Computer-Aided Design AND APPLICATIONS

Construction and Application of Industry-University-Research Platform Based on Software Engineering and Internet of Things Technology in Digital Art

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Abstract. In order to improve the practical effect of industry-university-research research, this paper combines software engineering and Internet of Things technology to build and apply the industry-university-research platform, and focuses on the analysis of system security and data processing in the operation process of industry-university-research research.Moreover, this paper combines the actual operation requirements of industry, university and research institute to propose a security situation assessment technology based on the fuzzy comprehensive evaluation method, and considers a variety of influencing factors to grasp the security status of the industry-university-research platform from multiple angles in all aspects.In addition, this paper imports the keyword co-occurrence matrix obtained by ROST software into SPSS19.0 software for cluster analysis and statistical clustering results. Finally, this paper combines expert evaluation to comprehensively evaluate the effect of the platform. The research shows that the industry-university-research platform based on software engineering and Internet of Things technology proposed in this paper meets the current actual needs of industry-university-research research.

Keywords: Software engineering; Internet of Things; industry-university-research; platform; Digital Art.
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1 INTRODUCTION

The concept of industry-university-research is an education mode that combines production, teaching, and research. Moreover, it is a contemporary trend of cooperation formed by universities, engineering training centers, and enterprises jointly exploring and solving common problems such as personnel training, material production, and scientific and technological research. The emergence of the industry-university-research model can make good use of mechanical production, enabling college students to cultivate their own thinking mode, practical ability and innovative spirit in the process of practice, and then lead the results of technological research to technological innovation [1].As for the concept of industry-university-research cooperation, there is no clear definition at home and abroad. This field has always been valued by experts and scholars in related fields in my country and other countries or regions, and has achieved rich research results, which has greatly improved the industry-university-research cooperation theory. Now, we summarize several representative viewpoints as follows.Some scholars believe that the industry-university-research cooperative alliance refers to the close connection between science and technology innovation clusters and industrial clusters through universities, research institutes, etc. [2]. With the aid of the industrial cluster effect, external economic growth can be achieved, transaction costs can be effectively reduced, and the scientific and technological innovation alliance can be realized to strengthen the overall scientific and technological strength.Some researchers also pointed out that industry-university-research cooperation refers to the establishment of a consortium based on the interests of universities and enterprises. It uses certain models and operating mechanisms to complement each other's advantages, give full play to their respective strengths, achieve comprehensive development, and achieve the goal of mutual benefit and win-win results.Sachiko Harayama pointed out that industry-university-research cooperation refers to the formation of interactive cooperation between three heterogeneous parties driven by their own resources and driven by policies and markets. By participating in the cooperation mechanism to realize the combination of production factors, mutual cooperation and mutual promotion, effectively tap their own potential, and achieve common development [3].Digital Art involves combining academic research, industry collaboration, and practical applications to foster innovation and growth in the field.

As the country's soft power, scientific and technological innovation and knowledge innovation are the strategic support to enhance social productivity, overall national strength and international competitiveness, and are the driving force for rapid and sound economic development. Universities and research institutes, as important innovation entities in my country's basic research, cutting-edge technology research, and applied research, are the creators of innovative scientific research results and knowledge resources of industry-university-research cooperation. As the main force of industry-university-research innovation, enterprises undertake the mission of national economic development. Industry-university-research cooperation innovation between universities, scientific research institutes and enterprises has become the main way of technological innovation and knowledge innovation. It has a role in promoting the transformation rate of scientific and technological achievements, talent exchange and training, and the process of industrialization development, and it has contributed to the enhancement of my country's economic development. And international competitiveness has important practical significance.

This paper combines the construction and application of the industry-university-research platform with software engineering and the Internet of Things technology, and combines the current status of the industry-university-research application to construct the system function structure, which provides a reference for the further development of the subsequent industry-university-research.

2 RELATED WORK

The division of policies and regulations for industry-university-research cooperation in foreign countries is mainly based on the characteristics of national legislation. Many Western countries implement a federal system. The federal government and the state government enjoy a certain relationship of power equality and restriction. Some policies and regulations related to the social development of the region are generally controlled by the state government. Therefore, the formulation of technological innovation policies and regulations is usually controlled by the state government. The state government is formulated according to the characteristics of the form of industry-university-research cooperation in the administrative region. Some scholars classify the types of policies according to the degree of government intervention in the market [4]. Literature [5] describes the transitional relationship between scientific knowledge and the relevant stages of technological application, industrial activity and economic value transformation. According to the government's intervention and intervention in the market, policies are divided into voluntary, mandatory, and mixed types. Literature [6] shows that policy deployment is an effective way to stimulate innovation. It believes that policy guidance on the market can increase enterprise risk investment, and technology innovation policies are divided into strategic layer, comprehensive layer and basic layer according to different structures and levels. . The strategic level is to make overall planning from the national perspective, the comprehensive level is to make regulations from the scope of the state, and the basic level is to limit the scope of activities in a specific area. Foreign research on the structure of industry-university-research policies and regulations is mainly based on the characteristics of the national legislative system, the method of policy deployment and the degree of government intervention in the market to classify the types of relevant policies, and the technology innovation policy is divided into strategic layer, comprehensive layer and basic Layer [7].

