

Research on the Construction and Application of the Evaluation System of Talents in Scientific Research in Big Data Environment

—Taking Post-doctors as an Example

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Abstract: In the “Thirteenth Five-year Plan”, the talent power strategy is placed in the prominent position, talents in scientific research is the core resource of the talent team, so the evaluation of talents in scientific research becomes the most important of the talent strategy. However, at present, the evaluation standard of talents in scientific research is not clear enough, the evaluation system is not perfect, so this paper chooses the postdoctoral group as the representative of talents in scientific research, according to scientific, purposeful and operability of the principles of building scientific research talent evaluation model, And based on Delphi Expert Consultation (Delphi) and entropy method to design the evaluation index system of talents in scientific research, has a high research value and research significance. The evaluation index system includes 5 dimensions, such as scientific research management, basic quality, scientific research contribution, scientific research potentiality and academic status. Finally, the evaluation system of talents in scientific research is used to evaluate the post-doctors, and the evaluation results are analyzed to provide practical experience for the comprehensive development and implementation of the evaluation work of talents in scientific research.

1. Introduction

The problem of talents is a key issue related to the overall development of the cause of the party and the State, which is embodied in: among the various resources on which the development of human society depends, talent resources are the most fundamental, it not only determines the degree of development and utilization of other resources, but also has other resources cannot be compared with the development and creativity. In June 2010, China issued the first medium-and long-term talent development plan since the founding of New China-the outline of the national medium and long Term Talent Development plan (2010-2020), and formulated a series of guidelines and policies for how to implement the strategy of “talent power” in the future. In March 2016, the CPC Central Committee issued the opinions on deepening the reform of the institutional mechanism for talent development, which clearly pointed out that there are not enough evaluation results in the field of talent evaluation to show the overall scientific research ability and research level of talents. At present, the unreasonable evaluation of scientific research personnel is mainly the following problems: first, the simplification of evaluation orientation, too much emphasis on the paper monographs, subject projects and other explicit Index, there are only paper theory, only academic theory, only the title theory and many other utilitarianism drawbacks, the second is the evaluation of the standard of homogenization, different disciplines, different fields, Different levels of talent are using a unified quantitative criteria and Index for evaluation and measurement, third, the evaluation criteria of the directivity is not strong, classification, stratification of the scientific comprehensive Evaluation system has not yet been established. Therefore, in view of the main problems existing in the evaluation of talents in our country, it is of great value and significance to establish an evaluation system that can comprehensively reflect the comprehensive strength of scientific

research talents, and can be applied to practice to guide the evaluation of scientific research talents.

In the research of Evaluation model and evaluation index of scientific research personnel, most of the previous researchers mentioned that academic ethics, academic knowledge, scientific research ability, scientific research achievements and other aspects as the main Index of measurement and evaluation [1], but often in the refinement of Index, many Index do not conform to the principle of maneuverability, For example, the communication ability and thinking ability in scientific research ability, social and economic benefits in scientific research results, etc., in the establishment of the model and the setting of Index do not conform to the scientific principle, the Index value is not easy to obtain, the index level is not clear enough, in the evaluation of scientific research personnel cannot be in Therefore, on the basis of a comprehensive analysis of scientific research personnel, this paper constructs a comprehensive evaluation model of scientific research personnel, designs a comprehensive evaluation index system of scientific research talents based on postdoctoral big data, Entropy value method and Delphi Expert Consultation Method, and deeply studies the evaluation model in scientific research talents, Practical application in the training and management of the work [2]. The evaluation index system of scientific research talents designed in this paper is a Level 3 index system which includes 5 dimensions, such as scientific research management, basic accomplishment, scientific research contribution, scientific research potential and academic status, and the design of quantitative index can objectively draw the evaluation conclusion on the basis of postdoctoral big data, and the design of qualitative index is used to assist the evaluation work, which can Scientific and purposeful to obtain the evaluation results of scientific research personnel.

