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A Two-Stage Bilateral Matching Study of Teams-Technology Talents in New R&D Institutions Based on Prospect Theory

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Abstract: This study considers two-stage bilateral matching of teams and scientific and technological talents in new R&D organizations and proposes a two-stage dual-objective bilateral matching method based on prospect theory. The matching of teams and scientific and technological talent in new R&D institutions is divided into two stages: elimination matching in the first stage and selection matching in the second stage. In the first stage, the evaluation index of the team to talent and the cost index of talent are constructed, the dual reference points of peer and expectation are set for evaluating talent, and the bottom-line reference points are set for talent cost. The comprehensive prospect value in the first stage is calculated based on prospect theory, and the matching in the first stage is completed based on the dual-objective optimization model with the highest evaluation value and the lowest cost value. In the second stage, using the matching results of the first stage, the team evaluates the talent again, while the talent ranks the team to obtain the satisfaction value, and completes the second stage of bilateral matching based on prospect theory and the dual-objective optimization model with the highest evaluation value and the highest satisfaction value. Finally, a case study and method comparison show that the proposed method is feasible and effective.

Keywords: prospect theory; new R&D institutions; scientific and technological talent; performance assessment; bilateral matching

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1. Introduction

In China, new R&D institutions, with their impressive innovation achievements and rapid development momentum, have developed into the pioneering force for source science and technology innovation and development of strategic emerging industries in various regions, creating a new model of science and technology R&D that leaps and bounds to enhance source innovation capacity and rapidly realize industrialization. The new R&D institution is a "four different", not exactly like a university, with different culture; not exactly like a scientific research institute, with different content; not exactly like an enterprise, with different objectives; not exactly like an institution, with different mechanisms. In particular, its essential characteristics of marketization, industrialization, diversification, socialization and internationalization also foreshadow an important direction for the reform and development of scientific research institutions in China.

The development of science and technology cannot be separated from talent, and scientific and technological talent is the first resource for the development of new R&D institutions. With the development of new R&D institutions, the requirements for scientific and technological talents are becoming increasingly high-end and comprehensive. First, they should be patriotic and dedicated, transforming their love for the country and the will to strengthen the country into the act of serving the country. Second, they should be active in innovative thinking and conduct research oriented by the scientific and technological needs of the country and the market as well as "high precision and shortage" projects. At the same time, new R&D institutions should also create various conditions for all kinds of talent to settle down, feel at ease and work, respect talent and creativity, innovate talent assessment mechanisms, and improve the assessment system of scientific and technological talent oriented toward innovation ability, quality, and contribution. There are many teams within the new R&D institutions, and these institutions give the teams a lot of autonomy to choose the direction of scientific research independently, issue performance and rewards independently, and implement the science and technology management system independently. Therefore, teams of new R&D institutions also have autonomy in selecting and employing people. The two-way choice between a team of new R&D institutions and scientific and technological talents is the issue of bilateral matching. On the one hand, the team of the new R&D institution looks for scientific and technological talents according to its own needs, and each team will propose its own personalized evaluation index that classifies and selects scientific and technological talents through an evaluation based on a personalized index, which will realistically consider the benefits and costs together. On the other hand, the tech talent will also look for teams according to their own needs; there will also be a ranking of the teams.

To study the bilateral matching of new R&D institutions and talents, the author searched the SCI literature on the performance assessment of new R&D institutions, performance assessment of scientific and technological talents, and bilateral matching. Moliterno et al. [1] proposed that performance comparison is central to the behavioral theory of the firm, that is, companies assess their performance based on their own prior performance ("historical comparison") and the performance of other organizations ("social comparison") and base subsequent organizational changes on this performance feedback. Bode and Singh [2] argue that the provision of opportunities for employees to participate in social activities helps attract, motivate, and retain employee talent. Abramo et al. [3] proposed that the ultimate goal of research innovation activities is not publication, but scientific and technological progress useful to science or practice, and that there is no incentive to produce low-value papers if innovation performance is assessed and funds are allocated based on the total impact of publications, rather than on the number of publications. Yin et al. [4] proposed the use of a blend of subjective and objective methods to assess green technology innovation capabilities which should consider indicators in four areas: input elements, technological output, economic aggregates, and social effects. Sun and Cao [5] point out that Chinese academic research on innovation has paid particular attention to R&D expenditures, performance assessments, regional innovation ecosystems, the role of state-owned enterprises in innovation, and the role of the Chinese Communist Party in innovation. Mao et al. [6] show that organizational innovation climate, knowledge management capabilities, and internal collaboration networks have a significant positive impact on innovation performance, and that internal collaboration networks have a significant mediating role between them. Chomać et al. [7] showed that consumer knowledge and preferences in the field of renewable energy determine the diffusion of RES solutions in personal use, thus stimulating the progress of energy transition. In general, to evaluate the performance of new R&D institutions, first, the evaluation indicators should be as comprehensive as possible, taking into account both subjective and objective factors. Second, in addition to assessing the established results, the innovation potential should also be assessed. Third, more attention should be paid to the quality of publications rather than the quantity. Fourth, the investment of funds and scientific and technological talents should be increased; and fifth, the economic promotion benefits as well as the social effects generated should be considered.

Chamorro et al. [8] discussed three methods for assessing talent: machine-learning algorithms, social sensing technologies, and user experience. Pillai et al. [9] investigated the application of AI technologies in talent acquisition, designed technology-organization-environment (TOE) and task-technology-adaptation (TTF) frameworks and proposed a model to explore the adoption of AI technologies for talent acquisition. Jiang et al. [10] proposed the development of technological talent in line with the globalization context and to integrate talent acquisition, research and development, technological innovation, and enterprise development. Wiblen and Marler [11] propose the role of digitization in talent identification, showing how the same digital talent management techniques can produce different ways to identify talent. Chaudhuri et al. [12] argued that company management with PhDs in key roles outperforms similar company management. Agarwal et al. [13] argue that stable shared leadership is at the root of firms becoming the center of gravity of their industry, accounting for the largest share of output. In general, the performance assessment of scientific and technical talents should be conducted by considering both their results and their potential. Second, regular, immediate, and dynamic assessment of scientific and technical talents should be conducted to form a digital database of assessments. Third, the capabilities of scientific and technical talents should be integrated with the development of the company and linked to economic and social benefits; and fourth, an artificial intelligence-based approach should be provided, and input assessment data can be quickly and accurately predicted and reasoned to draw assessment conclusions.

Eirinakis et al. [14] propose a time-optimal algorithm that identifies all stable worker-firm pairs and allocations under pairwise stability, individual preferences, and max-min criteria. Wang et al. [15] studied the bilateral matching decision problem using heterogeneous information and attribute associations. Kanoria and Saban [16] introduced a dynamic bilateral search model in which strategic agents incur costs to discover their value for each potential partner and can do so nonsimultaneously. Nguyen et al. [17] developed a many-to-one matching market model in which agents with multiunit demand aim to maximize the underlying linear objective subject to a multidimensional backpack constraint. Johari et al. [18] proposed that, in a service platform, the job type is known, but the worker type is unknown and must be learned by observing the matching results. Deng et al. [19] find that buyer and supplier conformance levels, conformance types, and inconsistency directions affect project performance. Chen et al. [20] found that matching the nature of CEO human capital and the type of acquisitions they make is associated with stronger performance. Chomać et al. [21] showed that global electricity price increases can be effectively reduced by conducting feasibility and matching analyses of renewable energy sources based on consumer investment and willingness to support them. In general, research on bilateral matching should consider the characteristics of heterogeneity, uncertainty, and incompleteness of input information. Second, improve the satisfaction and efficiency of bilateral matching based on certain methods. Third, consider multistage decision models; and fourth, match dynamically, conduct dynamic assessments, tap dynamic preferences, and consider dynamic reference point values, among others.

New R&D institutions have the mission of "high precision and shortage" of science and technology innovation, the mission of diversified and flexible reform of the science and technology system and mechanism, the mission to respond to market demand and generate economic and social benefits, and the mission of gathering high-end science and technology talents. It is particularly important and meaningful to study the matching of new R&D institutions with scientific and technological talents. Based on the fact that there is particularly little literature on the bilateral matching of new R&D institution teams and scientific and technological talents, this study applies the idea of bilateral matching. First, the new R&D organization team and technology talent are divided into two phases: the elimination matching phase and the selection matching phase. In the first stage of matching, since the number of talents is greater than the number of teams and a team can only match one talent, there are bound to be talents that are rounded off and cannot be matched, so we call it elimination matching. In the second stage of matching, the number of talents is equal to the number of teams, so we call it selection matching. Second, elimination matching considers the team's assessment of talent and the cost of talent introduction, and selection matching considers the mutual assessment of team and talent. Third, elimination matching considers the interval grey number to characterize the uncertain assessment and cost values, and selection matching considers the mean value of expert assessment and the talent's preference order value. Fourth, consider the psychological factors of decision makers, set a historical and desired double reference point for assessment value, set a bottom-line reference point for cost value and preference order value, and calculate the prospect value based on the reference point. Fifth, consider double objective matching, eliminate matching considering the double objective of maximum assessment value and minimum cost value, select matching considering the double objective of maximum assessment value and maximum satisfaction, reduce the double objective to a single objective, and construct a 0–1 integer programming optimal matching model. In this paper, the dual objectives are linear, and for simplicity of calculation, the dual objectives plus the weight information of the objectives can be simplified to a single objective. In order to make the matching results optimal, this paper uses 0–1 integer programming for solving the optimal solution.

2. Phase I Elimination Match between the Team of New R&D Institutions and Scientific and Technological Talents

The matching of new R&D organization teams and technology talents is divided into two stages. The first stage is the elimination of bilateral matching, that is, each team can match technology talents, the number of talents is greater than the number of teams, so not all technology talents can match the team, limited by the number of teams and the number of matches, there are always technology talents are eliminated in this matching process. In this study, there are n teams of new R&D institutions, and each team can only match one technological talent, and there are m technological talents, m > n; thus, so there will be m-n technological talents are eliminated. Therefore, this stage is referred to as elimination matching. Elimination matching must consider many factors, because eventually the new R&D organization has to explain the elimination reason for the eliminated tech talents, so the method of matching is very demanding.

In the first stage of matching, the highest value of the team's assessment of talent is considered, and the lowest value of the introduction cost of scientific and technological talent is also considered, historical reference points and desired reference points are set for the assessment value, bottom-line reference points are set for the cost value, the psychological factors of the team in the new R&D organization are fully considered, and scientific and technological talent is better compared, and finally, using the "0–1" integer planning model for bilateral matching. In the first phase of elimination matching, the total number of talents was greater than the number of R&D teams. Red smiling faces represent successfully matched tech talents, and green smiling faces represent unmatched tech talents that will be eliminated, as shown in Figure 1.