For the research on the policy and regulation system for industry-university-research cooperation, some scholars focus on the development of industrial clusters and regional innovation, mainly from the perspective of policy planning in terms of knowledge integration, scope of economic activities, and performance management. Literature [8] believes that the degree of knowledge integration between the main bodies of the industrial cluster and the scope of their economic activities are the key factors affecting economic benefits. Literature [9] believes that when companies cooperate, they usually use the spillover effect of knowledge to benefit from the industrial cluster. Therefore, knowledge management (KM) and performance management (PM) need to be considered when policy makers and cluster partners cooperate. Related factors. Some scholars have emphasized the role of science and technology intermediaries in the process of technology transfer. Literature [10] believes that the role of science and technology intermediaries should be played in the process of technology transfer, which can effectively reduce the cost of obtaining relevant information and increase the professionalism of cooperation. Literature [11] compares the similarities and differences in property management, technology transfer, and operating mechanism of five well-known research institutions in the United States, and extracts methods that can be used to establish or improve technology transfer institutions in the United States. Some scholars believe that it is necessary to pay attention to the relevant policies of universities' research funding, professional technical capabilities and property rights protection. Literature [12] emphasizes the technology used in the transfer of technology within universities and believes that it is necessary to improve the regulations on knowledge and technology in the process of technology transfer in universities. Literature [13] compares the research funding, intellectual property income and patent licensing of two specific universities in the United Kingdom and Japan, and believes that Japan’s industry-university-research cooperation can improve technology transfer through the implementation of patent strategies and technology transfer reviews. ability.

Regarding the problems in the policies and regulations of industry-university-research cooperation, some scholars analyze the shortcomings of existing policies from the cultural differences, direction and transaction barriers that exist in the cooperation between universities and enterprises. Literature [14] analyzes the obstacles to the partnership between universities and enterprises, and believes that the "cultural gap" between the two is a major obstacle to successful cooperation, and the professional knowledge of researchers should be fully utilized to develop cooperation. Strategy and system regulations. The literature [15] pointed out that there are mainly directional obstacles and transactional obstacles in the cooperation between universities and enterprises, and discussed the influence of cooperation experience, communication breadth and trust between partners on reducing different types of obstacles. Regarding the further improvement of policies and regulations for industry-university-research cooperation, some scholars have suggested that when formulating technological innovation policies, attention should be paid to the impact of the corresponding knowledge environment and the strategic needs of local regional innovation. Literature [16] analyzes the related motivations of university knowledge transfer and believes that in the regional innovation system, policies can promote university knowledge transfer and enhance regional innovation capabilities. It emphasizes that when policies are formulated, attention should be paid to the globalized knowledge environment. Literature [17] analyzes the relationship between scientific research innovation policies and local innovation performance, and believes that the government should plan regional innovation policies in a targeted manner according to the different strategic needs of each region when formulating policies.

3 SYSTEM ALGORITHM BASED ON SOFTWARE ENGINEERING AND INTERNET OF THINGS TECHNOLOGY

The first thing that the industry-university-research platform needs to consider is to ensure the stable operation of the platform during the industry-university-research process, of which system security is particularly important. However, software engineering and Internet of Things technology have been relatively mature in the development of industry, university and research. Therefore, this paper studies the information security of the system.

This paper combines the unique security information of the cryptographic industry-university-research platform in the cloud environment, and refers to the "Guidelines for Classification and Classification of Information Security Events" and the "Security Technical Requirements for Cryptographic Modules" to establish the industry-university-research platform situation assessment index system as shown in the figure.

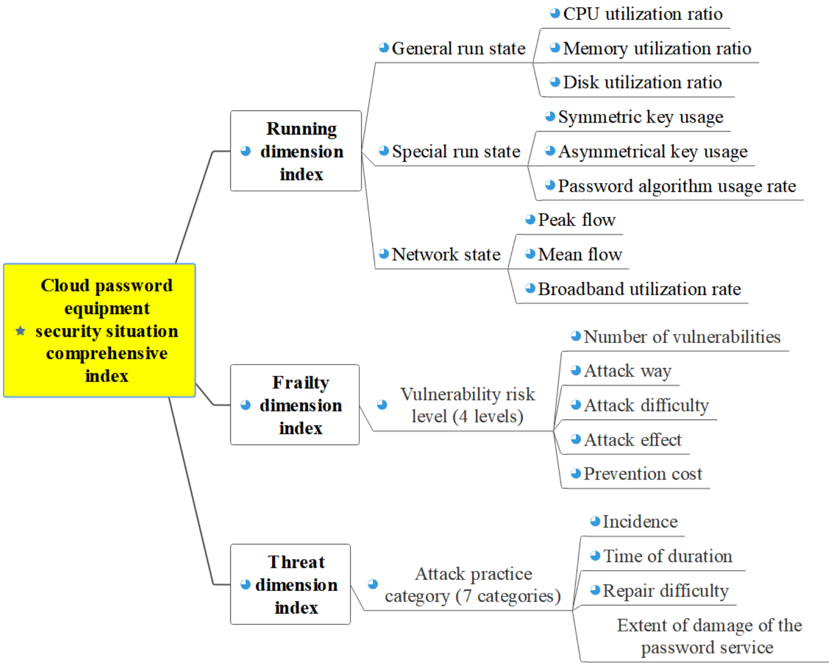

Figure 1: Cloud Crypto Industry-University-Research Platform Situation Evaluation Index System.

The index system generally divides the cloud crypto industry-university-research platform situation comprehensive index into three dimensions: operation dimension, vulnerability dimension, and threat dimension.

The evaluation indicators are different in types, units, and magnitudes. It is not scientific to proceed directly with the result. Therefore, to standardize the evaluation indicators, this paper chooses to convert each indicator value into a dimensionless value on the closed interval [0,1]. Situation assessment indicators are generally divided into quantitative indicators and qualitative indicators. The standardization methods of indicators are divided into standardization method and threshold method. In this paper, the threshold method is used to standardize the indicators:

1. Standardization of quantitative indicators

Quantitative indicators can be divided into three types: positive indicators, reverse indicators, and interval indicators. We assume that their corresponding index sets are θ_1,θ_2 and θ_3 respectively, and determine their maximum $\theta_{\max}$ and minimum $\theta_{\min}$ in their respective domains.