2. Construction of Evaluation Index System of Scientific Research Talents

2.1. Index Design

In the work of evaluation of scientific research talents, the government and talent researchers are most concerned about the effectiveness of talent evaluation, which is the core of carrying out talent evaluation work and carrying out talent research. From the literature review above, we know that the basic theories and models commonly used in the evaluation of scientific research talents at home and abroad are competency model theory, talent quality assessment theory, McLellan's "iceberg model", Spencer's improved version of "Iceberg model" and "onion model" and so on. These theories and models take management, metrology, behavioral science, psychology and other disciplines as the basis for the evaluation of scientific research talents. Although different evaluation models and index systems have effectively explored the evaluation of scientific research talents from various angles, combining evaluation model with qualitative index and quantitative index, but often falling into practical application, the drawbacks of the maneuverability of models and Index are revealed, and there are not many models that can support the actual work [3]. It can examine the scientific research potential of scientific research talents and has fewer quantifiable evaluation indexes. Therefore, this paper includes scientific research potential, scientific research management, scientific research status and other qualitative Index, initially constructed including scientific research ability, scientific research management, scientific research quality, scientific research contributions, scientific research potential, scientific research status, such as 6 primary Index, 15 two-level Index, 40 three-level Index of scientific research talent evaluation system, for different disciplines, different fields, Different types of scientific research personnel to make a comprehensive evaluation. Scientific research ability, as one of the important characteristics of scientific research talents, mainly examines the professional skills and academic level of scientific research personnel, etc., scientific research management is mainly from the team cooperation ability, management ability and other aspects of evaluation; the quality of scientific research mainly evaluates the integrity of scientific research personnel ethics, academic experience, whether there is academic misconduct, Whether personal data and curriculum vitae are true or not; Scientific research contribution is from the subject contribution, social contribution to carry on the comprehensive evaluation, the scientific research potential mainly from the academic exchange, the

research direction, the development trend and so on evaluation, the scientific research position mainly evaluates the scientific research talented Person's Honor award, the Scientific Research Service, the industry reputation and so on. The specific Index design is shown in table 1.

Table 1 Evaluation index of scientific research talents (Preliminary).

Level 1 Index	Level 2 Index	Level 3 Index
Scientific research capabilities	Learning Ability	Learning efficiency, learning awareness, memory, thinking agility
	Academic level	Knowledge level, core competence, innovation ability, oral expression
Scientific Research Management	Teamwork Skills	Team motivation, cooperation efficiency, cooperation results, in-group evaluation
	Project management Capabilities	Project topic Management, Project topic Practice
Scientific research Quality	Honesty and morality	Authenticity of personal materials, record of academic misconduct
	Academic Experience	Study experience, personal history, diploma, personal title
Scientific research contribution	Thesis contribution	The number of papers published, the sum of the influencing factors of the thesis, the subject influence of the thesis
	Patent contribution	Number of authorized patents, patent impact, social benefits arising from patents
	Social contribution	Social influence, social evaluation
Research potential	Academic exchanges	Academic conferences, overseas visits
	Research orientation	Prospect of research field, depth of research direction
	Development trend	Paper publishing trends, patent application trends
Scientific research Status	Research positions	Editorial board position of domestic and foreign periodicals, research team position at home and abroad
	Honor Rewards	Academic honors, research awards
	Industry reputation	Domestic peer evaluation, international influence

2.2. Selection of Index

Delphi method is essentially a feedback anonymous correspondence method. The general process is: After seeking expert advice on the issues to be predicted, organize, summarize, count, and then anonymously feedback to the experts, again for comments, then focus, and then feedback, until a unanimous opinion is obtained. Therefore, this paper designs the corresponding questionnaire (see Appendix 1), uses the questionnaire survey and the direct conversation way to consult the relevant experts in the field of talent research, summarizes, summarizes and feedback each round of experts' opinions, until the expert opinion tends to converge, concentrates the expert's wisdom to come up with a more reliable and practical index system. The first is the issuance, recovery and statistics of questionnaires. A total of 50 questionnaires were sent, 47 responses were returned, and the response rate was 94%, of which 47 were effectively returned and the effective response rate was 100%.

The statistical results are shown in table 2.

Table 2 Importance of Evaluation Index (preliminary) of scientific research talents.

Evaluation Index	1	2	3	4	5	6	7	8	9
Learning efficiency	0	0	0	1	6	11	16	7	6
Learning awareness	0	0	0	2	7	9	15	10	4
Memory	0	0	1	3	2	16	10	13	2
Thinking agility	0	0	0	0	5	13	11	11	4
Knowledge level	0	0	0	0	0	5	14	13	15
Core competence	0	0	0	0	3	10	9	18	7
Innovation ability	0	0	0	0	0	4	12	14	17
Oral expression	0	3	2	3	5	9	16	6	3
Team motivation	0	0	0	0	1	8	15	15	8
Cooperation efficiency	0	0	0	0	2	3	13	16	13
Cooperation results	0	0	0	0	1	6	12	19	9
In-group evaluation	0	0	0	3	3	11	10	12	8
Project topic Management	0	0	0	0	0	1	10	15	21