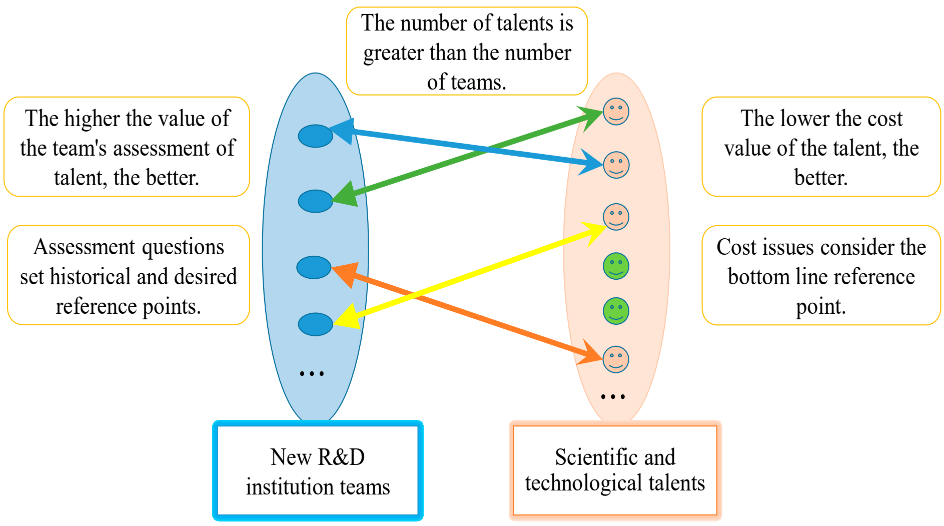

Figure 1. Phase I elimination matching chart for teams and talents in new R&D institutions.

2.1. Constructing Indicators for the Assessment of Scientific and Technological Talents by the Teams of New R&D Institutions

The assessment of scientific and technological talent has new requirements in this new era. Since new R&D institutions focus on breaking through core technologies, solving "neck" problems and transforming results, the development process of new R&D institutions requires scientific and technological talents to pay more attention to patriotism, technical potential and transformation ability. In Chinese history, many noble men and women had a strong sense of concern for the country and the people, and they took the affairs of the country as their responsibility, and they defended the motherland and cared for people's livelihood. No matter what environment we are in, we should love our country and take the affairs of our country as our responsibility. For example, in 2020, when we were fighting against the new coronavirus, many outstanding scientific and technological talents emerged in our country, creating Chinese speed in the field of nucleic acid detection, vaccines, saving critically ill patients, building hospitals, etc. They are not only a demonstration of scientific and technological ability, but more importantly, they have a patriotic heart and passion to serve the country. The technical potential of scientific and technological talent depends on their experience and personal drive. Graduating from a prestigious university can help him take fewer detours, critical innovation can keep him challenging new heights, cross-discipline can give him more inspiration for innovation, and so on. Transformation ability should first have good communication and collaboration ability, because the projects of new R&D institutions are usually completed by teams; second, there should be transformed results that generate economic and social benefits, as well as talent benefits, etc.

The author visited 10 new R&D institutions, researched scientific and technological talents, reviewed 50 papers on skills and literature on R&D institution development, and summarized and refined 15 new R&D institutions' benefit assessment indicators for scientific and technological talents, as shown in Table 1. Ten new R&D institutions were located in the Science and Technology Park of Yancheng City, Jiangsu Province. Yancheng is a coastal city with the largest mudflat wetlands and the largest wind energy. Ten new R&D institutions belong to different industries: two in the saline rice industry, two in the cable industry, two in the machinery industry, two in the wind power industry, and two in the energy industry. I visited the human resources departments of these new R&D institutions and communicated with the person in charge of their talent introduction, who generally reflected the high cost of talent introduction and insufficient satisfaction. They also proposed modifications to our assessment index framework, such as serving the motherland, graduating from prestigious universities, cross-discipline, and providing scientific and technological insights.

During my visit, I also found that different teams of new R&D institutions have different indicators for assessing scientific and technological talent because their requirements are different. For example, new R&D organization A has a strict confidentiality sign posted from the entrance, and there are confidentiality signs everywhere on the stairs and restrooms, indicating that the team has a particularly high requirement for confidentiality. The high-end nature of the technology of the new R&D organization makes the technology accessible to a certain extent. Any knowledge is public to a certain extent and confidential to a certain extent. Intellectual property, for example, may have many public methods, but there are still some details that are kept confidential. Secrecy sometimes represents importance, sophistication, and high-end, so that a few talented people can still learn and improve, but just not be known to the general public. Another example is new R&D organization B. Their recruitment website shows that they are looking for PhD students who have graduated from "985," which means that they require graduates from prestigious universities. Therefore, in this study, we consider the assessment of individualized indicators of scientific and technological talent by teams of new R&D institutions. The first team selected its own personalized indicators from the 15 indicators, and the second team selected its own personalized indicators, k_{1j} from the 15 indicators. The second team selected its own desired indicators k_{2j} from the 15 indicators until all n teams selected their desired indicators k_{nj} from the 15 indicators. The teams assign indicator weights as they select the indicators ω_{ij}.

Table 1. Indicators for assessing the benefits of new R&D organization teams for talents.

T-S Indicators	Assessment Indicators	Content of the Assessment
The team's evaluation indicators for talent	1. Serving the motherland	Love the country and love the Party, personal ideals into the great national development, and take pride in this, strong country has my, sincere enthusiasm to serve the country only grows.
	2. Professional ethics	The code of conduct to be followed in professional activities, patriotism and respect for work, honesty and friendliness, compliance with laws and regulations, etc.
	3. Critical innovation	It is important to think critically and creatively, to break down old traditions, to build new ideas, new methods, new processes, etc.
	4. Innovative results	Scientific and technical papers, scientific and technical projects, scientific and technical patents and other achievements.
	5. Entrepreneurial outcomes	The breadth and depth of application and transformation of scientific and technological achievements, generating economic benefits, social benefits, talent benefits, etc.
	6. Graduated from a prestigious school	Graduated from a prestigious school or conducted research under the guidance of a renowned teacher.
	7. Communication and collaboration	Good communication skills, an academic background in teamwork, and regular participation in various academic networking events where they actively contribute or share.
	8. Cross-cutting disciplines	Cross-disciplines can break down limitations, stand higher, plan farther, grasp more accurately, and generate more energy.
	9. Technology Insights	Accurate judgment of the situation and clear positioning for career development.
	10. Design and programming	Must have some design skills, have some programming skills and be able to maintain data and other information.
	11. Keeping secrets	Keep the contents, methods and processes of research and development strictly confidential.
	12. Self-control and self-discipline	Aspire to be a person of value, value time, pace yourself, spend your energy on things of value, read a lot of literature, do a lot of science experiments, and regular paper writing.
	13. Self-reliance and self-improvement	Good at independent thinking and inquiry questioning, adhere to independent innovation, always on the road of struggle and exploration.
	14. Physical fitness	Having a healthy body allows you to focus on the big things.
	15. Psychological quality	Resilient to pressure and work under pressure with the team's goals and mission in mind.

Because there are differences in the process of assessment of scientific and technological talents by the team of new R&D institutions due to the assessment experts' own learning, preferences, reference points, information asymmetry, etc., and the assessment results have a certain degree of uncertainty, this study uses interval grey numbers to characterize the uncertain assessment values. The interval grey number is an uncertain number that takes values in a certain interval or in a general set of numbers, and only the range of information values is known without knowing the exact information values, which is usually denoted by the symbol $\otimes$ to denote it. A grey number that has both a lower and an upper bound is called an interval grey number and is denoted as $\otimes \in [\underline{a}, \overline{a}]$ with $\underline{a}$

denotes the lower bound and $\bar{a}$ denotes the upper bound. Using the interval grey number to characterize the team's assessment value of talent, we obtain the n-decision matrix $A^k = \left[a_{ij}^k\right], i = 1, 2, \cdots m, j = 1, 2, \cdots p, k = 1, 2, \cdots n$, i denotes that there are m scientific and technical talents, j denotes that there are p assessment metrics, and k denotes that there are n teams.

$$A^k = \left[a_{ij}^k\left(\otimes\right)\right] = \begin{bmatrix} \underline{a}_{11}^k, \bar{a}_{11}^k & \underline{a}_{12}^k, \bar{a}_{12}^k & \cdots & \underline{a}_{1p}^k, \bar{a}_{1p}^k \\ \underline{a}_{21}^k, \bar{a}_{21}^k & \underline{a}_{22}^k, \bar{a}_{22}^k & \cdots & \underline{a}_{2p}^k, \bar{a}_{2p}^k \\ \cdots & \cdots & \cdots & \cdots \\ \underline{a}_{m1}^k, \bar{a}_{m1}^k & \underline{a}_{m2}^k, \bar{a}_{m2}^k & \cdots & \underline{a}_{mp}^k, \bar{a}_{mp}^k \end{bmatrix} \quad (1)$$

2.2. Constructing Cost Indicators for the Introduction of Scientific and Technological Talent

New R&D institutions must pay a certain price when introducing scientific and technological talent. We take the introduction of three years as an example: the cost in three years generally includes the settlement fee, science and technology start-up fee, salary, insurance, provident fund, performance incentives, project dividends, and other incentives. Some items under the difference are also relatively large, and we choose more representative indicators as the matching indicators, as shown in Table 2.

Table 2. Cost assessment indicators of new R&D organization teams for scientific and technological talents.

S-T Indicators	Assessment Indicators	Content of the Assessment
Cost metrics for talent	1. Wage insurance	The portion of institutional payments for salaries, insurance, etc., paid on an annual or monthly basis.
	2. Subsidy for house purchase	There is a lump sum settlement fee, annual or monthly provident fund contributions for home purchase, plus some allowance for home purchase, etc.
	3. Performance incentives	Performance is generally divided into four grades, excellent, good, pass, and fail, and the award is taken at whichever grade is met after the performance appraisal, which is estimated in this paper as the good grade.
	4. Project dividends	Estimated by dividing the total project amount by the number of people in the team on average.
	5. Other awards	There are some additional incentives when scientific and technological achievements are transformed into economic, social and talent benefits, and there are also institutions that implement training and incentives for particularly outstanding scientific and technological people, which are all costed and calculated on an average basis.

