016	0.075675	0.386488	0.028131	0.000000	0.111111	0.166667	0.045097	0.017897	0.045097	0.017897	0.045097
	Historical trajectory queryingC12	0.000000	0.037508	0.120126	0.000000	0.000000	0.055556	0.000000	0.000000	0.017897	0.028409	0.017897	0.028409	0.017897
	Real-time position trackingC11	0.289866	0.000000	0.190688	0.000000	0.084393	0.111111	0.055556	0.000000	0.028409	0.045097	0.028409	0.045097	0.028409
Linkage Capabilities C2	Linked Access Control System for Entrances and Exits C22	0.000000	0.024112	0.068366	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.053444	0.054260	0.000000	0.000000
	Linked Alarm SystemC24	0.405385	0.071455	0.119306	0.323834	0.109746	0.000000	0.000000	0.000000	0.114877	0.000000	0.129198	0.217638	0.174111
	Linked Electronic Fence System C23	0.000000	0.026686	0.139783	0.000000	0.000000	0.000000	0.000000	0.000000	0.072368	0.053444	0.000000	0.000000	0.000000
	Linked Maintenance and Operation Support SystemC25	0.080439	0.013064	0.052001	0.085676	0.020938	0.833333	0.833333	0.833333	0.030393	0.015141	0.034181	0.000000	0.043528
	Linked Video Surveillance SystemC21	0.127688	0.043304	0.234056	0.204002	0.047936	0.000000	0.000000	0.000000	0.000000	0.095610	0.000000	0.000000	0.000000

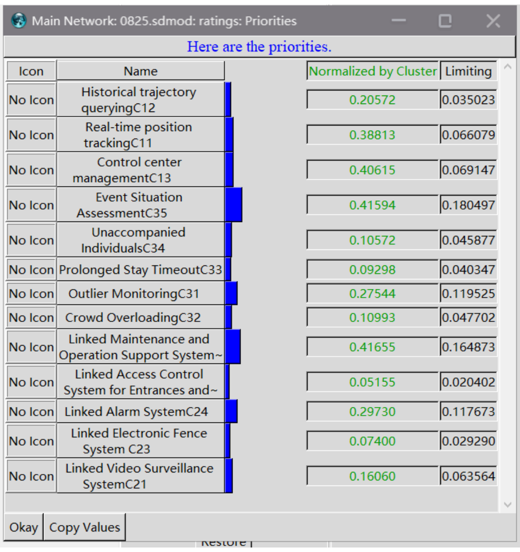
Table 8: Extreme super matrix.