Project topic Practice	0	0	0	0	0	2	13	12	20
Authenticity of personal materials	0	0	0	0	2	1	15	13	16
Record of academic misconduct	0	0	0	0	0	2	8	8	29
Study experience	0	0	3	2	9	8	11	10	4
Personal history	0	0	1	1	7	11	10	9	8
Diploma	0	0	2	1	2	5	19	11	7
Personal title	0	0	0	0	3	9	15	14	6
The number of papers published	0	0	0	0	0	0	11	17	19
The sum of the influencing factors of the thesis	0	0	0	0	0	0	6	19	22
the subject influence of the thesis	0	0	0	0	1	1	18	16	11
Number of authorized patents	0	0	0	0	0	2	10	15	20
Patent impact	0	0	0	0	3	7	11	16	10
Social benefits arising from patents	0	0	0	3	3	7	10	15	9
Social influence	0	0	0	6	11	9	15	6	0
Social evaluation	0	1	9	15	11	5	2	4	0
Academic conferences	0	0	0	2	3	10	15	14	3
Overseas visits	0	0	0	2	1	11	10	10	13
Prospect of research field	0	0	0	3	3	6	14	15	6
Depth of research direction	0	0	0	0	11	9	10	11	6
Paper publishing trends	0	0	0	2	9	18	7	1	0
Patent application trends	0	3	10	13	15	6	0	0	0
Editorial board position of domestic and foreign periodicals	0	0	0	1	7	11	11	14	3
Research team position at home and abroad	0	0	0	2	2	12	17	10	4
Academic honors	0	0	5	8	11	16	6	1	0
Research awards	0	0	6	11	9	10	11	0	0
Domestic peer evaluation	0	0	0	2	11	10	9	12	3
International influence	0	0	0	1	2	9	11	16	8

The data of the survey are applied to the statistical analysis of STATA software, and the average value, standard deviation and confidence interval of the evaluation index and the evaluation work of scientific research talents are calculated, and the concrete results are shown in table 3.

Table 3 Statistical analysis Results of Evaluation Index (preliminary) of scientific research talents.

Evaluation Index	Average	Standard deviation	Confidence interval		Confidence degree
			Lower	Upper	
Learning efficiency	6.85	1.27	6.48	7.22	0.95
Learning awareness	6.77	1.31	6.38	7.15	0.95
Memory	6.66	1.34	6.27	7.05	0.95
Thinking agility	6.47	1.22	6.11	6.83	0.95
Knowledge level	7.81	1.01	7.51	8.11	0.95
Core competence	7.34	1.17	7.00	7.68	0.95
Innovation ability	7.94	0.99	7.65	8.23	0.95
Oral expression	6.17	1.80	5.64	6.70	0.95
Team motivation	7.45	1.04	7.14	7.75	0.95
Cooperation efficiency	7.74	1.07	7.43	8.06	0.95
Cooperation results	7.62	1.01	7.32	7.91	0.95
In-group evaluation	7.04	1.43	6.62	7.46	0.95
Project topic Management	8.19	0.85	7.94	8.44	0.95
Project topic Practice	8.06	0.94	7.79	8.34	0.95
Authenticity of personal materials	7.85	1.06	7.54	8.16	0.95
Record of academic misconduct	8.36	0.92	8.09	8.63	0.95
Study experience	6.45	1.63	5.70	6.92	0.95
Personal history	6.85	1.50	6.41	7.29	0.95
Diploma	7.11	1.42	6.69	7.52	0.95
Personal title	7.23	1.112	6.91	7.56	0.95
The number of papers published	8.17	0.79	7.94	8.40	0.95
The sum of the influencing factors of the thesis	8.34	0.70	8.13	8.55	0.95
The subject influence of the thesis	7.74	0.92	7.47	8.01	0.95

Number of authorized patents	8.13	0.90	7.86	8.39	0.95
Patent impact	7.49	1.18	7.14	7.83	0.95
Social benefits arising from patents	7.23	1.43	6.81	7.65	0.95
Social influence	6.09	1.27	5.71	6.46	0.95
Social evaluation	4.68	1.51	4.24	5.12	0.95
Academic conferences	6.96	1.20	6.61	7.31	0.95
Overseas visits	7.36	1.39	6.95	7.77	0.95
Prospect of research field	7.13	1.35	6.73	7.52	0.95
Depth of research direction	6.834	1.37	6.43	7.23	0.95
Paper publishing trends	4.64	1.37	4.24	9.60	0.95
Patent application trends	4.23	1.13	3.90	9.08	0.95
Editorial board position of domestic and foreign periodicals	6.83	1.26	6.46	11.44	0.95
Research team position at home and abroad	6.91	1.18	6.57	12.02	0.95
Academic honors	5.28	1.26	4.91	9.87	0.95
Research awards	5.19	1.38	4.79	9.39	0.95
Domestic peer evaluation	6.57	1.38	6.17	10.84	0.95
International influence	7.34	1.22	6.98	12.23	0.95