The positive index means that the standardized value of the index increases with the increase of the index value. The standardization method is: for any $\theta_i \in \theta_1$, there are[18]:

$$\theta_i = (\theta_i - \theta_{\min}) / (\theta_{\max} - \theta_{\min}) \tag{1}$$

The reverse index means that the standardized value of the index decreases with the increase of the index value. The standardization method is: for any $\theta_i \in \theta_2$, there are:

$$\theta_i = (\theta_{\max} - \theta_i) / (\theta_{\max} - \theta_{\min}) \tag{2}$$

Interval indicators indicate that the indicator value is not a point value but an interval. The standardization method is: for any $\theta_i \in \theta_3$, there are[19]:

$$\theta_i = \begin{cases} \dfrac{\theta_i - \theta_{\min}}{\bar{\theta} - \theta_{\min}}, \theta_i \in \left[\theta_{\min}, \bar{\theta}\right] \\ \dfrac{\theta_i - \theta_{\max}}{\bar{\theta} - \theta_{\max}}, \theta_i \in \left[\bar{\theta}, \theta_{\max}\right] \\ 0, \text{other} \end{cases} \tag{3}$$

2. Standardization of qualitative indicators

The standardization of qualitative indicators is divided into direct standardization and indirect standardization.

For the classification of evaluation levels, this paper refers to the Internet Security Center (Center for Internet Security, CIS) network security threats related to the alert level information and the "Information Security Incident Classification and Classification Guidelines". According to the standardized results of each situation assessment index value (the range of values is [0,1]), the situation assessment level is divided into V={Excellent, Good, Moderate, Poor, Dangerous }, and the specific situation assessment level domain information is shown in table 1, and $V=\{v_1,v_2,v_3,v_4,v_5\}=\{0.1,0.3,0.575,0.825,0.95\}$ is the value obtained after taking the average value in each interval.

Security Level	*Index Range*	*Description*
Excellent	*[0,0.2]*	*The cloud network is operating normally and in an excellent state, and there are few or no network attack activities and security vulnerabilities, the password industry-university-research platform is operating in good condition, and the network and password resource consumption levels are low.*
Good,	*[0.2,0.4]*	*The cloud network operation is slightly affected and in good condition, and a small amount of network attack activities and security vulnerabilities have been discovered, the password industry-university-research platform is operating normally, and the network and password resource consumption levels are normal.*
Moderate	*[0.4,0.75]*	*The cloud network operation has been affected to a certain extent and is in a general state, and some network attack activities and security vulnerabilities have been discovered, the password industry-university-research platform has a general operating state, and the network and password resource consumption levels are high.*
Poor	*[0.75,0.9]*	*The cloud network operation has been greatly affected and is in a poor state, and many network attack activities and security vulnerabilities have been discovered, the password industry-university-research platform is operating in a poor state, and the network and password resource consumption levels are serious.*
Dangerous	*[0.9,1]*	*The operation of the cloud network has been greatly affected and is in a dangerous state, and a large number of network attack activities and security vulnerabilities have been discovered, the operating status of the password industry-university-research platform is extremely poor, and the level of network and password resource consumption is very serious.*

Table 1: Index of Security Level Classification.

Fuzzy Analytic hierarchy process (FAHP) can more accurately and objectively reflect the importance of each index in the situation assessment. The literature has proved the accuracy and rationality of FAHP. Therefore, this paper uses FAHP to calculate the weight of the indicator. First, the related concepts of fuzzy consistent matrix are given.

The definition 1 is: We assume that the matrix $R=\left(r_{ij}\right)_{n\times n}$, and if it satisfies: $0\le r_{ij}\le 1 \quad (i=1,2,\ldots,n;\ j=1,2,\ldots,n)$, then R is a fuzzy matrix[20].

The definition 2 is: If the fuzzy matrix $R=\left(r_{ij}\right)_{n\times n}$ satisfies: $r_{ij}+r_{ij}=1$, then the fuzzy matrix R is said to be a fuzzy complementary matrix.

The definition 3 is: If the fuzzy complementary matrix $R=\left(r_{ij}\right)_{n\times n}$ satisfies: $\forall i,j,k \quad r_{ij}=r_{ik}-r_{jk}+0.5$, then the fuzzy matrix R is called a fuzzy consistent matrix.

The property 1 is: First, the fuzzy complementary matrix $R=\left(r_{ij}\right)_{n\times n}$ is summed by rows, which is recorded as $r_i=\sum_{k=1}^{n} r_{ik}, i=1,2,\ldots,n$. Then, the following mathematical transformation $r_{ij}=\left(r_i-r_j\right)/2n+0.5$ is performed, and the transformation result is a fuzzy consistent matrix.

The specific steps of the fuzzy analytic hierarchy process are as follows:

1. This paper establishes a hierarchical structure to systematize, organize and hierarchize complex evaluation objects. The first layer is the target layer, which is the purpose of evaluation. The second layer is the main indicator layer, which is the preliminary classification of the target layer. The third layer is the sub-indicator layer, which embodies the main indicator layer.

2. This paper establishes a fuzzy judgment matrix. This paper uses the 0.1-0.9 scale method in the literature to determine the value of r_{ij}, as shown in table 2.

Scaling	*Definition*	*Explanation*
0.5	*Equally important*	a_i *and* a_j *are equally important*
0.6	*Slightly important*	*The former is slightly more important than the latter*
0.7	*Obviously important*	*The former is obviously more important than the latter*
0.5	*Much more important*	*The former is much more important than the latter*
0.5	*Extremely important*	*The former is extremely important than the latter*
0.1,0.2,0.3,0.4	*Inverse comparison*	*If the ratio of the importance of* a_i *to* a_j *is* r_{ij}*, then the ratio of the importance of* a_j *to* a_i *is* r_{ij} *=1-* r_{ij}*.*

Table 2: 0.1～0.9 Scaling Method.

