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Review of the Technique Assessment of Scientific Research Project Establishment

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ABSTRACT. *The technique assessment of scientific research is the basic part for technical assets assessment. This paper mainly introduces researches on the design theory and approaches for the technique assessment system. Methods based on index quantification, weight setting, and comprehensive modeling, such as AHP, multi-player fuzzy comprehensive assessment based on information entropy are introduced.*

Keywords: technique assessment model, project establishment assessment, assessment method

1. **Introduction.** Assessment can be divided into general assessment and professional assessment according to its standard. Technology project assessment belongs to professional assessment, so it must be in accordance with certain norms, and its' process must be in a certain range of social recognition. Based on the definition of the technology assessment by the Ministry of Science and Technology[1], technology project assessment can be regarded as one of the most important types of the assessment activities of science and technology.

In recent years, in the light of the specific practices of national scientific and technological project assessment, scientific research project assessment techniques mainly include the process of assessment preparation, assessment design, information acquisition, assessment analysis and synthesis, and generating assessment reports. It is mainly composed of methods and procedures, index system, model report generating. This paper will introduce a research direction on a systematic integrated technique assessment process which can make qualitative assessment more quantification.

2. **Technology Project Assessment Model.**

2.1. **Technology Project Assessment Chain.**[2] As with other projects, science and technology projects has lifecycle, which means it has the life stages of production, development, formation and termination. Different stages of the life cycle correspond to different assessment methods and assessment indexes. The relationship between the life cycle of the technology project and the assessment phase is shown in Figure 1 below:

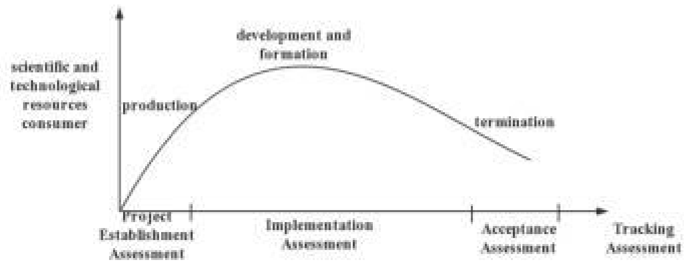

FIGURE 1. THE RELATIONSHIP BETWEEN PROJECT LIFECYCLE AND ASSESSMENT PHASES

The existing research literature and technology project management policies are more focused on the selection and acceptance of scientific and technological projects, but relatively few studies on the mid-term and follow-up assessment of science and technology projects. So this paper primarily discusses the assessment phrase of scientific research project establishment.

2.2. **Technology Project Assessment Model Design.** Project establishment assessment, implementation assessment, acceptance assessment, and tracking assessment constitute a life cycle. According to this lifecycle, the assessment model can be build based on the specific technology project life cycle characteristics and its main contradiction hope to resolve.

The assessment of project establishment is to select the best projects in a number of declared projects, which can achieve the optimal allocation of limited scientific and technology resources.[3][4] Its' mathematical model can be expressed as follows:

$$S_i = \sum_{j=1}^{k} c_j w_j$$

S_i is the i-th project score; c_j is the value of index j; w_j is the weight of index j.

According to the above formula, all projects score can be ranked. Assuming d_i is the i-th project needed technology resources, and D is limited total amount of scientific and technological resources, then:

$$\sum_{i=1}^{m} d_i \leq D \leq \sum_{i=1}^{m+1} d_i$$

The projects which score before m will be funded.