From the analysis of the statistical results in the table above, we know that among the preliminary 40 indexes, the indexes such as “Oral expression”, “Learning experience”, “Social influence”, “Social evaluation”, “Paper publishing trend”, “Patent application trend”, “Academic honor” and “Scientific research reward” are relatively relevant to the evaluation of scientific research talents. Therefore, this paper chooses to ignore these 8 indexes in the later research, the correlation degree of the remaining indexes is higher than 6.5, and the lower limit of the confidence interval is greater than 6, which indicates that the correlation of the index basically satisfies the evaluation requirements. Secondly, we use the method of direct conversation to consult the relevant experts in the field of talent research, and finally determine the evaluation index system of scientific research talents. In the course of expert consultation, many experts pointed out that in the design process of Index, we should try to avoid non-quantitative Index that are difficult to measure, such as “Thinking Agility”, “Memory”, “Learning efficiency”, “Learning consciousness”, and “Innovation ability”, etc., “Knowledge level” can be used directly “Paper publication quantity” to replace, the two have the problem of duplication of content, experts recommend retaining the “Number of papers published” This quantifiable Index, so the two level Index “Learning ability” is no longer retained; in the measurement of paper contribution Index, experts recommend that we no longer focus only on the number of papers published, but also on the impact factors of the paper and the quality of the paper “The sum of the influence factors of the thesis “should be put in a more important position, at the same time, some experts think that “Core competitiveness “is not easy to quantify, can be replaced by the published” Paper Impact Factor sum “, this proposal has been affirmed by other experts, so this article no longer guarantee the” Academic level “index, the corresponding first-level Index also no longer retained; In addition, the first level of Index “Scientific research quality” some experts believe that the concept is easy to confuse with scientific research ability, the proposal changed to “Basic literacy”; The relevant experts believe that “The subject influence of the paper” and “The sum of the influence factors of the paper” in a sense is the same thing, can be expressed in a “The sum of the influencing factors of the paper”, some experts believe that “the social benefits of patent” some are time-sensitive, some have hysteresis, so it will bring great difficulties to the measurement, the results also lack of accuracy and scientific, so this article will ignore the Index; in the “Scientific research potential”, “Scientific research management”, “Scientific research status” such as qualitative Index of the investigation, but also more combined with the objective situation from the actual point of view to comprehensive measurement, so on the advice of relevant experts, made the following adjustments: “Cooperation efficiency” and “Cooperation results” duplication, from “Cooperation results” as quantifiable Index, “Research field prospects” and “Depth of research direction” content is duplicated, and “ The depth of scientific research direction “is not easy to quantify, so only the” Research field prospects “Index is retained;” Scientific status “is changed to” Academic status “; and the” Domestic peer evaluation

“Index is revised to” Domestic influence “, measured by domestic awards. After concentrating the wisdom and suggestions of a number of experts, the evaluation Index system of scientific research talents with 5 primary index, 10 two level index and 21 three level index is finally formed, as shown in table 4. In the application of index system, for different stages and different fields of scientific research personnel will be based on the actual situation of Index and their weights corresponding adjustment, so that the evaluation results more accurate.

Table 4 Evaluation Index of scientific research Talents (revised).

Level 1 Index	Level 2 Index	Level 3 Index	Note
Scientific Research Management	Teamwork Skills	Team Motivation	Through the detailed measurement of team funds
		Results of cooperation	Participate in academic achievements during topics and projects
		In-Group evaluation	Measured by in-group scoring
	Project management Capabilities	Project Topic Management	Measurement through the completion of topics and projects
		Project Topic Practice	Truthfully record.
Basic accomplishment	Honesty and morality	Authenticity of personal materials	True Y, False N, not clear U
		Record of academic misconduct	True Y, False N, not clear U
	Academic Experience	Personal History	Truthfully record.
		Diploma	Truthfully record.
		Personal title	Truthfully record.
Scientific research contribution	Thesis contribution	Number of papers published	Subject to periodicals
		The sum of influencing factors in papers	The latest version of the periodical information is subject to
	Patent contribution	Number of authorized patents	The publication of information by the National Patent Office shall prevail
		Patent impact	The proportion of patent use shall prevail
Research potential	Academic exchanges	Academic Conferences	The meeting in which the presenter is involved shall prevail
		Overseas visit	Truthfully record.
	Research orientation	Prospect of research Field	Comprehensive evaluation
Academic status	Research positions	Editorial board position of domestic and foreign periodicals	Truthfully record.
		Positions of scientific research team at home and abroad	Truthfully record.
	Industry reputation	Domestic peer evaluation	Domestic honors prevail, such as “Changjiang Scholar” and other
		International influence	Foreign honors prevail, such as foreign first-class journals, foreign academicians, etc.

2.3. Determination of the Weight of the Index

The design of the index system should be combined with the actual application needs, which can provide practical help and guidance for the actual work. Although the previous research has determined the content of various Index, but the determination of the weight of Index in order to make the evaluation system of scientific research personnel really play a role, but also related to the core content of talent evaluation. Therefore, this subsection will determine the weight of evaluation Index through calculation, the construction of a complete evaluation index system. The common methods to determine the weight of Index are expert scoring method, expert sorting method, sorting index method, Analytic hierarchy Process (AHP), Entropy value method and so on. The calculation results of entropy value method are more accurate than analytic hierarchy process (AHP), which is more in line with the principles of science and maneuverability, so this paper selects the method to calculate the index weight.