3. The consistency test of the fuzzy judgment matrix in this paper.

4. This paper solves the weights. We assume that there are n index layer nodes in the target node, and the weight of the i-th index layer node of the target node is:

$$\omega_i = \frac{1}{n} - \frac{1}{2\alpha} + \frac{\sum_{j=1}^{n} r_{ij}}{n\alpha} \tag{4}$$

On the basis of the above-mentioned pre-work, the fuzzy comprehensive evaluation method also needs to solve three problems: membership function determination, fuzzy operator selection and result vector synthesis.

1. Determination of membership function

The membership function is a function to quantify the degree of membership of the standardized value of the determination index for each evaluation level.

According to the evaluation result of this paper $V = \{v_1, v_2, v_3, v_4, v_5\} = \{0.1, 0.3, 0.575, 0.825, 0.95\}$, the membership function of the standardized index value is constructed as follows:

$$\mu_{v_1} = \begin{cases} 1 & 0 \le x \le 0.1 \\ 5(0.3 - x) & 0.1 < x < 0.3 \\ 0 & x \ge 0.3 \end{cases} \tag{5}$$

$$\mu_{v_2} = \begin{cases} 0 & x \le 0.1, x \ge 0.575 \\ 5(x - 0.1) & 0.1 < x < 0.3 \\ (23 - 40x)/11 & 0.3 \le x < 0.575 \end{cases} \tag{6}$$

$$\mu_{v_3} = \begin{cases} 0 & x \le 0.3, x \ge 0.825 \\ 40(x - 0.3)/11 & 0.3 < x < 0.575 \\ 3.3 - 4x & 0.575 \le x < 0.825 \end{cases} \tag{7}$$

$$\mu_{v_4} = \begin{cases} 0 & 0 \le x \le 0.575, x \ge 0.95 \\ 4x - 2.3 & 0.575 < x \le 0.825 \\ 2(19 - 20x)/5 & 0.825 \le x < 0.95 \end{cases} \tag{8}$$

$$\mu_{v_5} = \begin{cases} 0 & 0 \le x \le 0.825 \\ 2(4x - 3.3) & 0.825 < x \le 0.95 \\ 1 & x \ge 0.95 \end{cases} \tag{9}$$

2. Fuzzy operator selection

Fuzzy weight vector W and fuzzy evaluation matrix C are used for fuzzy operation to obtain fuzzy comprehensive evaluation vector $B = W \bullet C$.

3. Result vector synthesis

The fuzzy comprehensive evaluation vector can provide richer evaluation information than other methods. In actual application, it is usually converted into a specific score, which requires a certain mathematical method to synthesize the fuzzy comprehensive evaluation vector.

The maximum membership principle method is: This paper defines the fuzzy comprehensive evaluation result vector $B = \left(b_1, b_2, \ldots, b_m\right)$. If $\mathrm{b}_r = \mathrm{Max}_{1 \le i \le m}\left\{b_i\right\}$, the evaluation result is set as the r-th level.

The piecewise assignment method is: This paper determines the specific value of each evaluation level according to the needs of the actual problem, and then uses the corresponding membership degree in the fuzzy evaluation result to weight the score and get a point value. We assume that the m evaluation levels are assigned the score $S = \left(s_1, s_2, \ldots, s_m\right)$ in turn, then the comprehensive evaluation value is:

$$\mathrm{E} = BS^T = \sum_{i=1}^{m} b_i v_i \tag{10}$$

Finally, the security level of the evaluation object is determined according to the score of E.

The fuzzy comprehensive evaluation method in this paper is a multi-level fuzzy comprehensive evaluation method, which is mainly divided into the following steps:

1. This paper determines the evaluation index set $U = \left\{u_1, u_2, ..., u_n\right\}$ according to the evaluation object, which is also called the evaluation factor set. This paper classifies and stratifies the influencing factors of the evaluation object scientifically and rationally, and establishes a stratified evaluation model.

2. This paper determines the situation assessment domain $V = \left\{v_1, v_2, ..., v_m\right\}$, and selects the appropriate membership function. According to the standardized index values, this paper establishes the index fuzzy evaluation matrix $C = \left(c_{ij}\right)_{n \times \mathrm{m}}$.

3. The weight vector $W = \left(\omega_1, \omega_2, \ldots, \omega_n\right)$ of the hierarchical solution index. Comprehensive network security administrator's judgment on the importance of various evaluation criteria and evaluation factors, and FAHP is used to determine the weight vector.

4. In this paper, the fuzzy comprehensive evaluation vector is calculated hierarchically, and the fuzzy operator selects the weighted average type $M(\bullet, \oplus)$, as shown below:

$$B = W \bullet C = (\omega_1, \omega_2, \dots, \omega_n) \bullet \begin{bmatrix} c_{11} & c_{12} & \dots & c_{1m} \\ c_{21} & c_{22} & \dots & c_{2m} \\ \dots & \dots & \dots & \dots \\ c_{n1} & c_{n2} & \dots & c_{nm} \end{bmatrix} = (b_1 b_2 \dots b_m) \tag{11}$$

Among them, $b_j = \sum_{i=1}^{n} \omega_i \cdot c_{ij} \quad (j = 1, 2, \dots, m)$.

5. This paper chooses the highest level of comprehensive evaluation vector. According to the results of (4) and (5), the fuzzy comprehensive evaluation vector of the highest-level target is obtained.