3. **Technology Project Assessment Index System.**

3.1. **Technology Project Assessment Index Introduction.** The project assessment index system is an essential information system for the assessment of science and technology projects. The construction of the information system mainly includes the arrangement of the system elements and the arrangement of the system structure. The system elements refer to the individual assessment indexes, and the system structure refers to the relationship among single assessment index, which is the structure of the index system. The assessment index consists of the name, meaning, calculated caliber range, calculation method, unit of measurement, calculation time and spatial scope of the index. The structure of the index system has four basic forms, which are simple collection, tree structure, cluster structure and matrix structure. [5][6]But a large number of theoretical research and assessment practices show that the tree structure is most suitable for scientific and technological project assessment index system. This is because the assessment of science and technology projects related to a variety of attributes or status, which is generally from a variety of criteria for comprehensive assessment. The tree structure exactly reflects the binary one-to-many relationship in this multi-objective assessment. The tree structure of science and technology project assessment index system is shown in Figure 2:

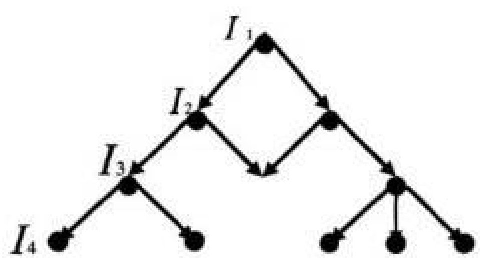

FIGURE 2. TREE STRUCTURE OF ASSESSMENT INDEX SYSTEM

3.2. **Technology Project Assessment Index Type.** The assessment of science and technology projects can be broadly divided into the following three categories [7]:

(1) Classification according to the function of index:

- Screening indexes are to assess whether the project meets the basic conditions of scientific and technological project assessment. The projects which do not meet any of the screening indexes will be excluded. Such indexes ensure that invalid assessment applications are excluded at the very beginning, which can lower assessment efforts.
- Competitive indexes are the most important part of the assessment index system, and it judges the project by comparing the different evaluated items in the same direction.
- Reference indexes are to provide fact basis, such as the applicators award situation, by describing the basic situation of the applicators and related historical data. As these indexes are not suitable for assessment alone, and different applicators are not comparable, so these indexes information is only for reference rather than determining the final assessment results.

(2) Classification according to the content of index:

➢ Input indexes are mainly described as the human, capital, material and information resources of scientific projects, as well as the guarantee conditions for the project implementation.

➢ Procedure indexes are mainly description of the progress of science and technology projects. It plays a great role in monitoring projects and improving efficiency. In the past assessment index system, such indicators are always overlooked.

➢ Output indexes are mainly description of the output of scientific and technological projects, such as the technical levels, the degree of technological innovation, the technological innovation, the degree of transformation, the specific benefits, the technical benefits, the economic benefits, the application potential, and the practical performance of the results.

The input indexes, procedure indexes and output indexes form an integrated closed-loop management system of scientific and technological projects. From the assessment process, its forward-feedback indexes are suitable for establishment assessment and development assessment. The feedback indexes are applicable to acceptance assessment and tracking assessment. The relationship among input indexes, procedure indexes and output indexes are shown in Figure 3:

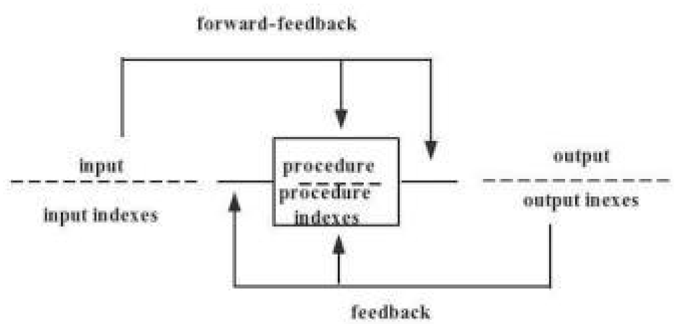

FIGURE 3. THE RELATIONSHIP AMONG INPUT PROCEDURE AND OUTPUT INDEXES

(3) Classification according to the assessment direction:

➢ Benefit (forward) indexes means that the higher values indicate the better performance.

➢ Cost (backward) indexes means that the lower values indicate the better performance.

According to the quantification degree of the assessment indexes, the indexes can be divided into qualitative indexes, semi-quantitative indexes and quantitative indexes. In addition, according to the intrinsic attributes of the indexes, the indexes are divided into economic indexes, technical indexes and social indexes. It is a complex system engineering to achieve a comprehensive assessment, so it is impossible to use only a single category of assessment indexes. Instead, the combination use of the above-mentioned various assessment indexes can be successfully completed assessment.