In the process of evaluation of scientific research personnel, through expert scoring, the entropy

value method is used to empower the evaluation index, the entropy value corresponding to different indexes is calculated, the data is processed according to the steps of calculating the weight by entropy value method, and finally the weight of the evaluation index of scientific research talents is obtained by Excel tool.

2.3.1. Principle of Entropy Value Method

The concept of entropy originates from thermodynamics and is a measure of the uncertainty of system state. In information theory, message is a measure of the degree of system order, and entropy is a measure of the degree of system disorder, the absolute value of the two is equal, but the symbol is the opposite. According to this property, the inherent information in the evaluation can be used to obtain the information entropy of each index by entropy value method, the smaller the information entropy, the lower the disordered degree of information, the greater the utility value of the information, the greater the weight of the index. By means of entropy value method, we can adjust and assign the index weight dynamically according to the difference between different indexes, using the utility value and entropy value of the index, which can not only fully show the difference between the indexes, but also reflect the difference in the process of expert scoring. If there is a large difference between an Index and other Index, it indicates that the absolute value of its entropy is small and the index weight is large, and conversely, if the difference between this index and other indexes is small, the entropy value is large and the weight is small. The biggest characteristic of entropy value method is that the weight of the information given by the decision matrix is calculated directly, but the subjective judgment of the decision maker is not added, so the index weight calculated by the method is more scientific and accurate.

2.3.2. Calculation of index weight based on entropy value method

2.3.2.1. Establishment of matrices and data standardization

The evaluation system of scientific research talents in this paper has 5 first-level Index, so the whole evaluation system as a big data set M, the remaining 5 primary Index as 5 sub-datasets, namely $M=\{m_1, m_2, m_3, m_4, m_5\}$, each sub-dataset includes their own level two Index and three level Index,

Through the scoring results of previous experts, the weights are solved by combining the entropy value method.

Based on the results of 47 expert scores, the total data matrix is 47×21 , recorded as X:

$$X = \begin{matrix} A_1 \\ \vdots \\ A_m \end{matrix} \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix}, m \leq 47, n \leq 21$$

Then the matrix X is standardized, and the standardized formula is: $x_1 = x_{ij} / \sum x_j$, the range of values is $[0,1]$, and the standardized data obtained can be used for subsequent calculations.

2.3.2.2. Calculation of index weight of sub-dataset

First to solve the m_1 , scientific research management. This sub-data set includes a total of 2 two level Index, 5 three level Index. Therefore, the n value in the matrix X_1 is 5, according to the above standardized matrix p_1 , the evaluation index entropy value in m_1 is calculated e_{1j} :

$$e_{1j} = -k \sum_{j=1}^{47} p_{1j} \ln p_{1j}$$

$k > 0, k = \frac{1}{\ln m}$, $e_{1j} \geq 0$, here $m=47$, that is, the number of experts. Therefore, the utility value (that is, the difference factor) is $g_{1j} = 1 - e_{1j}$, and the weight of each index is: $a_{1j} = g_{1j} / \sum_{j=1}^5 g_{1j}$. By using the additive of entropy, the weight of the level two index can be obtained by the weight of the three level index, so that the weight of all the indexes can be obtained. The solution process for the other four sub-datasets can refer to the above steps and will not be repeated.

The calculation of entropy value method can be realized by the auxiliary of various software, this paper selects Excel software to realize the final solution process, and the detailed calculation steps are as follows:

The first step is to calculate the entropy value of 4 sub-datasets separately.

m_1 :

① After the initial matrix is standardized, the standardized results are obtained (see table 5):

Table 5 The Standardized Results.