6. This paper calculates the final situation value, adopts the segmented assignment method, and obtains the final evaluation score E by using formula (4.10).

3.1 Application Examples

Here, this paper takes the situation assessment of the operation dimension as an example to introduce the specific steps of the fuzzy comprehensive evaluation method. Table 3 shows the hierarchical model of operational dimension indicators.

1. Determine the set of factors

In this example, the factor set is divided into two layers, the first layer is:

$U = \{u_1, u_2, u_3\} =$ {special operation state, general operation state, network state}

The second layer is:

$u_1 = \{u_{11}, u_{12}, u_{13}\} =$ {symmetric key usage rate, asymmetric key usage rate, cryptographic algorithm usage rate}

$u_2 = \{u_{21}, u_{22}, u_{23}\} =$ {usage rate, memory usage rate, disk usage rate}

$u_3 = \{u_{31}, u_{32}, u_{33}\} =$ {Peak traffic, average traffic, broadband utilization}

2. Determine the field of situation assessment and establish a fuzzy assessment matrix

According to the classification content of the situation assessment in section 1.3, the domain of situation assessment is defined as V={excellent, good, medium, poor, dangerous}={v_1, v_2, v_3, v_4, v_5}={0.1, 0.3, 0.575, 0.825, 0.95}. When the actual standardized values of each factor are as follows, there are:

$$u_{11} = 0.8, u_{12} = 0.7, u_{13} = 0.6, u_{21} = 0.5, u_{22} = 0.4, u_{23} = 0.3, u_{31} = 0.7, u_{32} = 0.4, u_{33} = 0.5 \tag{3}$$

Hierarchical calculation of weight vector

According to this example, run the dimensional hierarchy structure, construct the fuzzy judgment matrix layer by layer from bottom to top, and use FAHP to calculate the index weight of each layer. Refer to the 0.1~0.9 quantity scale table, $\{u_{11},u_{12},u_{13}\}$ relative to u_1 fuzzy judgment matrix R_1 is established. According to the properties of the fuzzy complementary matrix, R_1 is adjusted to the fuzzy consistent matrix $\bar{R}_1$.

$$R_1=\begin{bmatrix}0.5 & 0.6 & 0.8\\ 0.4 & 0.5 & 0.7\\ 0.2 & 0.3 & 0.5\end{bmatrix}\quad \bar{R}_1=\begin{bmatrix}0.5 & 0.55 & 0.65\\ 0.45 & 0.5 & 0.6\\ 0.35 & 0.4 & 0.5\end{bmatrix}$$

According to formula (4), the weight vector of $\{u_1,u_2,u_3\}$ relative to u_1 is calculated as $W_1=(0.40,0.35,0.25)$.

In the same way, this paper establishes fuzzy judgment matrices R_2、R_3 and R of $\{u_{21},u_{22},u_{23}\}$、$\{u_{31},u_{32},u_{33}\}$ and $\{u_1,u_2,u_3\}$ relative to u_2、u_3, and U. Then, this paper adjusts to the corresponding fuzzy consensus matrices $\bar{R}_2$、$\bar{R}_3$ and $\bar{R}$ respectively. Finally, according to formula (4), the weight vector of $\{u_{21},u_{22},u_{23}\}$ relative to u_2 is $W_2=(0.35,0.35,0.30)$, and the weight vector of $\{u_{31},u_{32},u_{33}\}$ relative to u_3 is $W_3=(0.28,0.34,0.38)$, and the weight vector of $\{u_1,u_2,u_3\}$ relative to U is $W=(0.42,0.26,0.32)$.

4. Hierarchical calculation of fuzzy comprehensive evaluation vector

$u_1=\{u_{11},u_{12},u_{13}\}$, the weight vector of $\{u_{11},u_{12},u_{13}\}$ relative to u_1 is $W_1=(0.40,0.35,0.25)$, and the single-factor evaluation matrix formed by the fuzzy evaluation of $\{u_{11},u_{12},u_{13}\}$ obtained from the table is:

$$C_1=\begin{bmatrix}0 & 0 & 0.10 & 0.90 & 0\\ 0 & 0 & 0.50 & 0.50 & 0\\ 0 & 0 & 0.90 & 0.10 & 0\end{bmatrix}$$

From formula (11), we have:

$$B_1=W_1\bullet C_1=(0.4,0.35,0.25)\bullet\begin{bmatrix}0 & 0 & 0.10 & 0.90 & 0\\ 0 & 0 & 0.50 & 0.50 & 0\\ 0 & 0 & 0.90 & 0.10 & 0\end{bmatrix}=(0,0,0.44,0.56,0)$$

In the same way, we can get:

$$B_2 = W_2 \bullet C_2 = (0.35, 0.35, 0.30) \bullet \begin{bmatrix} 0 & 0.27 & 0.73 & 0 & 0 \\ 0 & 0.64 & 0.36 & 0 & 0 \\ 0 & 1 & 0.00 & 0 & 0 \end{bmatrix} = (0, 0.62, 0.38, 0, 0)$$

$$B_3 = W_3 \bullet C_3 = (0.28, 0.34, 0.38) \bullet \begin{bmatrix} 0 & 0 & 0.50 & 0.50 & 0 \\ 0 & 0.64 & 0.36 & 0.00 & 0 \\ 0 & 0.27 & 0.73 & 0.00 & 0 \end{bmatrix} = (0, 0.32, 0.54, 0.14, 0)$$