Some scientific and technological talents can receive high rewards in teams of new R&D institutions, while others receive very little reward. Since the mechanism of new R&D institutions is very flexible and financially autonomous, there are many uncertain cost factors, and sometimes the rewards can far exceed salary income. In general, the cost of bringing in scientific and technological talent with higher performance evaluation values is relatively high. It is a real problem to match the teams of new R&D institutions with scientific and technical talents with high assessment values and low costs. In this study, the team of the new R&D organization and the technology talent are communicated and based on the cost assessment index in this study, both parties negotiate and finally determine an acceptable cost range. Using the interval grey number to characterize the cost value of talent introduction, we obtain a decision matrix of $1B = \left[b_{ij}\right], i = 1, 2, \cdots m, j = 1, 2, \cdots q$, with i denotes the number of m a scientific and technical talent, and j denotes that there are q evaluation index.

$$B = \left[b_{ij}\left(\bigotimes\right)\right] = \begin{bmatrix} \underline{b}_{11}, \overline{b}_{11} & \underline{b}_{12}, \overline{b}_{12} & \cdots & \underline{b}_{1q}, \overline{b}_{1q} \\ \underline{b}_{21}, \overline{b}_{21} & \underline{b}_{22}, \overline{b}_{22} & \cdots & \underline{b}_{2q}, \overline{b}_{2q} \\ \cdots & \cdots & \cdots & \cdots \\ \underline{b}_{m1}, \overline{b}_{m1} & \underline{b}_{m2}, \overline{b}_{m2} & \cdots & \underline{b}_{mq}, \overline{b}_{mq} \end{bmatrix} \quad (2)$$

2.3. Phase I Elimination Matching Results Based on Prospect Theory and Bilateral Matching Models

According to prospect theory and grey target theory, this study sets a double reference point for the appraisal value of the historical reference point and desired reference point. This study sets a bottom-line reference point for the cost value, uses the reference point as the bull's eye, and applies prospect theory to the data set.

In the first stage of matching the team of a new R&D institution with scientific and technological talents, although the assessment value of scientific and technological talents is given, the assessment value does not reflect whether the scientific and technological talents are good, how good they are, and whether the team is satisfied. Therefore, it is necessary to find a reference point for comparison, and the data for the reference point must be easily accessible.

2.3.1. Setting Reference Points for Assessment Values—Historical Reference Points and Desired Reference Points

The historical reference point is the assessment of the scientific and technological talents already introduced in the history of the new R&D institution team and the comparison with the assessment of the talents in the past, which can tell whether the batch of scientific and technological talents is better than the past or not as good as the historical scientific and technological talents. In general, the new R&D organization team hopes that the technology talent brought in is improving. If the assessment value is higher than the historical reference point, the new R&D institution team is satisfied. If the assessment value is lower than the historical reference point, the new R&D institution team is not satisfied.

The expectation reference point is the goal that the new R&D organization team expects the tech talent to achieve, and comparing it with the expectation in the decision maker's mind will determine whether the batch exceeds or falls short of expectations. In general, the new R&D organization team expects the technological talent to meet expectations, but expectations are usually not too low. If the assessment value is higher than the expected reference point value, the new R&D organization team is satisfied. If the assessment value is lower than the expected reference point value, the new R&D organization team is not satisfied.

There are many teams within the new R&D organization, and each team sends different evaluation experts; therefore, the reference point values are different for each team. The historical reference point values can be obtained by collating historical data, and the expected reference point values can be given by the evaluation experts, so that the historical reference point vector C_1^k and the desired reference point vector C_2^k The historical reference point vector and the desired reference point vector can be obtained.

$$C_1^k = \left[c_{1j}^k\left(\bigotimes\right)\right] = \left\{\left[\underline{c}_{11}^k, \overline{c}_{11}^k\right], \left[\underline{c}_{12}^k, \overline{c}_{12}^k\right], \cdots \left[\underline{c}_{1p}^k, \overline{c}_{1p}^k\right]\right\} \quad (3)$$

$$C_2^k = \left[c_{2j}^k\left(\bigotimes\right)\right] = \left\{\left[\underline{d}_{21}^k, \overline{d}_{21}^k\right], \left[\underline{d}_{22}^k, \overline{d}_{22}^k\right], \cdots \left[\underline{d}_{2p}^k, \overline{d}_{2p}^k\right]\right\} \quad (4)$$

2.3.2. Set the Reference Point for the Cost Value—Bottom Line Reference Point

New R&D institutions provide cost value for the introduction of individual scientific and technical talent, but it is not known whether the institution is satisfied. Therefore, a bottom-line reference point was set, and the cost value was compared with the bottom-line reference point. The bottom-line reference point is the bottom-line cost value that the institution can afford, and if the cost value is lower than the bottom-line reference point value, the new R&D institution feels a gain. If the cost value is higher than the bottom-line reference point value, the new R&D institution feels a loss. The bottom-line reference point data are jointly provided by the evaluation experts of the new R&D organization team, and because the team pays about the same cost to the scientific and technological talents, the bottom-line reference point represents the bottom-line cost of the entire new R&D organization. After the evaluation experts' determination, we obtained the bottom-line reference point value vector C_3.

$$C_3 = \left[c_{3j}\left(\bigotimes\right)\right] = \left\{[\underline{c}_{31}, \bar{c}_{31}], [\underline{c}_{32}, \bar{c}_{32}], \cdots \left[\underline{c}_{3q}, \bar{c}_{3q}\right]\right\} \quad (5)$$

2.3.3. Calculate the Distance from the Appraised Value and the Cost Value to the Reference Point Separately

The reference point is the bullseye of the gray target decision. If the assembled data is greater than zero, the target is hit. If the assembled data are less than 0, it is considered off-target. The values of the new R&D organization team's assessment of technological talent and the cost of introducing technological talent are uncertain and are characterized by interval grey numbers. Historical reference point values, desired reference point values, and bottom-line reference point values also have uncertainty and are characterized by interval grey numbers. To calculate the distance from the appraised value and cost value to the reference point, the formula for calculating the distance between the interval grey number and the interval grey number is used. In this study, we consider the kernel and half-interval length of the interval grey number to calculate the distance between the interval grey numbers.

Definition 1. *Let two grey numbers* $\otimes_1 \in [\underline{a}, \bar{a}]$, $\otimes_2 \in [\underline{c}, \bar{c}]$, *and define the kernel of the two interval grey numbers as*

$$\widehat{\bigotimes}_1 = \frac{1}{2}(\underline{a} + \bar{a}),\ \widehat{\bigotimes}_2 = \frac{1}{2}(\underline{c} + \bar{c}) \quad (6)$$

If $\widehat{\otimes}_1 > \widehat{\otimes}_2$, *then* $\otimes_1 > \otimes_2$.

Definition 2. *Let two grey numbers* $\otimes_1 \in [\underline{a}, \bar{a}]$, $\otimes_2 \in [\underline{c}, \bar{c}]$, *and define the length of the two interval grey numbers as*

$$l(\bigotimes_1) = \frac{1}{2}(\bar{a} - \underline{a}), l(\bigotimes_2) = \frac{1}{2}(\bar{c} - \underline{c}) \quad (7)$$

Definition 3. *Let two grey numbers* $\otimes_1 \in [\underline{a}, \bar{a}]$, $\otimes_2 \in \left[\underline{b}, \bar{b}\right]$, *and define the distance between the two interval grey numbers as*

$$d(\bigotimes_1, \bigotimes_2) = \left|\widehat{\bigotimes}_1 - \widehat{\bigotimes}_2\right| + \frac{1}{2}\left|l(\bigotimes_1) - l(\bigotimes_2)\right| \quad (8)$$

We calculated the assessed values separately according to the algorithm of interval grey numbers A^k *and the historical reference point value* C_1^k *and the distance between the evaluated value* A^k *from the desired reference point value* C_2^k *and the distance of the cost value B and the bottom-line reference point value* C_3 *to obtain the distance matrix* $d\left(A^kC_1^k\right)$, $d\left(A^kC_2^k\right)$, $d(BC_3)$.

2.3.4. Calculation of Prospective Values of Assessed and Cost Values Based on Distance

We compare the distances of the assessed and cost values calculated above to the reference point values by kernels of interval grey numbers. We substitute them into the prospect theory equation to obtain k matrix of prospective values of assessed values based on historical reference points, the k prospect value matrix of appraisal values based on desired reference points, and 1 prospect value matrix of cost values based on bottom-line reference points.

$$V_{ij(1)}^{kc_1} = \begin{cases} \left(d\left(A^k C_1^k\right)\right)^{\alpha} & \widehat{\otimes}_{a_{ij}^k(\otimes)} > \widehat{\otimes}_{c_{1j}^k(\otimes)} \\ -\theta * \left(d\left(A^k C_1^k\right)\right)^{\beta} & \widehat{\otimes}_{a_{ij}^k(\otimes)} < \widehat{\otimes}_{c_{1j}^k(\otimes)} \end{cases} \quad (9)$$

$$V_{ij(1)}^{kc_2} = \begin{cases} \left(d\left(A^k C_2^k\right)\right)^{\alpha} & \widehat{\otimes}_{a_{ij}^k(\otimes)} > \widehat{\otimes}_{c_{2j}^k(\otimes)} \\ -\theta * \left(d\left(A^k C_2^k\right)\right)^{\beta} & \widehat{\otimes}_{a_{ij}^k(\otimes)} < \widehat{\otimes}_{c_{2j}^k(\otimes)} \end{cases} \quad (10)$$

$$V_{ij(1)}^{c_3} = \begin{cases} (d(BC_3))^{\alpha} & \widehat{\otimes}_{b_{ij}(\otimes)} < \widehat{\otimes}_{c_{3j}(\otimes)} \\ -\theta * (d(BC_3))^{\beta} & \widehat{\otimes}_{b_{ij}(\otimes)} > \widehat{\otimes}_{c_{3j}(\otimes)} \end{cases} \quad (11)$$

As the assessed value is a benefit type of data, the larger the value, the better, with gains above the reference point and losses below it. Cost values, on the other hand, are cost-based data; the smaller the value, the better with gains below the reference point and losses above the reference point.