Main Network: 0825.sdmod: ratings: Limit Matrix

Clusters	Nodes	Crowd O...	Event Sit...	Outlier ...	Prolong...	Unacco...	Control c...	Historic...	Real-ti...	Linked ...	Linked Al...	Linked E...	Linked ...	Linked Vid...
Anomalous Event AnalysisC3	Crowd OverloadingC32	0.047702	0.047702	0.047702	0.047702	0.047702	0.047702	0.047702	0.047702	0.047702	0.047702	0.047702	0.047702	0.047702
	Event Situation AssessmentC35	0.180497	0.180497	0.180497	0.180497	0.180497	0.180497	0.180497	0.180497	0.180497	0.180497	0.180497	0.180497	0.180497
	Outlier MonitoringC31	0.119525	0.119525	0.119525	0.119525	0.119525	0.119525	0.119525	0.119525	0.119525	0.119525	0.119525	0.119525	0.119525
	Prolonged Stay TimeoutC33	0.040347	0.040347	0.040347	0.040347	0.040347	0.040347	0.040347	0.040347	0.040347	0.040347	0.040347	0.040347	0.040347
	Unaccompanied IndividualsC34	0.045877	0.045877	0.045877	0.045877	0.045877	0.045877	0.045877	0.045877	0.045877	0.045877	0.045877	0.045877	0.045877
Basic FunctionsC1	Control center managementC13	0.069147	0.069147	0.069147	0.069147	0.069147	0.069147	0.069147	0.069147	0.069147	0.069147	0.069147	0.069147	0.069147
	Historical trajectory queryingC12	0.035023	0.035023	0.035023	0.035023	0.035023	0.035023	0.035023	0.035023	0.035023	0.035023	0.035023	0.035023	0.035023
	Real-time position trackingC11	0.066079	0.066079	0.066079	0.066079	0.066079	0.066079	0.066079	0.066079	0.066079	0.066079	0.066079	0.066079	0.066079
Linkage Capabilities C2	Linked Access Control System for Entrances and Exits C22	0.020402	0.020402	0.020402	0.020402	0.020402	0.020402	0.020402	0.020402	0.020402	0.020402	0.020402	0.020402	0.020402
	Linked Alarm SystemC24	0.117673	0.117673	0.117673	0.117673	0.117673	0.117673	0.117673	0.117673	0.117673	0.117673	0.117673	0.117673	0.117673
	Linked Electronic Fence System C23	0.029290	0.029290	0.029290	0.029290	0.029290	0.029290	0.029290	0.029290	0.029290	0.029290	0.029290	0.029290	0.029290
	Linked Maintenance and Operation Support SystemC25	0.164873	0.164873	0.164873	0.164873	0.164873	0.164873	0.164873	0.164873	0.164873	0.164873	0.164873	0.164873	0.164873
	Linked Video Surveillance SystemC21	0.063564	0.063564	0.063564	0.063564	0.063564	0.063564	0.063564	0.063564	0.063564	0.063564	0.063564	0.063564	0.063564

6.3. Ranking and weighting of risk factors

After data entry according to Super Decision software, by clicking on the "priorities" command button, you can get the weight analysis table of each impact indicator, as shown in Figure 5:


Main Network: 0825.sdmod: ratings: Priorities

Here are the priorities.

Icon	Name	Normalized by Cluster	Limiting
No Icon	Historical trajectory queryingC12	0.20572	0.035023
No Icon	Real-time position trackingC11	0.38813	0.066079
No Icon	Control center managementC13	0.40615	0.069147
No Icon	Event Situation AssessmentC35	0.41594	0.180497
No Icon	Unaccompanied IndividualsC34	0.10572	0.045877
No Icon	Prolonged Stay TimeoutC33	0.09298	0.040347
No Icon	Outlier MonitoringC31	0.27544	0.119525
No Icon	Crowd OverloadingC32	0.10993	0.047702
No Icon	Linked Maintenance and Operation Support System~	0.41655	0.164873
No Icon	Linked Access Control System for Entrances and~	0.05155	0.020402
No Icon	Linked Alarm SystemC24	0.29730	0.117673
No Icon	Linked Electronic Fence System C23	0.07400	0.029290
No Icon	Linked Video Surveillance SystemC21	0.16060	0.063564

Okay Copy Values

Figure 5: Results of the impact indicator weights.

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The resulting stable weighting matrix is further optimized and organized to finally obtain the weights occupied by the elements at all levels that affect the wisdom degree, as shown in Table 9:

Table 9: Indicator weight results.

Objective	Primary indicators	Primary indicator weights	Secondary indicators	Local weights	Global weights	order
Correctional Facility Positioning System Intelligence Index System A	Basic Functions C1	0.170249	Real-time position tracking C11	0.38813	0.066079	6
			Historical trajectory querying C12	0.20572	0.035023	11
			Control center management C13	0.40615	0.069147	5
	Linkage Capabilities C2	0.395802	Linked Video Surveillance System C21	0.16060	0.063564	7
			Linked Access Control System for Entrances and Exits C22	0.05155	0.020402	13
			Linked Electronic Fence System C23	0.07400	0.029290	12
			Linked Alarm System C24	0.29730	0.117673	4
			Linked Maintenance and Operation Support System C25	0.41655	0.164873	2
	Anomalous Event Analysis C3	0.433948	Outlier Monitoring C31	0.27544	0.119525	3
			Crowd Overloading C32	0.10993	0.047702	8
			Prolonged Stay Timeout C33	0.09298	0.040347	10
			Unaccompanied Individuals C34	0.10572	0.045877	9
			Event Situation Assessment C35	0.41594	0.180497	1

6.4. Constructing a fuzzy evaluation matrix

After further investigation and research by 20 industry-experienced prison police officers and experts, a fuzzy evaluation of the wisdom degree of the X City Public Security Prison Positioning System was carried out through the differences in the set wisdom degree levels and the weights accounted for by the indicators of the influencing elements.[9] .