3.3. **Setting Technology Project Assessment Index Method.** In this section, the three methods of setting initial assessment index are designed to meet the perfectibility of science. These methods are frequency statistics, theoretical analysis, and expert consultation. Frequency statistics is to select the higher frequently used of indexes from the current research report of scientific projects; theoretical analysis is to select the important assessment indexes on the basis of connotation and characteristics analysis of scientific projects; expert consultation is based on frequency statistics and theoretical analysis. In order to make the index operational, it's necessary to consider the characteristics and social development status of the projects. Experts' advice will further adjust and amend indexes to make them meet the feasibility principle. The technology project assessment index system in accordance with the above method called the initial index system.

In order to meet the principle of overall optimization and independence, the fuzzy assessment method[8][9] is used to filter the initial indexes, and the relatively independent indexes that contained rich information are left. The technology project assessment index system design flowchart is shown in Figure 4:

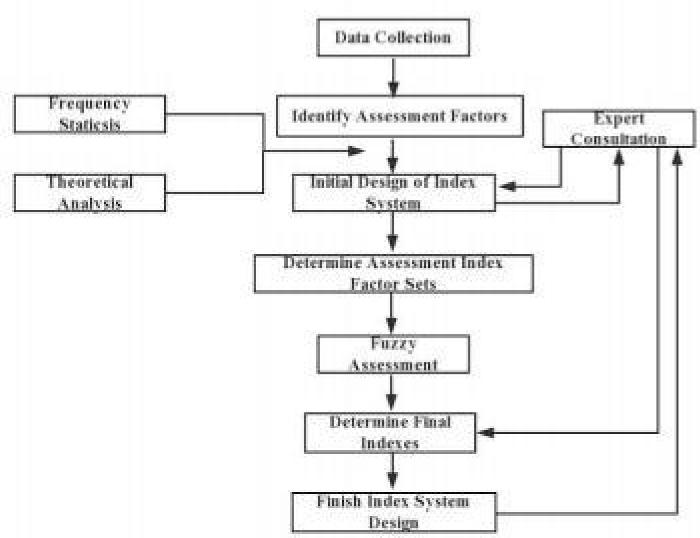

FIGURE 4. ASSESSMENT INDEX SYSTEM DESIGN FLOWCHART

The process of screening the initial indexes using fuzzy assessment method is as follows[10]:
(1) Determining assessment index factor sets.

From the validity, specificity, sensitivity and comparability of index to determine assessment index factor sets. Each index that meet the above four conditions at the same time can be selected into index sets.

- Validity: This factor reflects whether the projects continue to implement.
- Specificity: This factor reflects the different characteristics of the project implementation quality.
- Sensitivity: This factor reflects the impact on project implementation quality with changes in various factors.

- Comparability: This factor reflects whether the same project can compare with each other.

(2) Determining the weight of assessment index factors.

Through the effect of the four assessment factors, corresponding weights to them are assigned using the method of AHP (Analytic Hierarchy Process) [11]and the weight sets W was established. W = (w1,w2,w3,w4), and then:

$$\sum_{i=1}^{4} w_i = 1$$

After expert assessment, $W = (w_1,w_2,w_3,w_4) = (0.34,0.28,0.22,0.26)$

(3) Determining assessment level matrix.

There are 5 ratings for each assessment factor, which are very good, good, ordinary, slightly poor, and poor. Each rating gives the corresponding score: 9,7,5,3,1, and then rating matrix V is as follow:

$$V = (v_1, v_2, v_3, v_4, v_5) = (9,7,5,3,1)$$

(4) Summarizing and calculating the results of expert consultation.

If there are 12 experts to consult, and every expert gives score to initial indexes above. The result is as follows:

① Summarizing expert score results(As shown in Table1).