Formula (9) in $V_{ij(1)}^{kc_1}$ denotes the prospective value of the first stage team's assessment of talent based on the historical reference point, as determined by the assessment value $a_{ij}^k(\otimes)$ and the reference point value $c_{1j}^k(\otimes)$ calculated as a power function of the distance between the assessment value and the reference point value. Equation (10) in $V_{ij(1)}^{kc_2}$ denotes the prospect value of the assessment value based on the desired reference point, calculated as a power function of the distance between the assessment value $a_{ij}^k(\otimes)$ and the value of the reference point $c_{2j}^k(\otimes)$ is calculated as a power function of the distance between the assessed value and the reference point value. Equation (11) in $V_{ij(1)}^{c_3}$ indicates that the assessment value is based on the prospective value of the historical reference point, obtained by a power function of the distance between the assessment value $b_{ij}(\otimes)$ and the value of the reference point $c_{3j}(\otimes)$ is calculated as a power function of the distance between the assessment value and the reference point value. The prospect value is determined by the subjective perception of the decision maker, and the gains and losses are relative to the reference point.α and β denote the decision-maker's risk attitude coefficients in the gain and loss regions, respectively. $\alpha, \beta < 1$ denote that the decision-maker's sensitivity is decreasing, and in this study, $\alpha = 0.88$, $\beta = 0.88$. θ is the coefficient of the decision-maker's loss perception, and because decision-makers are risk-averse in the face of gains and risk-averse in the face of losses. When $\theta > 1$, decision-makers are steeper and more sensitive in the loss region than in the gain region. In this study, $\theta = 2.25$.

2.3.5. Normalization of Assessed Value Prospect and Cost Value Prospect and Aggregation

The foreground values we obtained according to foreground theory do not meet the requirements of normalization and need to be normalized so that their values fall on [−1, 1]. We used the maximum value method for normalization, which is easy and convenient to operate and retains the characteristics of the original data.

$$M_{ij(1)}^{kc_1} = \frac{V_{ij(1)}^{kc_1}}{\max\limits_{i}\max\limits_{j} V_{ij(1)}^{kc_1}}.\ M_{ij(1)}^{kc_2} = \frac{V_{ij(1)}^{kc_2}}{\max\limits_{i}\max\limits_{j} V_{ij(1)}^{kc_2}}\ .\ M_{ij(1)}^{c_3} = \frac{V_{ij(1)}^{c_3}}{\max\limits_{i}\max\limits_{j} V_{ij(1)}^{c_3}} \quad (12)$$

Let the kth team be given an assessed value indicator weight of ω_j^k and the weight of the cost value indicator is μ_j then, the matrix of prospective values of assessed values based on historical reference points $N_i^{kc_1}$, the assessed value prospect value matrix based on the desired reference point $N_i^{kc_2}$, and the cost value prospect values based on the bottom-line reference point $N_i^{c_3}$ are.

$$N_{i(1)}^{kc_1} = \sum\nolimits_{j=1}^{p} \omega_j^k M_{ij(1)}^{kc_1},\ N_{i(1)}^{kc_2} = \sum\nolimits_{j=1}^{p} \omega_j^k M_{ij(1)}^{kc_2},\ N_{i(1)}^{c_3} = \sum\nolimits_{j=1}^{q} \mu_j M_{ij(1)}^{c_3} \tag{13}$$

For $N_{i(1)}^{kc_1}$, $N_{i(1)}^{kc_2}$, and $N_{i(1)}^{c_3}$ transpose processing.

$$TS_{ts(1)}^{c_1} = \left[N_i^{kc_1\,T}\right],\ TS_{ts(1)}^{c_2} = \left[N_i^{kc_2\,T}\right],\ TS_{ts(1)}^{c_3} = \left[N_i^{c_3\,T}\right] \tag{14}$$

Let the historical reference point weights of this study be θ and the desired reference point weight is $1-\theta$. First, the assessment value prospect value based on the historical reference point and the desired reference point is set to obtain the assessment value composite prospect value. Then, the assessment value composite prospect value is set with the cost value prospect value, and the weight of the assessment value composite prospect value is δ and the weight of the cost-value prospect value is $1-\delta$. After agglomeration, we obtained the first-stage matched composite prospect value, $S_{ij(1)}$.

$$TS_{ts(1)} = \delta \times \left(\theta \times \left(TS_{ts(1)}^{c_1}\right) + (1-\theta) \times \left(TS_{ts(1)}^{c_2}\right)\right) + (1-\delta) \times \left(TS_{ts(1)}^{c_3}\right) \tag{15}$$

2.3.6. Construction of a Bilateral Matching Model to Derive the Results of the First Phase of Elimination Matching

Professor Gale of Brown University and the renowned economist Professor Sharply pioneered the theory of bilateral matching decisions in 1962 with their article, "College Admissions and Stable Marriages". Let $\mu : P \cup Q \rightarrow Q \cup P$ be a one-to-one mapping, if $\forall P_i \in P$. $\forall Q_j \in Q$ satisfies $\mu P_i = Q_j \in Q$, and $\mu Q_j = P_i \in P$, then we call μ is a two-way matching. $\mu(P_i) = Q_j$ denote P_i with Q_j in μ in the match, and $\mu Q_j = Q_j$ indicates that Q_j in μ does not match.

For the bilateral matching decision problem between teams and scientific and technological talent in new R&D institutions, forming a reasonable and effective bilateral matching scheme is the common demand of teams and talent, and constructing a bilateral matching model and proposing a solution algorithm is the most crucial step. The traditional Gale—Sharply algorithm performs research in preference order, and this paper proposes bilateral matching based on uncertain interval grey numbers and prospect theory based on reference points. In the first stage, the new R&D organization team and the scientific and technological talents are many-to-many matching. The new R&D organization achieves complete matching, the scientific and technological talents are incomplete matching, and the scientific and technological talents without successful matching are eliminated. In this study, we constructed the first-stage elimination matching model M-1.

$$\text{MAX } Z = \sum_{t=1}^{n} \sum_{s=1}^{m} \pi_{ts} TS_{ts(1)} \tag{16}$$

$$\text{s.t.} \begin{cases} \pi_{ts} \in [0 \text{ or } 1] \\ \sum\limits_{t=1}^{n} \pi_{ts} = 1 \\ \sum\limits_{s=1}^{m} \pi_{ts} \leq 1 \end{cases} \tag{17}$$

The objective of the M-1 model is to transform the dual objective of maximizing the prospective value of the assessed value and prospective value of the cost value into a single objective. The constraints are as follows: the weight vector π_{ts} can only be 0 or 1; each new R&D organization team must be matched to a scientific and technological talent, and only one talent can be matched; each scientific and technological talent may not be matched to a new R&D organization team.

Theorem 1. *M-1 The model must have an optimal solution.*

Note: According to the optimality existence theorem, any single-objective programming with bounded feasible domain must be optimal over its feasible domain. M-1 The model is a single-objective programming problem, and the feasible domain of the model exists and is bounded. Therefore, the M-1 model must have an optimal solution. M-1 It can be solved using LINGO software, and the solution of $\pi_{ts} = 1$ means that the tth new R&D institution team and the sth technological talent are successfully matched. $\pi_{ts} = 0$ means that the tth new R&D institution team and the sth technological talent do not match successfully, and the m-n technological talents are eliminated.

3. New R&D Organization Team and Science and Technology Talent Second Stage selection Match

After the first phase of elimination matching, the number of teams and talents is equal, and the matching is still many-to-many. After one year, when the trial period expires, the team re-evaluates the talent and determines the team they will eventually work for. In the second stage of matching, the highest evaluation value of the team to the talent is considered, and the highest satisfaction of the feedback of the ranking value of the team by the tech talent is also considered, setting historical reference points and expectation reference points for the evaluation value and bottom-line reference points for the satisfaction, fully considering the psychological factors of the new R&D organization team and the tech talent in both directions to better realize the two-way selection, and finally using the 0–1 The integer planning model is used for bilateral matching. In the second stage of selection matching, because the number of scientific and technical talents is the same as the number of R&D teams, the pressure on decision makers will be much less, there will be no more unmatched situations, and teams and talents achieve complete matching, as shown in Figure 2.

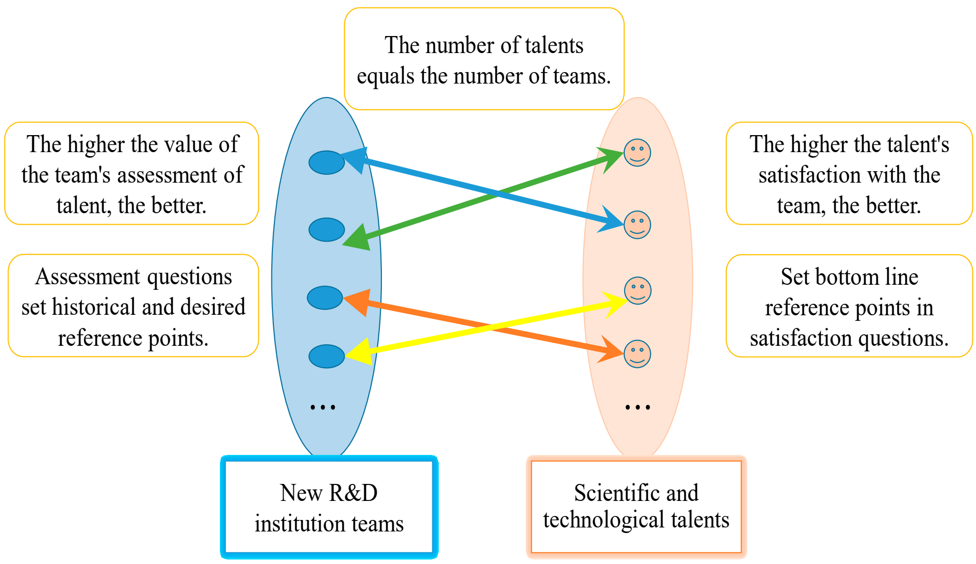

Figure 2. Matching diagram of the second stage of selection of teams and talents in new R&D institutions.

3.1. Collecting the Team's Assessment Value of Scientific and Technical Talents and the Ranking Value of Talents to the Team

The first phase of elimination matching is dominated by new R&D institutions and does not consider the dominant weight of talents. Therefore, the second phase of selection matching considers the assessment of scientific and technological talents by the team of new R&D institutions and also considers the ranking of scientific and technological talents to new R&D institutions.

We collected the assessed values of the second stage of the new R&D organization team for scientific and technological talents, characterized by the average value of the expert assessment. The reference point remains unchanged, and the data of the historical reference point and the desired reference point of the first stage are still used, since the expert assessments in this study are all scored on a percentage scale. In order to achieve the standardization requirements of the data, all the data are averaged and then divided by 100, so that all the assessed values, the reference point values lie between 0 and 1. We obtain the matrix of assessment values $E^k = \left[e_{ij}^k\right]$, $i = 1, 2, \cdots m$, $j = 1, 2, \cdots p, k = 1, 2, \cdots n$.