Experts	Team Motivation	Results of cooperation	In-Group evaluation	Project Topic Management	Project Topic Practice
1	0.02000000	0.021978022	0.018126888	0.018181818	0.021108179
2	0.025714286	0.019230769	0.021148036	0.020779221	0.023746702
3	0.017142857	0.024725275	0.024169184	0.023376623	0.018469657
4	0.02000000	0.019230769	0.021148036	0.023376623	0.021108179
5	0.02000000	0.024725275	0.018126888	0.020779221	0.021108179
6	0.014285714	0.021978022	0.012084592	0.018181818	0.018469657
7	0.02000000	0.013736264	0.027190332	0.023376623	0.023746702
8	0.02000000	0.024725275	0.021148036	0.018181818	0.023746702
9	0.017142857	0.019230769	0.027190332	0.020779221	0.018469657
10	0.022857143	0.021978022	0.018126888	0.023376623	0.023746702
11	0.025714286	0.019230769	0.024169184	0.023376623	0.021108179
12	0.017142857	0.016483516	0.024169184	0.020779221	0.018469657
13	0.025714286	0.024725275	0.015105740	0.018181818	0.023746702
14	0.02000000	0.021978022	0.027190332	0.023376623	0.015831135
15	0.025714286	0.024725275	0.021148036	0.023376623	0.021108179
16	0.022857143	0.019230769	0.024169184	0.015584416	0.023746702
17	0.025714286	0.021978022	0.021148036	0.018181818	0.018469657
18	0.022857143	0.016483516	0.024169184	0.020779221	0.021108179
19	0.017142857	0.024725275	0.018126888	0.023376623	0.023746702
20	0.022857143	0.021978022	0.027190332	0.018181818	0.021108179
21	0.02000000	0.019230769	0.015105740	0.023376623	0.018469657
22	0.017142857	0.021978022	0.018126888	0.020779221	0.023746702
23	0.02000000	0.024725275	0.024169184	0.023376623	0.023746702
24	0.017142857	0.019230769	0.012084592	0.023376623	0.018469657
25	0.02000000	0.021978022	0.021148036	0.018181818	0.023746702
26	0.02000000	0.019230769	0.021148036	0.020779221	0.021108179
27	0.025714286	0.013736264	0.018126888	0.023376623	0.018469657
28	0.02000000	0.019230769	0.024169184	0.020779221	0.023746702
29	0.022857143	0.024725275	0.018126888	0.018181818	0.018469657
30	0.017142857	0.019230769	0.024169184	0.023376623	0.023746702
31	0.022857143	0.024725275	0.021148036	0.020779221	0.021108179
32	0.017142857	0.024725275	0.027190332	0.023376623	0.023746702
33	0.022857143	0.019230769	0.024169184	0.018181818	0.023746702
34	0.022857143	0.021978022	0.021148036	0.023376623	0.015831135
35	0.025714286	0.019230769	0.018126888	0.020779221	0.023746702
36	0.022857143	0.021978022	0.024169184	0.023376623	0.018469657
37	0.02000000	0.021978022	0.018126888	0.020779221	0.023746702
38	0.022857143	0.019230769	0.024169184	0.018181818	0.021108179
39	0.025714286	0.021978022	0.015105740	0.020779221	0.018469657
40	0.02000000	0.016483516	0.027190332	0.023376623	0.023746702
41	0.022857143	0.021978022	0.018126888	0.020779221	0.023746702
42	0.02000000	0.024725275	0.021148036	0.023376623	0.018469657
43	0.022857143	0.021978022	0.027190332	0.023376623	0.023746702
44	0.02000000	0.024725275	0.012084592	0.020779221	0.021108179
45	0.022857143	0.021978022	0.027190332	0.023376623	0.023746702
46	0.022857143	0.024725275	0.018126888	0.023376623	0.018469657
47	0.022857143	0.021978022	0.024169184	0.020779221	0.021108179

② Calculate the entropy value of each evaluation Index, and the formula is: $e_{1j} = -k \sum_{j=1}^{47} p_{1j} \ln p_{1j}$: (see table 6)

Table 6 The Entropy Results.

Index	Team Motivation	Results of cooperation	In-Group evaluation	Project Topic Management	Project Topic Practice
Entropy value	0.997491435	0.997461646	0.994529838	0.998596215	0.998228168

③According to the calculated entropy value, the utility value corresponding to each index is calculated in turn, and the formula is: $g_{1j} = 1 - e_1$: (see table 7)

Table 7 The Utility Results.

Index	Team Motivation	Results of cooperation	In-Group evaluation	Project Topic Management	Project Topic Practice
Utility values	0.002508565	0.002538354	0.005470162	0.001403785	0.001771832

④Finally, the weight of each index is calculated, and the formula is: $a_{1j} = g_{1j} / \sum_{j=1}^5 g_{1j}$: (see table 8)

Table 8 The Weight of Index.

Index	Team Motivation	Results of cooperation	In-Group evaluation	Project Topic Management	Project Topic Practice
Weight	0.035427636	0.035848333	0.077253293	0.019825195	0.025023006

⑤The weight calculation steps for the remaining four sub-datasets are the same as above and are not repeated.

2.3.2.3. The weight of scientific research talent evaluation system is determined

The weight of the first level index and the two level index is calculated by the principle that entropy value can be added, and the evaluation system of scientific research talents is finally obtained as follows table 9:

Table 9 Weight of Evaluation index of scientific research talents.