TABLE 1. EXPERT SCORE RESULTS

Assessment Factors	The Weight of Index Factor Sets	Assessment Rating					the Number of Experts
		9	7	5	3	1	
Validity	0.34	8	4	0	0	0	12
Specificity	0.28	1	8	3	0	0	12
Sensitivity	0.22	2	10	0	0	0	12
Comparability	0.16	1	7	4	0	0	12

② Establishing assessment matrix D

The data rows and columns in assessment matrix D are consistent with the statistics table.

$$D = \begin{pmatrix} 8 & 4 & 0 & 0 & 0 \\ 1 & 8 & 3 & 0 & 0 \\ 2 & 10 & 0 & 0 & 0 \\ 1 & 7 & 4 & 0 & 0 \end{pmatrix}$$

③ Working out the fuzzy frequency matrix R

$$r_{ij} = \frac{d_{ij}}{n}$$

r_{ij} is the element of the fuzzy frequency matrix; d_{ij} is the element of the assessment matrix D; n is the number of experts.

④ Calculating the logic K value and the index acceptability.

$$R = \begin{pmatrix} 0.667 & 0.333 & 0.000 & 0.000 & 0.000 \\ 0.083 & 0.667 & 0.250 & 0.000 & 0.000 \\ 0.167 & 0.833 & 0.000 & 0.000 & 0.000 \\ 0.083 & 0.584 & 0.333 & 0.000 & 0.000 \end{pmatrix}$$

The logic K value depends on the acceptability (C_i) of the individual assessment factor.

$$C_i = \sum_{i=1}^{4} v_i r_{ij}$$

$$C_1 = 9 \times 0.667 + 7 \times 0.333 + 5 \times 0.000 + 3 \times 0.000 + 1 \times 0.000 = 8.333$$

$$C_2 = 9 \times 0.083 + 7 \times 0.667 + 5 \times 0.250 + 3 \times 0.000 + 1 \times 0.000 = 6.667$$

$$C_3 = 9 \times 0.167 + 7 \times 0.833 + 5 \times 0.000 + 3 \times 0.000 + 1 \times 0.000 = 7.333$$

$$C_1 = 9 \times 0.083 + 7 \times 0.584 + 5 \times 0.333 + 3 \times 0.000 + 1 \times 0.000 = 6.500$$

Then the acceptability of index "the structure of research team" is:

$$Y = K \sum_{i=1}^{4} c_i w_i = 7.35$$

⑤ Judging the index acceptability.

When the assessment factor is good, the corresponding value is 7. So when $Y = 7$, the index is selected, otherwise it cannot be selected. The degree of acceptability of index " the structure of research team " is 7.3537, so it is selected

4. The Transform Value and Setting Value of Assessment Index.

4.1. **The Transform value of Assessment Index.** [12]In the assessment process, a variety of qualitative indexes are always used, but the qualitative indexes do not have specific quantitative data, so quantification of qualitative indexes should be the first step. In general, qualitative indexes use the number between 0 to 1 to describe the quality of things. (As shown in Table 2.)

TABLE 2. QUANTIFICATION OF QUALITATIVE INDEXES

Excellent	Very good	good	average	poor
1	0.8	0.6	0.4	0.2

More specific and accurate grading can also be achieved, for instance, you can take the any number between - 100% to 100% to correspond to different levels. It should be noted that the quantification of the quantitative value should be checked its discrete coefficient to confirm the credibility. Quantitative indexes can be divided into efficiency (forward) indexes and cost (backward) indexes according to the assessment direction. The greater of the efficiency indexes, the project performance is better; the greater of the cost indexes, the project performance is worse. There is another kind of index called the moderate optimal indexes, and its best value is within the certain range. In order to unify the calculation, it is required to normalize all types of indexes. The specific method is as follows[13][14][15]:

(1) Reversing backward indexes:

$$X_i = \frac{1}{X_t}$$

X_t is actual value; X_i is the index value after transferring.

(2) The index of the existing minimum consumption quota coefficient transferring:

$$X_i = \frac{X_j}{X_t}$$

X_j is quota coefficient; X_t is actual value, X_i is the index value after transferring.

(3) The index of the existing maximum allowable amount transferring:

$$X_i = 1 - \frac{X_t}{X_h}$$

X_h is maximum allowable amount, X_t is actual value, X_i is the index value after transferring.