We consider the ranking of teams in new R&D institutions by scientific and technical talents to obtain information on the preference order of scientific and technical talents for teams $F = [f_{ts}], t = 1, 2, \cdots n, s = 1, 2, \cdots m$. To facilitate the assembly of data, the preference order was transformed into satisfaction according to certain rules. The transformation rules are listed in Table 3. According to the transformation rules, it is transformed into satisfaction information $G = [g_{ts}], t = 1, 2, \cdots n, s = 1, 2, \cdots m$.

Table 3. Rules for converting the preference order of talents to satisfaction with the teams.

Preference Order	Satisfaction
1	1
2	1-1/n
3	1-2/n
4	1-3/n

3.2. Matching Integrated Prospect Values Based on Historical, Desired, and Bottom-Line Reference Point Sets for the Second Stage

Based on the historical reference point value and the desired reference point value, the distance from the team's assessment of talent to the historical and desired reference points is calculated. Because it is a real number, the distance is directly subtracted and calculated by taking the absolute value. Let the bottom-line reference point of scientific and technological talents' satisfaction with the team be 0.5. Calculate the distance from the satisfaction to the bottom-line reference point, and because it is a real number, the distance is directly subtracted and calculated by taking the absolute value. The prospect value is calculated according to prospect theory.

$$V_{ij(2)}^{kc_1} = \begin{cases} \left|e_{ij}^k - e_j^{kc_1}\right|^\alpha & e_{ij}^k > e_j^{kc_1} \\ -\theta * \left|e_{ij}^k - e_j^{kc_1}\right|^\beta & e_{ij}^k < e_j^{kc_1} \end{cases} \tag{18}$$

$$V_{ij(2)}^{kc_2} = \begin{cases} \left|e_{ij}^k - e_j^{kc_2}\right|^\alpha & e_{ij}^k > e_j^{kc_2} \\ -\theta * \left|e_{ij}^k - e_j^{kc_2}\right|^\beta & e_{ij}^k < e_j^{kc_2} \end{cases} \tag{19}$$

$$V_{ts(2)}^{c_3} = \begin{cases} \left|g_{ts} - 0.5\right|^\alpha & f_{ts} > 0.5 \\ -\theta * \left|g_{ts} - 0.5\right|^\beta & f_{ts} < 0.5 \end{cases} \tag{20}$$

Combining the prospect value of the team's assessment of talent based on the historical reference point $V_{ij}^{kc_1}$ and the prospect value of the assessed value based on the desired reference point $V_{ij}^{kc_1}$, combining the indicator weights of the assessed values given by the team as ω_j^k,

$$N_{i(2)}^{kc_1} = \sum\nolimits_{j=1}^{p} \omega_j^k M_{ij(1)}^{kc_1} . N_{i(2)}^{kc_2} = \sum\nolimits_{j=1}^{p} \omega_j^k \, M_{ij(1)}^{kc_2} \tag{21}$$

For $N_{i(1)}^{kc_1}$, $N_{i(1)}^{kc_2}$ to transpose the treatment.

$$TS_{ts(2)}^{c_1} = \left[N_i^{kc_1 T}\right], \; TS_{ts(2)}^{c_2} = \left[N_i^{kc_2 T}\right] \tag{22}$$

point weight be $1 - \theta$. The assessment value prospect values based on the historical reference point and the desired reference point are first pooled to obtain the assessment value composite prospect value, and then the assessment value composite prospect value is pooled with the satisfaction prospect value, and the weight of the assessment value composite prospect value is σ and the weight of the satisfaction prospect value is $1 - \sigma$. After agglomeration, we obtain the second-stage matched composite prospect value, $S_{ij(2)}$.

$$TS_{ts(2)} = \sigma \times \left(\theta \times \left(TS_{ts(2)}^{c_1}\right) + (1-\theta) \times \left(TS_{ts(2)}^{c_2}\right)\right) + (1-\sigma) \times \left(V_{ts(2)}^{c_3}\right) \tag{23}$$

3.3. Construction of a Bilateral Matching Model to Derive the Second Stage Selection Matching Results

In the second stage, the new R&D organization team and the scientific and technological talents are many-to-many matched, the new R&D organization achieves complete matching, the scientific and technological talents are incompletely matched, and the scientific and technological talents without successful matching are eliminated. In this study, we constructed the first-stage elimination matching model, M-2.

$$MAX\ Z = \sum_{t=1}^{n} \sum_{s=1}^{m} \varphi_{ts} TS_{ts} \tag{24}$$

$$s.t. \begin{cases} \varphi_{ts} \in [0 \text{ or } 1] \\ \sum\limits_{t=1}^{n} \varphi_{ts} = 1 \\ \sum\limits_{s=1}^{m} \varphi_{ts} = 1 \end{cases} \tag{25}$$

The objective of the M-1 model is to transform the dual objective of maximizing the prospect value of the team's assessment of talent and the prospect value of talent's satisfaction with the team's sorting transformation into a single objective. The constraints are as follows: the weight vector φ_{ts} can only be 0 or 1; each new R&D organization team must be matched to a technology talent, and only one talent can be matched; each technology talent must be matched to a new R&D organization team; and only one team can be matched.

Theorem 2. *M-2 The model must have an optimal solution.*

Note: According to the optimality existence theorem, any single-objective programming problem with a bounded feasible domain must be optimal over its feasible domain. The M-2 model is a single-objective programming problem, and the feasible domain of the model exists and is bounded. Thus, the M-2 model must have an optimal solution. The M-2 model can be solved using LINGO software, and the solution of $\varphi_{ts} = 1$ means that the tth new R&D institution team and sth technological talent are successfully matched. $\varphi_{ts} = 0$ means that the tth new R&D institution team and the sth technological talent are not successfully matched.

In the second stage, the number of teams of new R&D institutions and scientific and technological talent are equal, and one team matches one scientific and technological talent, which is a many-to-many exact match, and a two-way selection match due to the consideration of two-way assessment.

3.4. Methodological Steps of This Paper

The steps of this study's prospect theory-based two-stage bilateral matching method for teams and scientific and technological talents in new R&D institutions are as follows.

In the first step, based on the first stage of elimination matching of new R&D institution teams and scientific and technological talents, a general framework of assessment indicators for new R&D institution teams, personalized assessment indicators, and indicators for the cost of introducing scientific and technological talents are constructed.

In the second step, the team-to-talent assessment data of new R&D institutions based on personalized assessment indicators in the first stage, historical reference point data and desired reference point data, cost of introducing technology talent data, and bottom-line reference point data, all characterized by interval grey numbers, were collected to calculate the benefit prospect value and cost prospect value of team-to-talent based on prospect theory and the given indicator weights, respectively.

In the third step, based on the benefit-cost weights, the integrated prospect values of the first stage are integrated, substituted into the M-1 model, and solved using LINGO software to obtain the elimination matching results of the first stage.

In the fourth step, based on the second stage of selection matching between the team of the new R&D institution and the scientific and technological talents, the assessment data of the team of the new R&D institution to the scientific and technological talents are collected, characterized by the mean value, following the historical reference point and desired reference point data in the first stage. The data were divided by 100 for normalization. While the ranking value of the scientific and technological talents to the team is collected, the ranking value is converted into satisfaction and given the satisfaction bottom-line reference point value. Based on the prospect theory and the given index weights, the evaluation prospect values of both team and talent are calculated.

In the fifth step, the prospect values of the second stage are integrated based on the team-talent weights, substituted into the M-2 model, and solved using LINGO software to obtain the selection matching results of the second stage.

4. Case Studies

4.1. Background of the New R&D Agency Team

The new R&D institution T was established in 2019 by the talent team of the University of D, the government, and social capital, of which the talent team holds 70% of the shares. The new R&D institution T aims at the frontier of science and technology and market demand and implements the specific measures of General Secretary Xi Jinping's "three firsts," reflecting the organic unity of superior disciplines, innovation clusters, and high-quality development. Currently, institutions are mainly engaged in new energy and intelligent distributed power generation, new high-efficiency refrigeration and heat pumps and equipment, key technologies for building environment and air quality, and new energy system optimization and monitoring research, actively building a national research platform for building intelligent environmental energy. As a leading domestic intelligent energy development and innovation enterprise, the institute adheres to the business philosophy of integrity, professionalism, aggressiveness, and cooperation and has accumulated rich experience in research and development, manufacturing, construction, operation, and maintenance in the fields of building energy conservation, distributed photovoltaic power generation, and comprehensive energy utilization, which is dedicated to providing customers with high-quality, fast, and efficient services. Few energy companies do energy extraction independently, and generally they work in partnership with many other companies. Now that many new energy companies are emerging, and they are eager to find clean alternative energy sources, there is a greater need for collaboration among scientific and technical talents in multiple fields. The need to recruit more scientific and technical talents and make their research and development direction match the team.

The new R&D institution T currently has four teams: the production team of high-efficiency building energy-saving equipment, the R&D team of intelligent environmental energy, the team of power engineering design and construction, and the team of distributed energy management. Since its establishment, the new R&D organization T has introduced 36 high-end talents from home and abroad, who have PhD degrees, achieved remarkable results in the industry, won national awards, and earned considerable economic income. The new R&D organization T has always attached importance to the introduction and training of scientific and technological talent. Scientific and technological talent development is good—constantly pioneering and innovative— and has won more than 20 national projects, the National Technical Invention Award, more than 20 national projects, one national technical invention award, more than 160 invention patents authorized, and four incubated enterprises.

The new R&D organization T is always looking for scientific and technical talents in environmental engineering and electronic information, requiring solid knowledge of environmental monitoring, theoretical knowledge of electronic information technology, relevant papers published in foreign professional academic journals, familiarity with laboratory-related technical experimental processes, a PhD degree, 1–3 years of relevant work experience, strong work responsibility, excellent language skills, and communication and coordination skills. Other requirements include the ability to handle complex problems and critical incidents independently, a strong work motivation, a sense of proactive service, etc. An annual salary of ¥100,000–¥1,000,000 is offered working in the Yangtze River Delta.

The new R&D institution T—in August this year, four teams put forward plans to recruit talents, the personnel department after screening, preliminary tests, practice, and other links. Finally, identified were six scientific and technical talents, the decision-making power to the team, and the team sent experts to conduct the first stage of elimination matching and the second stage of selection matching. Based on the results of the first-stage matching, the scientific and technical talents will enter four teams for a one-year probationary period and work in each team for three months. Science and technology talents will finalize which team to work on based on the second stage of selection matching. According to the two-way assessment index system proposed in this paper for teams and tech talents in new R&D institutions, both teams and talents have completed the assessment, and the data and bilateral matching are presented in detail next.