5. The highest level of comprehensive evaluation vector

$U = \{u_1, u_2, u_3\}$, and in formula (3), the weight vector of $\{u_1, u_2, u_3\}$ relative to U is $W = (0.42, 0.26, 0.32)$, then the highest-level comprehensive evaluation vector is:

$$B = W \bullet C = A \bullet \begin{pmatrix} B_1 \\ B_2 \\ B_3 \end{pmatrix} = (0.42, 0.26, 0.32) \bullet \begin{bmatrix} 0 & 0 & 0.44 & 0.56 & 0 \\ 0 & 0.62 & 0.38 & 0.00 & 0 \\ 0 & 0.32 & 0.54 & 0.14 & 0 \end{bmatrix} = (0, 0.26, 0.46, 0.28, 0)$$

6. Calculate the final situation assessment value

We assume that each safety evaluation level is assigned $S = (s_1, s_2, s_3, s_4, s_5) = (1, 2, 3, 4, 5)$, and the final situation evaluation value E is obtained according to formula (10):

$$E = BS^T = (0, 0.26, 0.46, 0.28, 0)(1, 2, 3, 4, 5)^T = 3.02$$

4 CONSTRUCTION AND APPLICATION OF INDUSTRY-UNIVERSITY-RESEARCH PLATFORM BASED ON SOFTWARE ENGINEERING AND INTERNET OF THINGS TECHNOLOGY

According to the changes in the allocation of resources of all parties and the changes in communication, it can be divided into three more specific stages, as shown in Figure 2.

The preparation stage of collaborative innovation is the starting point of the entire innovation process and lays the organizational foundation and innovation planning for subsequent collaborative innovation activities. The flow chart of the preparation phase is shown in Figure 3.

Knowledge innovation collaboration is mainly in charge of universities and research institutes. Based on the development requirements raised by the project, it formulates corresponding technical development plans and problem solutions, and fully calls relevant personnel, industry-university-research platform and other resources to complete the corresponding research and development work, as shown in Figure 4.

Knowledge transfer collaboration mainly refers to the exchange and transfer of knowledge generated in the process of cooperation among multiple project subjects, and is absorbed and applied to actual work by the project subjects that need this knowledge, as shown in Figure 5. Supply chain collaborative innovation knowledge transfer in the context of industry-university-research cooperation generally involves universities and research institutes transferring scientific and technological results generated by research and development to supply chain enterprises in accordance with established paths and rules.

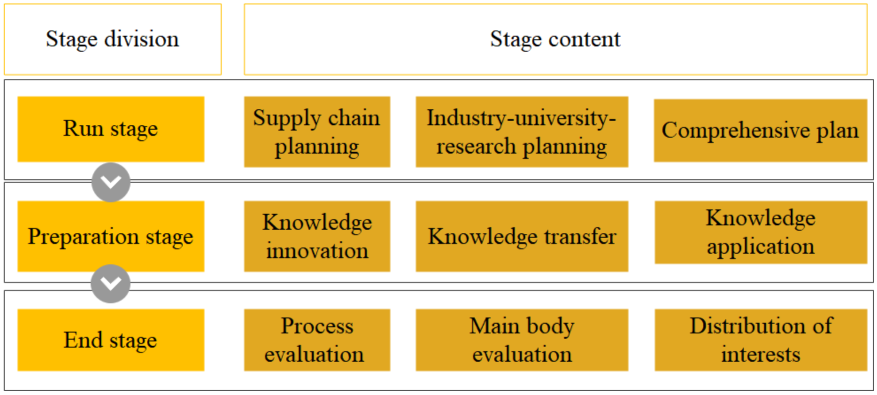

Figure 2: Three-Stage Flow Chart.

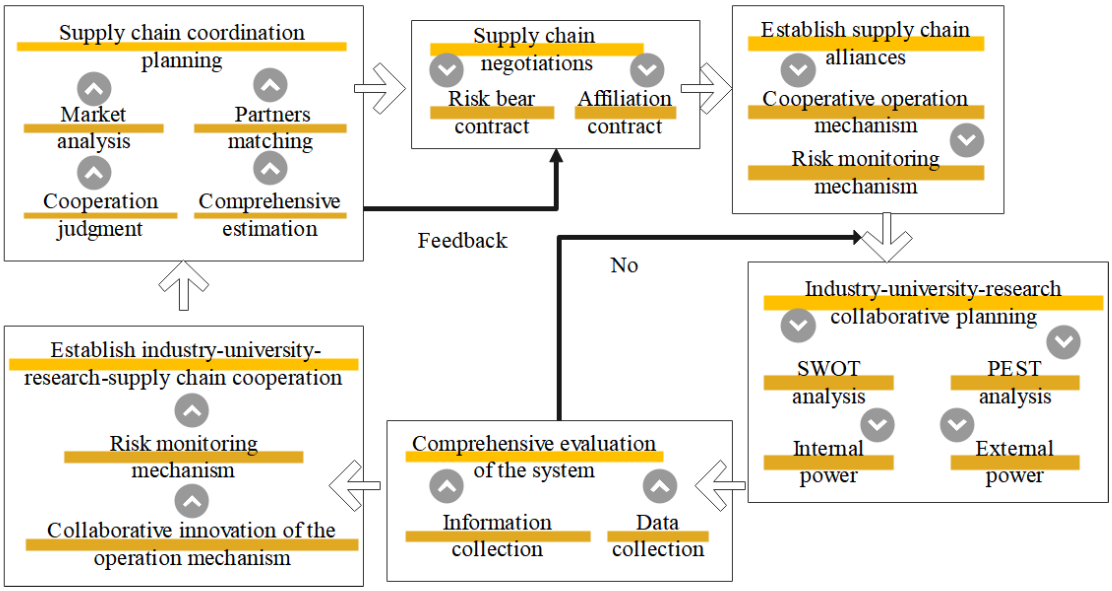

Figure 3: Flow Chart of Preparation Phase.