(1) The moderate optimal index transferring:

$$X_i = \frac{1}{X_t - X_\beta}$$

X_t is actual value, X_i is the index value after transferring, X_β is median of the group contained value from actual value to optimal value.

Index transferring can quantify the qualitative indexes and reverse backward indexed to make all indexes on the same direction. But the dimension of the index is not yet unified, so it is necessary to set the value of the transferring indexes.

4.2. **Setting values of indexes.** The common method of index setting is efficiency coefficient method[16] . If there are n assessment indexes and m assessment objects, then the n indexes and m objects constitute the following assessment matrix:$X = (X_{ij})_{m\times n}(1 \le i \le m, 1 \le j \le n)$, and each X_{ij} must be transferred from index. For each of assessment indicators, take $X_j^* = \max(X_{ij}), X_j^0 = \min(X_{ij})$,then $Y_{ij} = \frac{x_{ij} - x_j^0}{x_j^* - x_{ij}}$ $(1 \le i \le m, 1 \le j \le n)$. The matrix $Y = (Y_{ij})_{m\times n}$ is called the normalization matrix. After setting the efficiency coefficient, there are $0 \le Y_{ij} \le 1$, and indexes can be added and subtracted from each other.

5. **Technology Project Assessment Method.**

5.1. **Assessment Model Based on Analytic Hierarchy Process (AHP).** [7]There are a variety of methods to get the weight of assessment indexes. AHP is one of relatively mature and effective approach, especially for transferring blurred, intricate interrelationships into quantitative value. The principle is to decompose the problem into a number of different elements, and then grading those elements into orderly hierarchical chart according to the overall goal. Through comparing with its upper grade, the relative importance of a certain element can be determined and a comparison matrix is constructed. Finally, the weight of each element can be get[17][18].The specific steps are as follows:

(1) Establishing ladder-like hierarchical structure system.

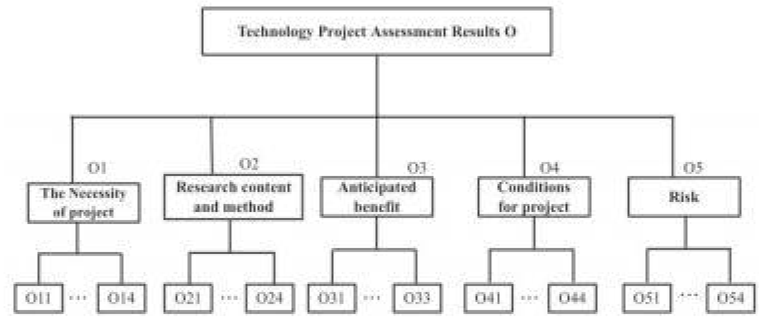

FIGURE 5.TECHNOLOGY PROJECT LADDER-LIKE HIERARCHICAL STRUCTURE.

O11 to O54 are technology project competitive assessment indexes.

(2) Constructing judgment matrix.

According to hierarchical structure, the upper layer of a certain factor can be treated as a criterion, and it can dominate the lower layer. Then lower layer factors can compare their importance to the upper layer with each other, and be given a certain score using the scaling method. (As shown in Table 3).

TABLE 3. THE SCALE OF JUDGMENT MATRIX.

Scale	Definition	Explanation
1	Equally importance	Two factors have equal importance.
3	Moderate importance	One of factors are slightly important than another.
5	Obvious importance	One of factors are obviously important than another.
7	Strong importance	One of factors is much more than another.
9	Extreme importance	One of factors are extremely important than another.
2,4,6,8		The median value of the above factors.

For a criterion X, several comparative factors constitute a two-two judgment matrix as follow:

$$U = (U_{ij})_{m \times n}$$

U_{ij} is the proportional scale of factor U_i and U_j compared with the importance of X, and $U_{ij} \times U_{ji} = 1$.

(3) Calculating the weight of the factors at each layer.