4.2. Phase I Phase-Out Matching of Teams and Scientific and Technological Talents in New R&D Institutions

We obtained the assessed values of the T1-T4 team for six scientific and technical talents from the HR director of the new R&D organization T; the values are characterized by interval gray numbers, as shown in Tables 4–7. There are 22 science and technology teams in the new R&D organization T. Four of the teams had similar specialties, and each team sent three experts to assess the science and technology talents under each indicator. Twelve experts from each of the four teams filled in the assessment values under the percentage system. In this study, the uncertainty of the team's assessment value of talent is fully considered; therefore, the interval grey number is used to characterize the assessment value.

Table 4. Assessed values of talents S by team T1 in new R&D institutions.

T1-S	Render Service to One's Country	Critical Innovation	Entrepreneurial Achievements	Interdisciplinary Subject (in Science)	Self-Control and Self-Discipline
S1	[78, 88]	[68, 75]	[80, 81]	[69, 79]	[70, 73]
S2	[77, 84]	[70, 70]	[55, 76]	[74, 75]	[82, 88]
S3	[70, 79]	[75, 81]	[50, 66]	[68, 75]	[77, 81]
S4	[82, 88]	[65, 80]	[68, 70]	[68, 71]	[65, 69]
S5	[80, 83]	[76, 78]	[73, 88]	[72, 90]	[68, 73]
S6	[76, 78]	[66, 88]	[74, 78]	[70, 73]	[68, 74]
Historical reference point	[70, 80]	[60, 90]	[50, 80]	[60, 75]	[70, 85]
Desired reference point	[75, 85]	[70, 80]	[70, 85]	[70, 85]	[70, 80]

Table 5. The assessed values of the new R&D organization team T2 for the talents S.

T2-S	Professional Ethics	Innovative Results	Entrepreneurial Achievements	Communication and Collaboration	Keep a Secret
S1	[70, 73]	[68, 75]	[76, 78]	[75, 90]	[83, 88]
S2	[75, 80]	[67, 88]	[85, 88]	[73, 85]	[65, 78]
S3	[77, 86]	[62, 78]	[75, 86]	[65, 71]	[72, 85]
S4	[73, 82]	[65, 75]	[67, 69]	[72, 73]	[66, 88]
S5	[68, 92]	[68, 81]	[62, 70]	[72, 75]	[65, 82]
S6	[66, 77]	[68, 74]	[65, 69]	[70, 76]	[72, 75]
Historical reference points	[70, 80]	[60, 80]	[60, 85]	[55, 80]	[60, 90]
Desired reference point	[70, 90]	[70, 90]	[70, 90]	[60, 80]	[70, 85]

Table 6. Assessed values of the new R&D organization team T3 for talents S.

T3-S	Render Service to One's Country	Entrepreneurial Achievements	Top Students	Technology INSIGHTS	Physical Quality (in Ideological Education)
S1	[73, 77]	[78, 88]	[75, 87]	[70, 76]	[68, 78]
S2	[65, 74]	[77, 84]	[72, 76]	[70, 84]	[80, 90]
S3	[73, 78]	[65, 79]	[66, 88]	[72, 90]	[71, 83]
S4	[68, 85]	[62, 88]	[72, 74]	[79, 88]	[80, 91]
S5	[82, 83]	[61, 83]	[70, 82]	[61, 77]	[78, 85]
S6	[75, 78]	[66, 71]	[66, 85]	[72, 78]	[70, 84]
Historical reference points	[70, 90]	[60, 85]	[60, 80]	[65, 85]	[70, 90]
Desired reference point	[70, 90]	[70, 90]	[70, 85]	[70, 90]	[75, 90]

Table 7. Assessed values of the new R&D organization team T4 for the talents S.

T4-S	Professional Ethics	Innovative Results	Communication and Collaboration	Design and Programming	Psychological Quality (in Ideological Education)
S1	[70, 81]	[56, 83]	[67, 91]	[68, 75]	[67, 76]
S2	[65, 76]	[75, 80]	[72, 82]	[73, 87]	[73, 82]
S3	[65, 86]	[68, 86]	[70, 92]	[68, 79]	[67, 86]
S4	[76, 90]	[74, 85]	[50, 68]	[68, 82]	[61, 85]
S5	[77, 86]	[50, 64]	[80, 83]	[88, 92]	[77, 86]
S6	[80, 82]	[70, 77]	[66, 88]	[77, 78]	[68, 70]
Historical reference points	[60, 85]	[60, 85]	[70, 85]	[50, 80]	[60, 80]
Desired reference point	[70, 90]	[70, 90]	[70, 90]	[70, 85]	[70, 85]

As can be seen from the above table:

(1) Each of the four teams of new R&D institutions selected their own personalized assessment indicators and assessed their talent based on personalized assessment indicators.

(2) Assessment data have a certain level of uncertainty, characterized by interval grey numbers, which are different for each assessment.

(3) The four teams of new R&D institutions provide both historical and desired reference point data, which are also uncertain and characterized by interval grey numbers.

The data in the above table do not show a bilateral match between the NRA team and scientific and technological talent, and a suitable method of integration is needed to facilitate comparison and analysis. Since the teams of the new R&D institutions rely on the new R&D institutions to select and hire scientific and technological talents, but the mechanism is very flexible, the new R&D institutions give the teams great hiring decisions and autonomy, and the funds are also allocated in a lump sum way, so the team leaders were invited to use the Delphi method to determine the indicator weights, and after several confirmations, it was finally determined that the personalized indicator weights of the four teams of the new R&D institutions were $\omega_{1j} = (0.2, 0.1, 0.3, 0.2, 0.2)$, and $\omega_{2j} = (0.1, 0.3, 0.3, 0.2, 0.1)$, and $\omega_{3j} = (0.1, 0.4, 0.2, 0.2, 0.1)$, and $\omega_{4j} = (0.15, 0.3, 0.15, 0.25, 0.15)$. In this study, a historical reference point and an expected reference point were set, and assuming that both reference points are equally important, $\theta = 0.5$.

Based on the interval grey number distance formula and foreground theory formula, indicator weights, and reference point weights, we integrate to obtain the matrix of foreground values based on the dual reference points of historical reference points and desired reference points, as shown in Table 8.

Table 8. Prospect values for the assessment of talents S by the new R&D organization teams T.

T-S	S1	S2	S3	S4	S5	S6
T1	0.0632	−0.0103	−0.3488	−0.1857	0.2396	−0.1200
T2	0.0641	0.2749	−0.0912	−0.4754	−0.1589	−0.3928
T3	−0.1087	0.0490	−0.2983	0.0006	−0.1589	−0.6959
T4	−0.2245	0.0500	−0.0045	−0.0671	0.1089	−0.1271

As can be seen from the table above:

(1) The results of the assessment of scientific and technological talents by the four teams of the new R&D institutions are different: some are satisfied, some are not, and the degree of satisfaction and dissatisfaction are also different and ranked differently.

(2) Team T1 of the new R&D institution is satisfied with S1 and S5, and dissatisfied with S2, S3, S4 and S6, with a satisfaction rate of 33.33%, and the ranking of scientific and technological talents is S5 $\succ$ S1 $\succ$ S2 $\succ$ S6 $\succ$ S4 $\succ$ S3.

(3) Team T2 of the new R&D organization is satisfied with S1 and S2, and is dissatisfied with S3, S4, S5 and S6, with a satisfaction rate of 33.33%, and ranks the scientific and technological talents as S2 $\succ$ S1 $\succ$ S3 $\succ$ S5 $\succ$ S6 $\succ$ S4.

(4) Team T3 of the new R&D organization is satisfied with S2 and S4, and is dissatisfied with S1, S3, S5 and S6, with a satisfaction rate of 33.33%, and ranks the scientific and technological talents as S2 $\succ$ S4 $\succ$ S1 $\succ$ S5 $\succ$ S3 $\succ$ S6.

(5) Team T4 of the new R&D organization is satisfied with S2 and S5, and is dissatisfied with S1, S3, S5 and S6, with a satisfaction rate of 33.33%, and ranks the scientific and technological talents as S5 $\succ$ S2 $\succ$ S3 $\succ$ S4 $\succ$ S6 $\succ$ S1.

If we let the new R&D organization team T and tech talent S match directly through the satisfaction of prospect value representation, then it appears that teams T1 and T5 select technology talent S5, and teams T3 and T4 select tech talent S2 so that only two tech talents are selected. The phenomenon of internal talent grabbing occurs, which does not achieve the overall optimum of the new R&D organization. In the first stage, we select the technology talent that can match the applicable stage and eliminate the two tech talents. Some may also say that removing the least satisfactory ones is necessary. Our analysis found that T1 team eliminated S3, T2 team eliminated S4, T3 team eliminated S6, and T4 team eliminated S1. This eliminates too many again because we do not know how dominant the team is in the process.

In the first stage of matching the team of the new R&D organization and the scientific and technological talent belonging to the elimination stage, we must consider the high satisfaction of the team of the new R&D organization with the assessed value of the scientific and technological talent relative to the reference point, in addition to the low cost of introducing scientific and technological talent. We collected data on the cost of introducing these six scientific and technological talents into different teams, as shown in Table 9.

Table 9. Costs of bringing in scientific and technological talents S.

S-T	Wage Insurance	Home Purchase Subsidy	Performance Incentives	Project Dividends	Other Awards
S1	[25, 30]	[45, 65]	[20, 26]	[10, 25]	[5, 16]
S2	[24, 28]	[50, 60]	[18, 20]	[10, 12]	[4, 18]
S3	[30, 40]	[20, 50]	[15, 30]	[8, 16]	[5, 12]
S4	[23, 28]	[40, 50]	[16, 28]	[6, 20]	[3, 18]
S5	[30, 32]	[55, 60]	[25, 28]	[12, 15]	[6, 14]
S6	[28, 35]	[38, 45]	[14, 30]	[7, 20]	[5, 10]
Bottom line reference point	[32, 32]	[50, 50]	[25, 25]	[15, 15]	[15, 15]

As can be seen from the table above:

(1) The cost of introducing scientific and technical talent S is different and uncertain and can only be estimated as an approximate range within which any value taken is possible, which we characterize as an interval grey number.

(2) The cost of bringing in scientific and technological talent under different projects varies, with the cost of housing subsidies generally being higher, and other incentives lower.

(3) The new R&D organization gives a bottom-line reference point, and feels a loss when the cost of bringing in technology talent exceeds the bottom-line reference point, and a gain when the cost of bringing in technology talent is less than the bottom-line reference point.