Knowledge application collaboration mainly emphasizes that supply chain companies absorb relevant knowledge and apply it to the actual production process. At the same time, universities and research institutes should pay attention to the application situation and provide corresponding technical support when necessary, as shown in Figure 6.

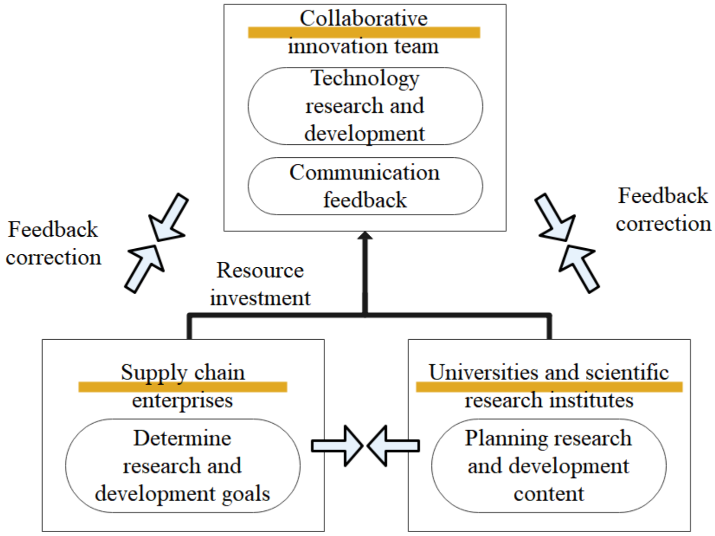

Figure 4: Flow Chart of Knowledge Innovation Collaboration.

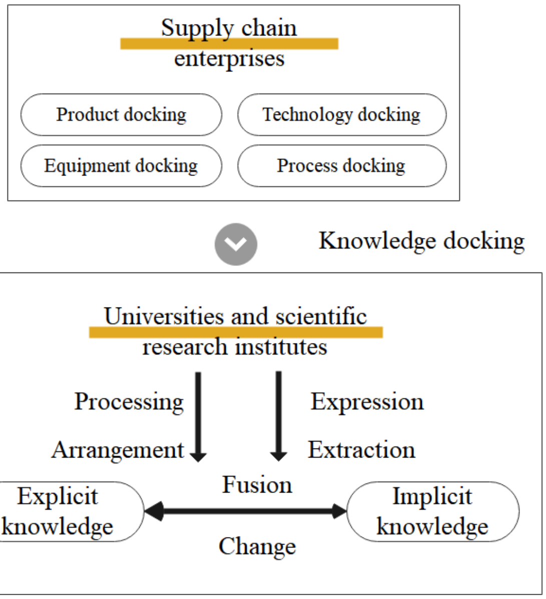

Figure 5: Flow Chart of Knowledge Transfer Collaboration.

According to the industry-university-research platform construction requirements, this paper draws a co-occurrence network diagram, as shown in Figure 7. In this paper, the keyword co-occurrence matrix obtained by ROST software is imported into SPSS19.0 software for clustering analysis, and closely related keywords are grouped together to form clusters to obtain the clustering results of industry-university-research's collaborative innovation related policies, as shown in Figure 8.

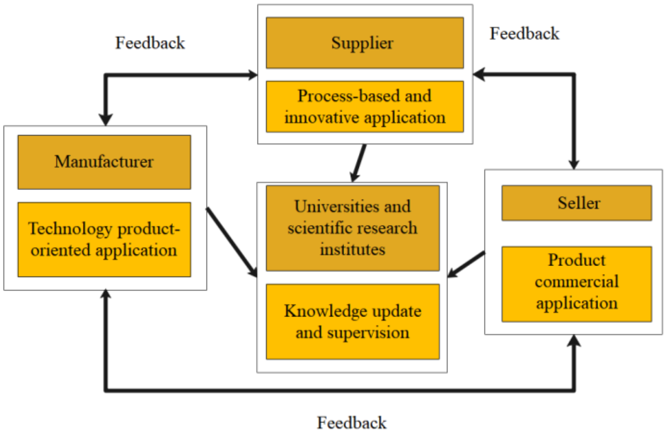

Figure 6: Flow Chart of Knowledge Application Collaboration.

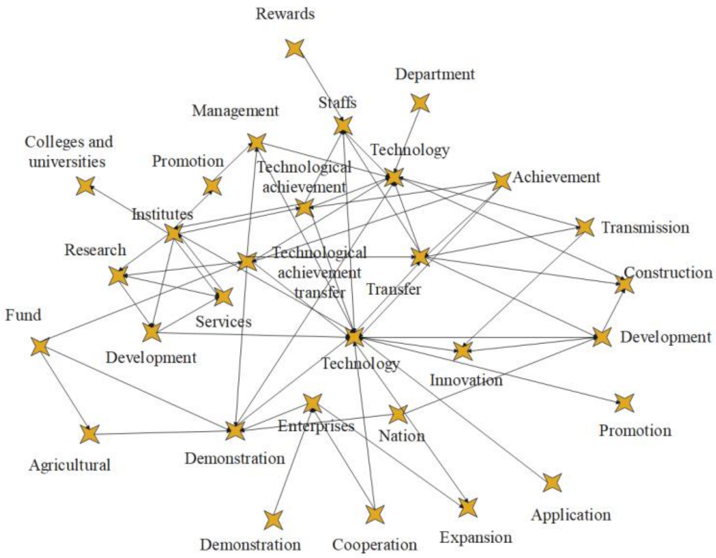

Figure 7: Co-Occurrence Network Diagram.