According to the information provided by the judgment matrix, the maximum eigenvalue and eigenvector of arbitrary precision can be obtained by power law. The eigenvector represents the weight of the influence of each factor on the upper level. As the judgment matrix itself has a certain error, the use of more simple approximation of the square root method accuracy can fully meet the actual requirements. The specific steps of the root method are as follows:

① Calculating the product M_i of each row of factors.

$$M_i = \prod_{j=1}^{n} u_{ij}$$

② Calculating the nth root of Mi.

$$W_i = \sqrt[n]{M_i}$$

③ Normalizing the vector $W = [W_1, W_2, \dots W_n]$.

$$W_i = \frac{w_i}{\sum_{j=1}^{n} w_j}$$

Then $W = [W_1, W_2, \dots W_n]$ is the eigenvector, and W_i is the weight of index.

(4) Consistency check.

Carrying out the consistency test is to assess the reliability of the judgment matrix. Specific steps are as follows:

① Calculating the random consistent index *CI*.

$$\lambda_{max} = \frac{1}{n-1}\sum_{i=1}^{n}\frac{\sum_{j=1}^{n} u_{ij}\times w_j}{w_j}$$ (n is the maximum scale ofjudgment matrix)

$$CI = \frac{\lambda_{max} - n}{n-1}$$ (n is the matrix order; λ_{max} is the maximum eigenvalue.)

② Calculating the consistency ratio *CR*.

$$CR = {CI}/{RI}$$ (RI is the average random consistent index in Table 4.)

TABLE 4. AVERAGE RANDOM CONSISTENT INDEXES.

Order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.58	0.89	1.12	1.26	1.36	1.41	1.46	1.49	1.52	1.54	1.56	1.58	1.59

When CR <0.1, it is considered that the consistency of the judgment matrix is acceptable; when CR> = 0.1, the judgment matrix should be corrected properly.

(5) Calculating the combination weight of the various factors on the system layers.

5.2. **Fuzzy Assessment Method Based on Analytic Hierarchy Process.** Fuzzy assessment [7][19][20][21][22]method takes impact of a variety of factors into consideration for a purpose to make a comprehensive decision in a fuzzy environment. This method firstly needs to establish the index sets of the assessment object; secondly, makes a comprehensive assessment of the factor sets; thirdly, calculates the fuzzy transformation matrix using the appropriate weight vector and operator of each factor; finally, normalizes the final level of the results, and gets the comprehensive assessment results according to the principle of maximum membership. [23]The detailed calculation process of the fuzzy assessment model based on the analytic hierarchy process is as follows:

(1) Using the analytic hierarchy process to study the weight of assessment indexes.

(2) Establish the two-dimensional fuzzy relation matrix of the project.

(3) Comprehensive assessment. The basic steps of comprehensive assessment are:

① Assessment index system.

$U = \{u_1, u_2, \dots, u_{15}\}$

② The weight vector determined by the hierarchy method.

$W = \{w_1, w_2, \dots, w_{15}\}$

③ Calculating the comprehensive assessment vector of project. After assessment of competitive indexes of n projects, the matrix $R = (R_1, R_2, \dots, R_{15})^T$ can be determined.

The comprehensive assessment vector is:

$B = W_o R = (b_1, b_2, \dots, b_{15})$

"$_o$" is synthetic operator; using $M(\cdot, \oplus)$ optional type; "$\cdot$" means real number multiplication; "$\oplus$"indicating the smaller number between sum of two numbers and 1. A comprehensive assessment of the conclusions can be get according to the principle of maximum membership $a \oplus \{a + b\}$.

5.3. **Assessment Model Based on Entropy Weight Fuzzy Comprehensive Assessment Method.**[7] The index weights[24][25][26] calculated through analytic hierarchy process method is flexible and depends on human's subjectivity to a certain extent, which reduces the accuracy of the assessment results. Another method based on entropy weight fuzzy comprehensive assessment can be a supplement. This method mainly uses the entropy of original data to determine the weight of index, so this assessment results are closer to the objective facts.