Level 1 Index	Weight	Level 2 Index	Weight	Level 3 Index	Weight
Scientific Research Management	0.193377463	Teamwork Skills	0.148529262	Team Motivation	0.035427636
				Results of cooperation	0.035848333
				In-Group evaluation	0.077253293
		Project management Capabilities	0.044848201	Project Topic Management	0.019825195
				Project Topic Practice	0.025023006
Basic accomplishment	0.269328627	Honesty and morality	0.056984382	Authenticity of personal materials	0.034277856
				Record of academic misconduct	0.022706526
				Personal History	0.090028344
		Academic Experience	0.212344245	Diploma	0.079448926
				Personal title	0.042866975
Scientific research contribution	0.098321901	Thesis contribution	0.029835632	Number of papers published	0.016950307
				The sum of influencing factors in papers	0.012885325
		Patent contribution	0.068486269	Number of authorized patents	0.022603322
				Patent impact	0.045882947
Research potential	0.190871737	Academic exchanges	0.12267308	Academic Conferences	0.055659143
				Overseas visit	0.067013937
		Research orientation	0.068198657	Prospect of research Field	0.068198657
Academic status	0.248100272	Research positions	0.1161021	Editorial board position of domestic and foreign periodicals	0.062323249
				Positions of scientific research team at home and abroad	0.053778851
		Industry reputation	0.131998172	Domestic peer evaluation	0.080151272
				International influence	0.051846900

3. Application Examples of Evaluation System of Scientific Research Talents

3.1. Overview

This study, in cooperation with the postdoctoral station of Nanjing General Hospital, has been

successfully applied to the evaluation of post-doctoral station personnel in Nanjing General Hospital, so the following is an example of two post-doctoral postdoctoral in the field of medicine, focusing on the supporting role and concrete operation of the evaluation Index system of scientific research talents in the evaluation of scientific research talents. The basic situation of two post-doctoral reviews is shown in the following table 10:

Table 10 Basic situation of postdoctoral evaluation.

Evaluation Index	Postdoctoral A	Postdoctoral B
Degree	Doctor	Doctor
Graduated institutions	Stanford University	Peking university
Research fields	Clinical	Clinical
Research orientation	Nephropathy	Cardiovascular disease
Working institutions	Large triple-A hospital in China	Large triple-A hospital in China
Date of birth	1982	1971
Institutional positions	Associate Professor, deputy chief physician	Professor, chief physician

3.2. Evaluation Objectives

In order to understand the development of postdoctoral post-doctoral, the PhD station of Nanjing General Hospital provides practical improvement measures and suggestions for post-doctoral training and postdoctoral enrollment in the future, and evaluates the postdoctoral post of postdoctoral terminus in station and outbound. Postdoctoral has a PhD degree or above, recognized by domestic and even international academic circles, and the number of academic achievements produced in many, with a good academic level and development potential. According to the different evaluation objectives, the evaluation criteria, quantitative index calculation and assignment of qualitative index in the index system can be adjusted accordingly.

3.3. Quantitative Analysis of evaluation Index

Quantitative index data has the characteristics of scientific and accurate, but qualitative Index do not have specific data, so it is necessary to quantify qualitative Index, give specific values that can be used for calculation and comparison, so that the scientific research talent system has the basis for application in practical work. In this paper, the data assignment is divided into 9 sub-values, from low to high in order 1 to 9, and according to the analysis results assigned value, and finally find a comprehensive score.

3.3.1. Scientific Research Management Teamwork Ability

Team motivation can be measured by the use of team funds; The results of the collaboration are measured by the number of participants and the status of their awards; and the in-group evaluations are judged by the anonymous scores of the team members, measured by the score of each option. Project Management capability: Project subject management can be measured by the completion progress and award of the project subject, the project is divided into provincial and ministerial projects, national projects, international cooperation projects and other projects, according to the project level, the project topic practice can be divided according to the participation role level, respectively: Project leader, Project Core member, Project participants.

3.3.2. Basic accomplishment Honesty and morality

The authenticity of personal materials and the record of academic misconduct, etc., according to the real situation to assign a value, that is, the existence of counterfeiting is 0, does not exist is 1. The Index is a one-vote rejection Index, there is a false situation, and then the combined score of 0. Academic experience: Personal history, Degree education, personal title and other Index are recorded truthfully one by one, quantitative analysis can be.

3.3.3. Scientific Research contribution Thesis contribution

The number of papers published is subject to the publication, the sum of the influence factors of

the paper is based on the latest version of the periodical information, all truthfully recorded and assigned value. Patent contribution: The number of authorized patents is based on the publication of information by the State Intellectual Property Office, and the patent influence is assigned to the proportion of the use of the patent. At present, scientific metrology is used more and more frequently in the evaluation of scientific research talents, on the basis of the traditional evaluation indexes such as the number of papers published, the frequency of papers cited, the influence factors of periodicals and so on, the evaluation index of academic papers and periodicals based on citation analysis tends to be reasonable and perfect, H index, G index, The application of A Index and R Index also makes the evaluation method richer and more accurate. However, the existing index system also has different degrees of defects and shortcomings, such as the inability to achieve in the number and quality of the paper above the overall balance, and secondly in the qualitative Index of the often neglected situation, so the scientific metrology Index are used to improve and enhance the establishment of the index system. The evaluation index system of scientific research talents in this paper evaluates the talents from the aspects of the number of papers published, the sum of the influence factors of the papers, the influence and so on, and the indexes are more inclined to the assessment and evaluation of the talents themselves and the quality of the scientific research achievements. In this specific application, the source of the paper is SCI core journals, EI core journals, ISTP papers, etc., the patent data from the State Intellectual Property Office of China Patent Database and de Winter patent database, as well as patent citation and conversion data.

