# Evaluation System of Aerospace Science and Technology Talents Based on Fuzzy Comprehensive Evaluation

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**Abstract.** Space science and technology talents are the strategic resources to win the international competition, the important force to achieve independent innovation in space, and the main force to transform space science and technology achievements. Therefore, it is very important to establish a set of evaluation system for space science and technology talents. The establishment of the evaluation system for the correct evaluation of talents, their personal and enterprise development plays a very good incentive role. At present, there are few researches on the evaluation of aerospace science and technology talents, and the simple subjective evaluation method of scoring is often used for evaluation. At the same time, the evaluation indicators are more qualitative indicators and less quantitative indicators, which are not well combined and cannot accurately reflect the evaluation results. This paper solves this problem by establishing the evaluation index system of space science and technology talents and using the fuzzy evaluation method, which plays an important role in the construction of space science and technology talents in the future.

**Keywords:** Fuzzy evaluation · Aerospace science and technology personnel · incentive

## 1 Introduction

The report to the Party's 20th National Congress pointed out that "education, science and technology, and human resources are the basic and strategic support for comprehensively building a modern socialist country." A high quality education system is the basis for the development of science and technology and talents. Looking back at the historical course of China's space industry, it is of great importance to build scientific and technological personnel in the context of cooperation between countries [1]. In 1956, when the Soviet Union withdrew its experts from China, China's space program became self-reliant and created the miracle of "two bombs and one star". After being kicked out of the Galileo project by Europe in 2002, China developed the Beidou Navigation System. In 2011, the United States adopted the Wolf Clause to restrict the cooperation between the United States and China in the space field, and China's space agency made unremitting efforts to complete the sampling work of the lunar probe [2]. Currently, the

new round of scientific and technological revolution is developing rapidly in the world, and the space field has become a new focus of the game of great powers. Talent is the key factor to promote the high-quality development of our space industry and win the initiative of international competition, whose role in the game between countries cannot be underestimated [3]. The evaluation of space science and technology talents affects the adjustment and development direction of the education system of space science and technology talents.

At present, there are still some problems in the space field, such as too few researches on the evaluation of scientific and technological talents, and the lack of scientific and rational evaluation methods. First, it simply uses the subjective evaluation method of scoring, which fails to distinguish the professional differences between aerospace science and technology talents and other talents. Second, there are more qualitative indicators and less quantitative indicators, which can not reflect the evaluation results well.

## 2   Construction of Evaluation Index System Framework for Aerospace Science and Technology Talents

The construction of evaluation indexes for aerospace science and technology talents shall be carried out around evaluation objectives, evaluation items and evaluation indexes [4]. The evaluation objectives generally represent the evaluation requirements for the quality and academic performance of aerospace science and technology talents. Evaluation item is the secondary index of evaluation objective; As a three-level index, the evaluation index corresponds to the specific content of the second-level index. The specific comprehensive evaluation index system of scientific and technological talents is shown in Table 1. Level 1 indicators are quality, professional knowledge, job contribution. The secondary indexes of quality literacy include moral literacy and professional literacy; The secondary indexes of professional knowledge include basic knowledge, professional level; The secondary indicators of job contribution are scientific research, performance contribution, and other tasks. The three indexes of moral accomplishment include ideology and politics, character accomplishment; The three levels of professionalism include compliance, professionalism, teamwork; The three indexes of basic knowledge include educational level, computer level; The three indexes of professional level include academic status, business communication; The three levels of scientific research include project research, award results, and publication of papers; The three levels of performance contribution include team building, talent cultivation and work performance; Tertiary indicators of other tasks include other activities.

## 3   Fuzzy Evaluation Model and Establishment of Aerospace Science and Technology Talents

### 3.1   Establish the Evaluation Factor Set of Aerospace Science and Technology Talents

That's the corresponding index:

$$U = \{u_1, u_2, ..., u_n\}$$

**Table 1.** Space science and technology talent evaluation index system

| Level indicators | The secondary indicators | Level 3 indicators |
|---|---|---|
| Quality literacy | Moral quality | Ideology and politics |
| | | Character accomplishment |
| | Professionalism | Discipline |
| | | Professional quality |
| | | Team collaboration |
| Professional knowledge | Basic knowledge | Educational level |
| | | Computer skills |
| | Professional level | Academic standing |
| | | Business communication |
| Position contribution | Scientific research | Topic research |
| | | Reward achievement |
| | | Papers published |
| | Performance contribution | Team building |
| | | Cultivation of talents |
| | | Job performance |
| | Other tasks | Task activities |

### 3.2 Establish the Weight of Each Evaluation Index

$$A = \{a_1, a_2, ..., a_n\}$$

### 3.3 Establish Evaluation Level

$V = \{v_1, v_2, ..., v_n\}$. The corresponding level can be converted to the corresponding level, that is:

$V = \{v_1, v_2, ..., v_n\} = \{\text{Excellent, good, medium, poor}\} = \{A, B, C, D\}$ D. The *evaluation.*

### 3.4 Fuzzy Matrix is Established

$R = (r_{ij})_{n \times m}$ The experts will vote the evaluation objects according to the evaluation level, and finally count the votes.