Entropy is a measure of uncertainty in information theory, which means that the greater the amount of information, the smaller the uncertainty, and the smaller the entropy, on the contrary, the smaller the amount of information, the greater the uncertainty, and the greater the entropy. When a system may be in a different state of n, the probability of each state is $P_i(i = 1,2, \dots, n)$, and the entropy ofthe system is:

$$E = -\sum_{j-1}^{n} P_i \ln P_i (0 \le P_i \le 1; \sum_{i=1}^{n} P_i = 1)$$

The weight can be determined using the entropy of the index, and the basic calculation steps are as follows:

(1) Calculating the proportion of the value of the I-th object under the j-th index in the normalized matrix$Y = (Y_{ij})_{m \times n}$.

$$P_{ij} = \frac{Y_{ij}}{\sum_{j=1}^{m} Y_{ij}} (1 \le i \le m, 1 \le j \le n)$$

(2) Calculating the entropy of the j-th index.

$$e_j = -k \sum_{j=1}^{m} P_{ij} \ln P_{ij} (1 \le j \le n; when\ k > 0, k = \frac{1}{\ln(m)}, e_j \ge 0)$$

(3) Calculating the difference coefficient of the j-th index.

For the j-th index, the difference coefficient of index Y_{ij} is higher, the effect on the assessment is greater and the entropy is smaller. On the contrary, the difference is less, the effect on the assessment is lower and the entropy is greater. Assuming the weight of the j-th assessment index determined bye_j is g_j , the definition of difference coefficient is the following.

$$g_j = \frac{1 - e_j}{n - \sum_{j=1}^{m} e_j} (1 \le j \le n; 0 \le g_i \le 1, \sum_{j=1}^{m} g_j = 1)$$

When a subjective judgment needs to be added, the weight V_j can be introduced. Then

$$W_j = \frac{v_j g_j}{\sum_{j=1}^{n} v_j g_j} (1 \le j \le n)$$

In particular, when "$v_1 = v_2 = \ldots = 1$, the j-th index weight is

$$w_j = \frac{g_j}{\sum_{j=1}^{n} g_j} (1 \le j \le n)$$

(4) Obtaining the weight vector $W = (w_1, w_2, w_3 \ldots w_n)$.

5.4. **Assessment Model Based on Ideal Solution.**[7] The ideal solution (also called weighted square sum method)[28][29] is a new multi-index comprehensive assessment method. This method utilizes the information of the assessment matrix to objectively assign the weight coefficient to each index, and takes the weighted square sum of every solutions as the assessment basis. Therefore, this method is relatively simple.

Given the assessment matrix $X = (X_{ij})_{m \times n}$, then the basic steps of the assessment model based on the weighted square sum method are as follows:

(1) Standardizing the assessment index matrix X. Each index of standardized matrix $Y = (Y_{ij})_{m \times n}$ is forward index.

(2) Studying the ideal points of assessment.

$$v* = \{v_1 * v_2 * \cdots v_n *\}$$
$$v_n * = \{y_{ij}\} (1 \le j \le n)$$

(3) Assuming the weight vector $W = (w_1, w_2, \ldots w_{15})$ of the assessment index, the normalization weight matrix is

$$z = (z_{ij})_{m \times n} = (w_i y_{ij})_{m \times n}$$

The square sum of the distance from the solutions to the ideal point is the basis of the judgment. According to $d_i = \sum_{j=1}^{n} (Z_{ij} - w_j v_{ij} *)^2 = \sum_{j=1}^{n} (y_{ij} - v_{j*})^2 w_j^2 \ (1 \le j \le m)$, the optimization model can be constructed.

$$\min H = \sum_{i=1}^{m} d_i - \sum_{i=1}^{m} \sum_{j=1}^{n} (y_{ij} - v_j *)^2 w_j^2$$

$$\text{s.t.} \sum_{j=1}^{n} w_j = 1$$

Using Lagrangian function:

$$L = \sum_{i=1}^{m} \sum_{j=1}^{n} (y_{ij} - v_j *)^2 w_j^2 + (\sum_{j=1}^{n} w_j - 1)$$