Set the intelligence degree level of the monitoring center positioning system into four levels: excellent, good, medium and poor, and assign values to each of the four levels.85 70 60 50

According to the order of the score from high to low, in order to indicate the level of wisdom of the positioning system in which the element is located, the expert evaluation results are shown in Table 10:

Table 10: Weight set W for evaluation indicators.

Number	Secondary indicators	Global weights	Assessment levels			
			Excellent	Good	Average	Poor
1	Real-time position tracking C11	0.0661	10	1	1	0
2	Historical trajectory querying C12	0.0350	9	2	1	0
3	Control center management C13	0.0691	8	2	2	0
4	Linked Video Surveillance System C21	0.0636	8	3	1	0
5	Linked Access Control System for Entrances and Exits C22	0.0204	8	2	2	0
6	Linked Electronic Fence System C23	0.0293	9	2	1	0
7	Linked Alarm System C24	0.1177	7	4	1	0
8	Linked Maintenance and Operation Support System C25	0.1649	8	3	1	0
9	Outlier Monitoring C31	0.1195	9	2	1	0
10	Crowd Overloading C32	0.0477	8	2	2	0
11	Prolonged Stay Timeout C33	0.0403	7	4	1	0
12	Unaccompanied Individuals C34	0.0459	10	2	0	0
13	Event Situation Assessment C35	0.1805	9	2	1	0

Statistical weights for single-factor indicators R

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$$R=\begin{bmatrix} 0.8333 & 0.0833 & 0.0833 & 0 \\ 0.75 & 0.1667 & 0.0833 & 0 \\ 0.6667 & 0.1667 & 0.1667 & 0 \\ 0.6667 & 0.25 & 0.0833 & 0 \\ 0.6667 & 0.1667 & 0.1667 & 0 \\ 0.75 & 0.1667 & 0.0833 & 0 \\ 0.5833 & 0.3333 & 0.0833 & 0 \\ 0.6667 & 0.25 & 0.0833 & 0 \\ 0.75 & 0.1667 & 0.0833 & 0 \\ 0.6667 & 0.1667 & 0.1667 & 0 \\ 0.5833 & 0.3333 & 0.0833 & 0 \\ 0.8333 & 0.1667 & 0 & 0 \\ 0.75 & 0.1667 & 0.0833 & 0 \end{bmatrix} \quad (20)$$

Fuzzy Comprehensive Judgment Conclusion B

$$B=W\bullet R=[0.7025 \quad 0.2065 \quad 0.0909 \quad 0] \quad (21)$$

Fuzzy Comprehensive Score v

$$v=B*VCT=0.7025*85+0.2065*70+0.0909*60+0*50=79.628 \quad (22)$$

According to the given rating, the intelligence level assessment of X City Prison Positioning System is considered "Good." The results objectively reflect its level of intelligence.

7. Conclusions

In this paper, the ANP-Fuzzy-based wisdom evaluation study provides public security prisons with a methodology that comprehensively considers multiple factors, which helps to identify the system's shortcomings and room for improvement, thus realizing a more effective and intelligent operation of the prison positioning system. In terms of decision support, a systematic evaluation framework is provided to provide managers and decision makers with an in-depth understanding of the intelligence of the location system in the institution, which helps to give full consideration to the comparison of the ANP-Fuzzy intelligence evaluation results of different public security institution location systems to identify the relative strengths and weaknesses between different systems and the direction of improvement.

Meanwhile, in the future, the ANP-Fuzzy method can be considered to be combined with other intelligent technologies, such as machine learning and deep learning, in order to further enhance the intelligence and performance of the public security prison positioning system, and to provide more reliable decision support for the construction of intelligent public security prisons.

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