From the above clustering results, it can be seen that there are two major categories in the policy text. The first category focuses on theory and mainly centers on the transformation of scientific and technological achievements, and then guides the practice of industry-university-research related subjects. The other is to focus on practice, that is, to focus on policies and measures that actually need to be implemented. In terms of specific measures, it promotes the transformation of scientific and technological achievements, thereby improving the level of industry-university-research collaborative innovation. On the basis of the above analysis, a large amount of clustering data is obtained through the network, and the effect of this system in the industry-university-research research is calculated, and the results are shown in Figure 9.

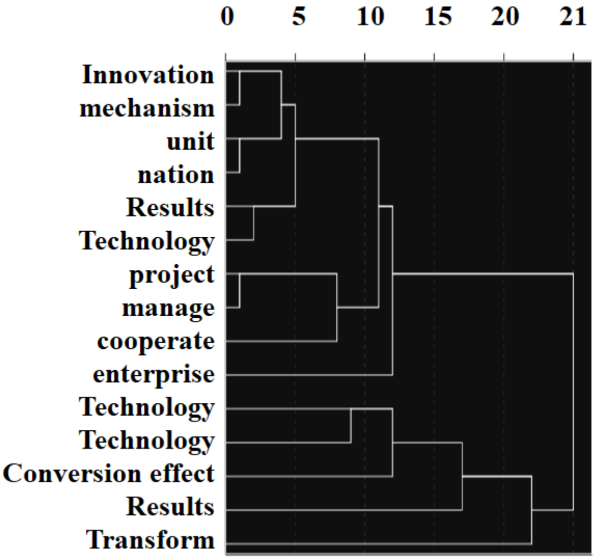

Figure 8: Cluster Analysis Results.

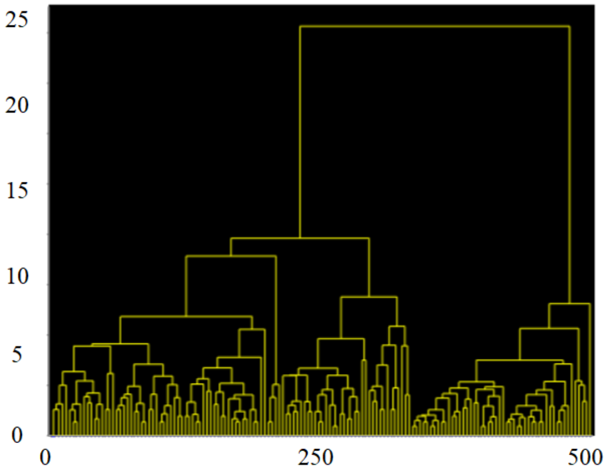

Figure 9: Clustering of the Use Effect of the Industry-University-Research Platform.

From the above analysis, it can be seen that the industry-university-research platform construction effect of this paper is relatively obvious. On this basis, the effect of the system of this paper is evaluated through expert evaluation, and the results shown in Table 3 below are obtained.

Num	*Expert evaluation*	*Num*	*Expert evaluation*	*Num*	*Expert evaluation*
1	*90.06*	*24*	*88.68*	*47*	*94.06*

2	*94.04*	*25*	*92.03*	*48*	*94.07*
3	*90.84*	*26*	*94.67*	*49*	*92.46*
4	*95.98*	*27*	*96.05*	*50*	*95.90*
5	*88.67*	*28*	*95.04*	*51*	*94.55*
6	*91.91*	*29*	*86.40*	*52*	*88.69*
7	*93.34*	*30*	*95.86*	*53*	*91.34*
8	*92.08*	*31*	*87.03*	*54*	*89.36*
9	*87.25*	*32*	*91.40*	*55*	*92.25*
10	*86.02*	*33*	*93.20*	*56*	*94.58*
11	*93.40*	*34*	*95.22*	*57*	*94.22*
12	*86.70*	*35*	*87.60*	*58*	*88.99*
13	*87.88*	*36*	*94.53*	*59*	*96.64*
14	*86.69*	*37*	*92.81*	*60*	*92.49*
15	*94.49*	*38*	*95.31*	*61*	*88.39*
16	*86.93*	*39*	*96.10*	*62*	*88.61*
17	*94.56*	*40*	*87.40*	*63*	*93.94*
18	*91.56*	*41*	*96.77*	*64*	*94.40*
19	*96.83*	*42*	*93.87*	*65*	*90.04*
20	*94.45*	*43*	*94.53*	*66*	*89.09*
21	*93.27*	*44*	*91.21*	*67*	*92.39*
22	*88.14*	*45*	*86.05*	*68*	*87.17*
23	*87.63*	*46*	*90.74*	*69*	*89.81*

Table 3: Statistical Table of Expert Evaluation Results of Industry-University-Research Platform Based on Software Engineering and Internet of Things Technology.

From the above research, it can be seen that the industry-university-research platform based on software engineering and Internet of Things technology proposed in this paper meets the current actual needs of industry-university-research.

5 CONCLUSION

Industry-university-research cooperative innovation is both a cooperative activity and an innovation activity. It is a "new combination" formed by a variety of different innovation elements around a new goal, and it derives multiple interrelated influencing factors.Focusing on the influencing factors of industry-university-research cooperative innovation, the use of economic utility theory to analyze industry-university-research cooperative innovation has enriched the practical methods of industry-university-research related research. At the same time, with the help of Kelly's grid technology, we can dig out important influencing factors and analyze the results to promote in-depth cooperation and innovation in industry-university-research. Furthermore, it is of great significance to enhance the industry-university-research innovation profit maximization and research results market competitiveness.This paper combines software engineering and Internet of Things technology to build and apply the industry-university-research platform, combined with the industry-university-research application status to build the system function structure, which provides a reference for the further development of industry-university-research. The research shows that the industry-university-research platform based on software engineering and Internet of Things technology proposed in this paper meets the current actual needs of industry-university-research.

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