Let $\frac{\partial L}{\partial w_j} = 0, \frac{\partial L}{\partial \lambda} = 0,$ then

$$w_j = \frac{1}{\left[\sum_{j=1}^{m} \frac{1}{\sum_{i=1}^{m} (y_{ij} v_j *)^2}\right] \left[\sum_{i=1}^{m} (y_{ij} - v_j *)^2\right]}$$

$$\lambda = -\frac{1}{2 \sum_{j=1}^{n} \frac{1}{\sum_{i=1}^{m} (y_{ij} - v_j *)^2}}$$

The weighting coefficient of each assessment index can be determined by the above formula.

(4) Calculating the assessment value of each solution.

$$d_i = \sum_{j=1}^{n}(y_{ij} - v_j *)^2 w_j^2 + \lambda(\sum_{j=1}^{n} w_j - 1)$$

(5) According to the assessment value d_j, all solutions are sorted. The value of d_j is smaller, the solution is more excellent. Through the weighted square sum method, the weight coefficient of each index is obtained, which eliminates the subjectivity of the traditional fuzzy assessment method, and also solves the restriction of the requirement of original data in entropy weight fuzzy assessment method.

5.5. **Assessment Model based on Neural Network BP Algorithm.** BP neural network[30] is the most widely used neural network, because its structure is simple and the working state is the easiest to achieve. The basic steps of the neural network BP algorithm assessment model are as follows:

(1) Training sample selection

The training samples of the network should contain as many pattern categories as possible, and the general samples are the majority. At the same time, some noise is added to the sample to improve the anti-noise ability of the network. The samples should be independent and irrelevant as far as possible through orthogonal design method. The index data is quantized by transforming the original data or the non-quantized data by the normalization, so that it falls within the [0,1].

(2) Input layer and output layer unit design

The input data of this model is determined by the number of elements of the project assessment index system, using 11 input units, n = 11; only one output layer unit, m = 1.

(3) Network layers and hidden layer unit number

In this model, a three-layer forward feedback network model is used. Under certain conditions, for any givenε>0, there is a three-layer forward feedback network, which can approximate any continuous function with the accuracy ofthe mean square error.

The number of hidden layer unit is small, the learning process may not converge; the larger the number of units, the stronger the network mapping ability. In this model, we use the smaller and larger hidden layers to train separately. According to the training error, we choose the appropriate hidden layer number, and then determine the number of hidden layer units by referring to the formula of determining the hidden layer number. The empirical formula is as follows:

$$K < \sum_{i=0}^{n} C_z^i \quad Z = log2^n \quad Z = \sqrt{n+m+a}$$

K is the number of samples; n is the number of input neurons, Z is the number of hidden cells, m is the number of output neurons, and a is the constant between [0,10].

(4) Activation function.

This model chooses the function of sigmoid ($y = f(x) = \frac{1}{1+e^{-x_p'}}, y' = y \times (1 - y)$) as activation function. Sigmoid function has nonlinearity. When the weight is very large, it can approximate the threshold function; when the weight is very small, it approximate linear function.

(5) Initial weight of BP network.

X initial weight is set to a smaller random number. When you use unipolar S-type function, the value in [-0.3,0.3] can be selected to make the weight of the neural cell output close to zero, so that we can adjust the larger slope of the S function. If it is too large, the weighted input may fall in the saturation region of the S-type function; if the correction of the set weight is close to zero, the adjustment process stops quickly.

(6) Learning rate.

Large learning t rate may lead system instability, and small will lead the training cycle too long and slow convergence. Generally, a smaller learning rate is chose to maintain the system stability by observing the error drop curve. Down faster means that the learning rate is more appropriate.

6. **Conclusions.** In this paper, the whole technology assessment process of scientific projects is summarized. Firstly, the assessed project should be decomposed into small units of work. The second step is to identify the indexes of each unit, and then calculate the weight of shifted indexes. In the fifth chapter, the specific assessment methods are introduced. Different projects have each own importance, so the value of index weight should be different. This summarization can make assessment process more standardization.

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