3.3.4. Research Potential Academic Exchange

The academic conference is an important index to measure the degree of communication between researchers and the outside world, but the Index to reflect the future development trend of scientific researchers, especially to participate in the world's top academic conferences, and as one of the presenters, can basically show that the researchers in the academic community has made outstanding achievements, the forefront of research direction, This article is based on the participation of the presenter, the study abroad is in accordance with the school rankings, professional rankings truthfully recorded and assigned value. Research interests: The future of the research field can be measured by the total number of communications in the past five years, as well as the impact of the top publications in the field, comprehensive evaluation.

3.3.5. Academic Status Scientific research

The position of editorial board of periodicals at home and abroad and the position of scientific research team at home and abroad can be distinguished according to the level of ordinary position, important position, leader, etc.

Industry reputation: Domestic peer evaluation is a qualitative Index, can be obtained in the domestic honor to measure and assign value, such as "Changjiang Scholar", "youth" and so on, international influence is based on the honor obtained abroad, such as foreign academicians.

3.4. Evaluation Results show

Through the calculation and comprehensive analysis of the indexes of two selected postdoctoral students, the evaluation results shown in table 11 below are obtained and provided to the Postdoctoral Management center of Nanjing General Hospital, with a view to providing assistance to the future postdoctoral enrollment, training and management work.

Table 11 Presentation of evaluation findings.

Evaluation Index	Postdoctoral A	Postdoctoral B
Scientific Research Management	More participation in projects, project backbone and participants, no project leader information found	More scientific research projects, more as the project leader and backbone to participate in the project, scientific research management ability is strong
Basic accomplishment	Personal materials are true, there is no record of any academic misconduct, scientific research Foundation is very	Personal materials are true, there is no record of any academic misconduct, scientific research Foundation is very good

	good	
Scientific research contribution	In the past 5 years, the number of papers published is large, there are high-frequency cited articles as the 1th author or communication author, the sum of the influence factors is greater than 10; no patent output	In the past 5 years, the number of papers published is small, not as the 1th author or communication author of high-frequency cited articles, the total impact factor is less than 5, there are 4 domestic patents, patents have not been converted
Research potential	Attend academic conferences more, and mainly in the capacity of the presenter to attend, no visiting scholar experience, research direction is very frontier, broad prospects	Attend academic conferences more, and mainly in the capacity of the presenter to attend, no visiting scholar experience, research direction is very frontier, broad prospects
Academic status	In the field of first-class international journals as editorial board and evaluation, with a high degree of international peer recognition	In the field of first-class international journals as editorial board and evaluation, with a high degree of international peer recognition

4. Conclusions and Prospects

In recent years, experts and scholars at home and abroad have carried out multi-angle research and exploration on the construction and application of Evaluation index and system of scientific research talents, but there have been many problems in the evaluation system of scientific research personnel, such as too scattered, broad, difficult to obtain qualitative Index, quantitative Index and too much emphasis on quantity and neglect of quality. Therefore, it also brings that the evaluation index of scientific research talents cannot land on paper, and there are common difficult phenomena and problems in practical application. Based on the scientific, purposeful and operable nature, this paper designs the three level evaluation index system with 5 dimensions, covers and refines the more comprehensive qualitative and quantitative indexes, and makes an empirical study based on tech data and postdoctoral data of the postdoctoral station of Nanjing General Hospital. Thus to a certain extent, it solves the problem that the evaluation index of scientific research talents lacks scientific and difficult to operate. However, there are some shortcomings in the research of this paper, such as the Imperfect index system, the lack of refinement of the assignment level, and the need to further improve the method of dealing with big data.

Therefore, in the next research, will be based on the neural network method applied to the evaluation, in the empirical link can be more accurate processing of big data, at the same time, according to different application scenarios, corresponding adjustment evaluation index weight, the establishment of a more systematic and complete evaluation system and model of scientific research personnel, for more talent management to provide support.

References

- [1] Anderson C.J., Glassman M., McAfee R.B., & Pinelli T. (2001) An Investigation of Factors Affecting How Engineers and Scientists Seek Information. *Journal of Engineering Technology Management*, 18, 131-155.
- [2] Cagliano R., Chiesa V., & Manzini R. (2000) Differences and Similarities in Managing Technological Collaborations in Research, Development, and Manufacturing: A Case Study. *Journal of Engineering Technology Management*, 17, 193-224.
- [3] Florida Richard. (2002) The Economic Geography of Talent. *Annals of the Association of American Geographers*, 92, 4, 743-755(13).