The introduction cost alone does not indicate the situation of scientific and technological talents, and we need to use the bottom-line reference point to measure whether the new R&D institutions pay the introduction cost as a gain or a loss. In this paper, we calculate the introduction cost of scientific and technological talents based on the bottom-line reference point, and set the index weight of the introduction cost of scientific and technological talents as $\omega_{5j} = (0.25, 0.25, 0.2, 0.2, 0.1)$ to get the prospective value of the introduction cost of six scientific and technological talents.$ST_{1j} = (-0.2509, 0.0188, 0.2156, 0.3149, -0.0846, 0.2919)$. From the prospective values of the introduction cost of scientific and technological talent, it can be seen that:

(1) Scientific and technological talents S1 and S5 are beyond the bottom-line reference point, and new R&D institutions would feel a loss if they brought them in.

(2) Scientific and technological talents S2, S3, S4, and S6 do not exceed the bottom-line reference point, and new R&D institutions will feel the benefits of bringing them in.

(3) The highest prospective value of the introduction cost of S4 for scientific and technological talents indicates that S4 is the least expensive, but this does not mean that the introduction of S4 is appropriate and has to be considered in conjunction with the assessment of S4 by the team of the new R&D institution.

We cannot consider the selection and recruitment of scientific and technological talent from the perspective of cost alone, but should be combined with the possible benefits of scientific and technological talent for comprehensive consideration. In this study, we consider dual-objective bilateral matching between the maximum team satisfaction and the minimum cost of introducing scientific and technological talents in the new R&D organization, and simplify the dual objective into a single objective to construct a matching model. To achieve the overall optimum of the new R&D organization, we apply the M-1 bilateral matching model in this paper for matching and set the weights of the benefit assessment of the team and the scientific and technological talents as $\delta = 0.5$, and the weight of cost assessment is $1 - \delta = 0.5$. This is because if technology talent can create more value, the more promising technology talent cannot be missed because of the low cost of the new R&D organization. The comprehensive prospect value is based on the combination of historical reference points and desired reference points, and the introduction cost, which fully considers the psychological and cost factors of decision makers. The higher the comprehensive prospect value, the higher the satisfaction of decision-makers, and the lower the comprehensive prospect value, the lower the satisfaction of decision-makers. Based on the prospect value of the assessment value, the prospect value of the introduction cost, and the weights of the two prospect values δ, we obtain the matrix of integrated prospect values for the first-stage matching of new R&D organization team T and scientific and technological talent S, as shown in Table 10.

Table 10. Combined Phase I outlook values for new R&D organization teams T and talents S.

T-S	S1	S2	S3	S4	S5	S6
T1	−0.0939	0.0042	−0.0666	0.0646	0.0775	0.0859
T2	−0.0934	0.1468	0.0622	−0.0802	−0.1218	−0.0505
T3	−0.1798	0.0339	−0.0413	0.1578	−0.1218	−0.2020
T4	−0.2377	0.0344	0.1056	0.1239	0.0121	0.0824

As can be seen from the table above:

(1) After incorporating the cost of introduction, the satisfaction rate and ranking of scientific and technological talents by the team of new R&D institutions changed.

(2) Team T1 of the new R&D organization is satisfied with S2, S4, S5, and S6, and is dissatisfied with S1 and S3, with a satisfaction rate of 66.67%, and ranks scientific and technological talents as S6 ≻ S5 ≻ S4 ≻ S2 ≻ S3 ≻ S1.

(3) Team T2 of the new R&D organization is satisfied with S2 and S3, and is dissatisfied with S1, S4, S5 and S6, with a satisfaction rate of 33.33%, and ranks the scientific and technological talents as S2 ≻ S3 ≻ S6 ≻ S4 ≻ S1 ≻ S5.

(4) Team T3 of the new R&D organization is satisfied with S2 and S4, and is dissatisfied with S1, S3, S5 and S6, with a satisfaction rate of 33.33%, and ranks the scientific and technological talents as S4 ≻ S2 ≻ S3 ≻ S5 ≻ S1 ≻ S6.

(5) Team T4 of the new R&D organization is satisfied with S2, S3, S4, S5 and S6, and is dissatisfied with S1, with a satisfaction rate of 83.33%, and ranks the scientific and technological talents as S4 ≻ S3 ≻ S6 ≻ S2 ≻ S5 ≻ S1.

The combined prospect values of the first-stage matching of new R&D organization team T and technology talent S were substituted into the M-1 bilateral matching model and solved using LINGO software to obtain the first stage team-talent matching results, as shown in Table 11.

Table 11. Results of the first stage matching of new R&D organization teams T and talents S.

Matching Teams	Phase I Matching Technology Talent	Phase I Combined Prospect Value
T1	S6	0.0859
T2	S2	0.1468
T3	S4	0.1578
T4	S3	0.1056

From the above table we can see that:

(1) New R&D organization teams T1, T2, and T3 were matched with the highest overall prospect value of science and technology talent, and T4 was more satisfied with S3.

(2) Tech talents S1 and S5 are eliminated during the first matching phase.

The match between the team of the new R&D institution and the scientific and technological talents in the first stage considers the team's assessment of the talents and the cost of introducing talent, which is more in line with the actual situation. In the process of the team's assessment of talent, the team's personalized indicators, historical reference points, and desired reference points are taken into account so that the team's psychological gain and loss can be obtained, and whether the team is satisfied, and the degree of satisfaction can be seen from the assessment prospect value. In the process of negotiating the introduction cost between the team and the talent, the bottom-line reference points of the new R&D organization are taken into account so that the gain and loss of the new R&D organization as a whole on the cost can be obtained, whether it is satisfied, and the degree of satisfaction from the cost prospect value. The prospect values of the combined benefits and costs of the team and talent were substituted into the M-1 model for bilateral matching and the matching results obtained were more convincing.

4.3. Second-Stage Trial Matching of Teams and Scientific and Technical Talents in New R&D Institutions

After the first phase of elimination matching, S2, S3, S4, and S6 enter the second phase of probationary matching. Each science and technology talent enters the new R&D institution to work and learn for a one-year probationary period, which is applied in four teams on a rotating basis for a three-month probationary period. After a year of probation in team T of the new R&D organization, the new R&D organization team again evaluated the scientific and technical talents to determine which team the scientific and technical talents would eventually work inside. In this study, we collect the values of the second stage of the assessment of scientific talent by the new R&D organization team, which is characterized by the mean value, with the historical and desired reference points also using the data given in the first stage. All data are divided by 100 and normalized so that they fall between [0,1], as shown in Tables 12–15. For ease of calculation, the scientific and technical talents were still matched with their original numbers.

Table 12. Assessment values of talents S by the new R&D organization team T1 phase 2.

T1-S	Render Service to One's Country	Critical Innovation	Entrepreneurial Achievements	Interdisciplinary Subject (in Science)	Self-Control and Self-Discipline
S2	0.8475	0.7605	0.7325	0.7500	0.7775
S3	0.8025	0.7900	0.8025	0.7975	0.8475
S4	0.8475	0.8125	0.6975	0.7375	0.7150
S6	0.7850	0.7050	0.7325	0.8075	0.7800
Historical reference points	0.7500	0.7500	0.6500	0.6750	0.7750
Desired reference point	0.8000	0.7500	0.7750	0.7750	0.7500

Table 13. Assessment values of talents S by the new R&D organization team T2 phase 2.

T2-S	Professional Ethics	Innovative Results	Entrepreneurial Achievements	Communication and Collaboration	Keep a Secret
S2	0.8575	0.8300	0.7200	0.8175	0.7850
S3	0.7900	0.7625	0.8000	0.7600	0.8150
S4	0.8650	0.8225	0.7750	0.8075	0.7275
S6	0.8025	0.8125	0.8125	0.7650	0.7775
Historical reference points	0.7500	0.7000	0.7250	0.6750	0.7500
Desired reference point	0.8000	0.8000	0.8000	0.7000	0.7750

Table 14. Assessment values of talents S by the new R&D organization team T3 phase 2.

T3-S	Render Service to One's Country	Entrepreneurial Achievements	Top Students	Technology INSIGHTS	Physical Quality (in Ideological Education)
S2	0.8275	0.7300	0.7350	0.7700	0.8175
S3	0.7900	0.8500	0.8200	0.7450	0.7200
S4	0.8575	0.6975	0.8325	0.7500	0.7675
S6	0.8125	0.7950	0.7775	0.7950	0.8575
Historical reference points	0.8000	0.7250	0.7000	0.7500	0.8000
Desired reference point	0.8000	0.8000	0.7750	0.8000	0.8250

Table 15. Assessment values of talents S by the new R&D organization team T4 phase 2.

T4-S	Professional Ethics	Innovative Results	Communication and Collaboration	Design and Programming	Psychological Quality (in Ideological Education)
S2	0.8175	0.7825	0.7475	0.8200	0.7325
S3	0.7375	0.6800	0.7700	0.7725	0.7575
S4	0.8350	0.7700	0.8375	0.7400	0.7900
S6	0.7950	0.8725	0.8725	0.7750	0.8400
Historical reference points	0.7250	0.7250	0.7750	0.6500	0.7000
Desired reference point	0.8000	0.8000	0.8000	0.7750	0.7750

As can be seen from the above table:

(1) The assessed values of the four teams of the new R&D organization on the S of the scientific and technological talents have changed compared to the assessed values in the first stage. Because scientific and technological talents have been on trial for a period of time, the new R&D organization teams are not familiar with the scientific and technological talents to the same extent and have a new understanding of the scientific and technological talents. The scientific and technological talents are also influenced by the team culture and values in the new working environment. For example, if everyone in the team is determined

to serve the motherland, and meetings are often held with ideological education, then scientific and technical talents will also strengthen their love for the motherland in this atmosphere, and these changes are reflected in the changes in assessment values.

(2) The reason for taking the average value in this assessment is that the match in the second stage is a fit-for-post match and no more talent will be eliminated, so the matching pressure will be much less. Eventually, the teams will all be matched with tech talent, and the tech talent will all be matched with teams. For simpler and easier calculations, the uncertainty is ignored in the second-stage match.

(3) Reference points were set and teams of new R&D institutions were asked to provide the corresponding reference point data. The reference point data were not updated in the second stage, also for the convenience of calculation, and because the time difference between the first and second stages is only one year, the time of scientific and technological talents in each team is only three months, and the change in the reference points will not be very large, so the dynamics of the reference points were not considered in this study.

In the second stage, the reference point values are the average of the reference point values in the first stage divided by 100 normalized data, and the indicator weights and reference point weights are the same as those in the first stage. Based on the assessed values, reference point values, indicator weights, and reference point weights of the second stage of the new R&D organization team T to the scientific and technological talent S, we obtained the prospect value matrix of the second-stage match between the new R&D organization team T and the scientific and technological talent S, as shown in Table 16.