### 3.5 Perform Fuzzy Transformation

$$B = A \cdot R \tag{1}$$

$B = \{b_1, b_2, ..., b_m\}$ is the fuzzy comprehensive evaluation of the evaluation system.

$$b_j = \sum_{i=1}^{m} a_i \cdot r_{ij} \tag{2}$$

make the evaluation level according to the principle of maximum membership.

### 3.6 The Normalization Process

$$B' = \frac{B}{\sum\limits_{j=1}^{m} B_j} \tag{3}$$

### 3.7 The Fuzzy Comprehensive Evaluation Value of Aerospace Science and Technology Talents is Obtained

$$H = B' \cdot C \tag{4}$$

## 4 The Example Analysis

Taking the scientific research index of a certain aerospace science and technology talent as the evaluation object [5], the weight is assigned by Delphi method. The weight of the project research is 0.5, the weight of the reward results is 0.3, the weight of the paper publication is 0.2, and the evaluation grade is excellent, good, medium and poor, with the corresponding score of 10, 8, 5 and 2 points respectively. Ten experts conducted the evaluation, and the results are shown in Table 2.

**Table 2.** Evaluation form for scientific research of talents in aerospace science and technology

| Indicators | The weight | 10points (excellent) | | 8points (good) | | 5points (medium) | | 2points (poor) | | score |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Expert number | The percentage of | Expert number | The percentage of | Expert number | The percentage of | Expert number | The percentage of | |
| Subject research | 0.5 | 5 | 0.5 | 3 | 0.3 | 2 | 0.2 | 0 | 0 | 4.20 |
| Reward achievement | 0.3 | 6 | 0.6 | 3 | 0.3 | 1 | 0.1 | 0 | 0 | 2.67 |
| Papers published | 0.2 | 4 | 0.4 | 2 | 0.2 | 2 | 0.2 | 1 | 0.1 | 1.36 |

**Table 3.** Scientific research weight evaluation table

| Indicators | Weight | | | | | $a_i$ |
|---|---|---|---|---|---|---|
| | 0 | 0.1 | 0.2 | 0.3 | 0.4 | |
| Subject research | / | 2 | 8 | / | / | 0.2951 |
| Reward achievement | / | 3 | 4 | 3 | / | 0.3279 |
| Papers published | / | / | 7 | 3 | / | 0.377 |

### 4.1 Establish the Evaluation Factor Set of Aerospace Science and Technology Talents

That is, the corresponding indicators are:

$$U = \{u_1, u_2, ..., u_n\}$$
$$= \{\text{Project research, award results, paper publication}\}.$$

### 4.2 The Weights of Each Evaluation Index are Established According to Delphi Method

That is:

$$A = (0.2951, 0.3279, 0.377)$$

### 4.3 Ten Experts Scientifically Studied the Second-Level Indicators and Determined the Weight Matrix of the Three Third-Level Indicators

The results are shown in Table 3. Then its weight matrix is:

$$A = (0.2951, 0.3279, 0.377)$$

### 4.4 Establish Evaluation Level

$V = \{v_1, v_2, ..., v_n\}$, the corresponding level can be converted to the corresponding level, that is:

$$V = \{v_1, v_2, ..., v_n\} = \{\text{Excellent, good, medium, poor}\} = \{A, B, C, D\}$$

### 4.5 The Evaluation Fuzzy Matrix is Established

$R = (r_{ij})_{n \times m}$. According to Table 2, its fuzzy matrix is as follows:

$$R = \begin{vmatrix} 0.5 & 0.3 & 0.2 & 0 \\ 0.6 & 0.3 & 0.1 & 0 \\ 0.4 & 0.2 & 0.2 & 0.1 \end{vmatrix}$$

## 4.6  Perform Fuzzy Transformation

$B = A \cdot R$, that is:

$$B = A \cdot R = (0.377, 0.3, 0.2, 0.1)$$

## 4.7  The Normalization Process

$B' = \dfrac{B}{\sum\limits_{j=1}^{m} B_j}$, that is:

$$B' = (0.386, 0.307, 0.205, 0.102)$$

## 4.8  The Fuzzy Comprehensive Evaluation Value of Aerospace Science and Technology Talents is Obtained

$H = B' \cdot C$, that is:

$$H = B' \cdot C = 79.54$$

The hierarchy of aerospace science and technology talents is shown in Table 4:

Comparing with Table 4, it can be concluded that the fuzzy comprehensive evaluation of the scientific research of the aerospace science and technology talents is Grade A. Similarly, other index evaluation levels can be obtained according to the above methods and steps.

**Table 4.**  The hierarchy of aerospace science and technology talents

| Talent level of aerospace science and technology | Level | Value |
|---|---|---|
| Authority | A | 91–100 |
| Command ability | A | 86–90 |
| | B | 81–85 |
| Generalship | A | 76–80 |
| | B | 71–75 |
| Specialist | A | 66–70 |
| | B | 60–65 |
| The backbone | A | 50–55 |
| | B | 49 the following |

# 5 Conclusions

By analyzing the evaluation index of space science and technology talents, this paper establishes the evaluation system of space science and technology talents by using the comprehensive evaluation method of fuzzy mathematics. Through the establishment of fuzzy evaluation model, data calculation and processing are carried out to make the evaluation results more fair and just, which has important reference significance for the future training, screening, construction and development of talent team.

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