Table 16. Prospect values for the second stage assessment of talents S by the new R&D organization teams T.

T-S	S2	S3	S4	S6
T1	0.0235	0.0910	−0.0313	0.0080
T2	0.0398	0.0379	0.0578	0.0733
T3	−0.0524	0.0172	−0.0773	0.0391
T4	0.0218	−0.0772	0.0309	0.1056

As can be seen from the table above:

(1) After the trial of scientific and technical talents, both the satisfaction and satisfaction rates of the new R&D organization team with scientific and technical talents have changed.

(2) Team T1 of the new R&D organization is satisfied with S2, S3, and S6, but is not satisfied with S4, with a satisfaction rate of 75%, and ranks the scientific and technological talents as S3 $\succ$ S2 $\succ$ S6 $\succ$ S4.

(3) Team T2 of the new R&D organization is satisfied with all scientific and technological talents, with a satisfaction rate of 100%, and the ranking of scientific and technological talents is S6 $\succ$ S4 $\succ$ S2 $\succ$ S3.

(4) Team T3 of the new R&D organization is satisfied with S3 and S6, and is dissatisfied with S2 and S4, with a satisfaction rate of 50%, and ranks the scientific and technological talents as S6 $\succ$ S3 $\succ$ S2 $\succ$ S4.

(5) Team T4 of the new R&D organization is satisfied with S2, S4, S6, and is not satisfied with S3, with a satisfaction rate of 75%, and ranks the scientific and technological talents as S6 $\succ$ S4 $\succ$ S2 $\succ$ S3.

After the probationary period, the tech talent will be called a full staff member in the new R&D organization team; in the second stage of matching, the new R&D organization team is 50% dominant, and we need to consider the choice of technology talent. In this study, scientific and technical talents ranked the four teams, as shown in Table 17.

Table 17. Ranking of talents S on the second stage of the new R&D institution teams T.

S-T	S2	S3	S4	S6
T1	4	3	3	2
T2	3	1	2	1
T3	1	2	1	4
T4	2	4	4	3

Since the ordinal values cannot be matched, ordinal values are converted into satisfaction values: ordinal number 1 indicates satisfaction of 1, ordinal number 2 indicates satisfaction of 0.75, ordinal number 3 indicates satisfaction of 0.5, and ordinal number 4 indicates satisfaction of 0.25. Let satisfaction of 0.5 be the reference point of the scientific and technical talents. According to prospect theory, we obtain the prospect value of the scientific and technical talents' satisfaction with the team, as shown in Table 18.

Table 18. Ranking prospect values of talents S for the second stage of the new R&D organization team T.

S-T	S2	S3	S4	S6
T1	−0.6643	0.0000	0.0000	0.2952
T2	0.0000	0.5434	0.2952	0.5434
T3	0.5434	0.2952	0.5434	−0.6643
T4	0.2952	−0.6643	−0.6643	0.0000

We weighted the prospect values of the team-to-talent assessment and the prospect values of the talent-to-team assessment in the second stage to obtain the combined prospect values of the second stage match, as shown in Table 19.

Table 19. New R&D organization teams T and talents S Phase II composite prospect values.

Combined Prospect Value	S2	S3	S4	S6
T1	−0.3204	0.0455	−0.0157	0.1516
T2	0.0199	0.2907	0.1765	0.3083
T3	0.2455	0.1562	0.2330	−0.3126
T4	0.1585	−0.3707	−0.3167	0.0528

As can be seen from the table above:

(1) After combining the rankings of talent degree teams, the satisfaction rate, satisfaction rate, and ranking of the bilateral match between teams of new R&D institutions and scientific and technological talents changed.

(2) Team T1 of the new R&D organization is satisfied with S3 and S6, and is dissatisfied with S2 and S4, with a satisfaction rate of 50%, and ranks the scientific and technological talents as S6 $\succ$ S4 $\succ$ S4 $\succ$ S2.

(3) Team T2 of the new R&D organization is satisfied with S2 and S3, and is dissatisfied with S1, S4, S5, and S6, with a satisfaction rate of 33.33%, and ranks the scientific and technological talents as S6 $\succ$ S4 $\succ$ S4 $\succ$ S2.

(4) Team T3 of the new R&D organization is satisfied with S2 and S4, and is dissatisfied with S1, S3, S5 and S6, with a satisfaction rate of 33.33%, and ranks the scientific and technological talents as S2 $\succ$ S4 $\succ$ S3 $\succ$ S6.

(5) Team T4 of the new R&D organization is satisfied with S2, S3, S4, S5 and S6, and is dissatisfied with S1, with a satisfaction rate of 83.33%, and ranks the scientific and technological talents as S2 $\succ$ S6 $\succ$ S4 $\succ$ S3.

The prospective values of the team's second-stage assessment of talent were substituted into the M-2 model for bilateral matching, and the results of second-stage matching were obtained, as shown in Table 20. The overall assessment satisfaction for this match was 0.2478, and the match was stable.

Table 20. Results of the second stage matching of the new R&D organization teams T and the talents S.

Matching Teams	Phase 2 Matches Tech Talent	Phase II Composite Prospect Value
T1	S6	0.1516
T2	S3	0.2907
T3	S4	0.2330
T4	S2	0.1585

From the above table we can see that:

(1) The results of the matching between the new R&D organization team T and the scientific and technological talent S have been completely different from the previous matching results, and the indicators of each team's assessment of the scientific and technological talent have not changed, indicating that after a period of understanding, the team's understanding of the scientific and technological talent has changed. Therefore, bilateral matching should be based on dynamic ideas so that the matching results can be more accurate.

(2) In terms of the composite prospect values, the data on the composite prospect values for Phase 2 also validated the Phase 1 match, with all reaching satisfaction, but with plenty of room for satisfaction improvement. The combined team and talent satisfaction is more balanced, with the highest satisfaction rate for tech talent S3.

4.4. Comparison of Methods

The first stage of this paper is elimination matching, where different methods eliminate talents with different results. The second stage of selection matching only evaluates and ranks the scientific and technical talents matched in the first stage; therefore, other methods cannot obtain all the data of the second stage. This paper conducts a method comparison on the first stage of matching.

Method A: The approach in this study, considering a dual historical and aspirational reference point, is based on prospect theory, considering the cost of bringing in scientific and technical talent, and considering two stages.

Method B: Based on the approach presented in this paper, only historical reference points were considered for one phase.

Method C: Based on the method presented in this paper, only the desired reference point was considered for one stage.

Method D: on the data in this study, a phase was considered without considering the cost of introducing scientific and technological talent.

Method E: on the data in this study, a stage was considered based on regret theory.

Method F: on the data in this study, a phase was considered based on the grey correlation.

After calculation, the results are shown in Table 21.

Table 21. Bilateral Matching Results of Teams and Talents in New R&D Institutions under Different Methods.

Approach	First Phase Matching Results	Phase I Elimination of Talent	Reference Point	Consider the Cost of Introduction	Consider Psychological Factors
A	[T1,S6] [T2,S2] [T3,S4] [T4,S3]	S1, S5	Historical reference point Desired reference point	yes	Yes
B	[T1,S6] [T2,S1] [T3,S4] [T4,S2]	S3, S5	Historical reference point	yes	Yes
C	[T1,S1] [T2,S2] [T3,S4] [T4,S5]	S3, S6	Desired reference point	yes	yes
D	[T1,S5] [T2,S2] [T3,S4] [T4,S3]	S1, S6	Historical reference point Desired reference point	no	yes
E	[T1,S5] [T2,S2] [T3,S1] [T4,S6]	S3, S4	Historical reference point Desired reference point	yes	yes
F	[T1,S5] [T2,S2] [T3,S4] [T4,S3]	S1, S6	Historical reference point Desired reference point	yes	no

As can be seen from the table above:

(1) Under different approaches, some consider historical and desired dual reference points, some consider historical or desired single reference points, some consider introduction costs, some do not, some consider psychological factors, and some do not; thus, the results of bilateral matching are different.

(2) For the first stage of elimination matching, the scientific and technical talent eliminated is different under different methods, so the program still has a greater impact on the outcome of the elimination.

(3) Among the six different methods, the probability of being eliminated for scientific and technological talents S1, S3, and S6 was 50%, the probability of being eliminated for scientific and technological talents S5 was 33.33%, the probability of being eliminated for scientific and technological talents S5 was 33.33%, and the probability of being eliminated for scientific and technological talents S4 was 16.67%. Therefore, for scientific and technological talents, the higher the probability of being eliminated, the higher the risk, and it is necessary to find the direction of improvement from the personalized assessment index of the team of new R&D institutions, find the deficiency, and make efforts to improve so as to enhance their scientific and technological capabilities.

5. Conclusions

In summary, the following conclusions can be drawn.

First, this study characterizes the uncertain new R&D organization team's assessed value of scientific and technological talents and the cost of introducing scientific and technological talents by interval grey numbers, which shows the characteristics of multi-expert group decision-making of new R&D organization teams, inconsistent expert backgrounds and preferences, and the existence of an adjustment interval of talent policy, which is closer to reality.

Second, this study considers personalized assessment indicators for teams in new R&D institutions, because there are different teams in new R&D institutions, and different teams do not have exactly the same requirements for scientific and technological talents. Although the teams belong to the same new R&D institution, the focus of work is not quite the same, some focus more on market research, some focus more on R&D innovation, and some focus more on communication and collaboration. Therefore, this study provides a general framework of assessment metrics and allows teams to select individualized assessment metrics under the general framework, that is, some metrics will be selected and some will not, but the selected metrics must come from this metric framework. Different teams may choose different assessment metrics that are both relevant and easy to use.

Third, this study sets a dual reference point of historical reference point and desired reference point in the team assessment of talent, and a bottom-line reference point in the agreed cost of introduction of the team and talent, applying prospect theory based on the reference point to turn the assessed value and cost value into prospect value, fully considering people's psychology, and no longer comparing the absolute value of assessed value or cost value but comparing the relative value based on the reference point.

Fourth, the bilateral matching of teams and scientific and technological talents in new R&D institutions is divided into two stages, the first stage is elimination matching and the second stage is selection matching, both stages are many-to-many matching, but in the elimination matching of the first stage, all teams are matched and not all scientific and technological talents are matched, more scientific and technological talents than the number of teams will be eliminated. In the second stage of selection matching, there are equal numbers of teams and talents. Considering these two stages shows the idea of a dynamic assessment.

Fifth, in the first stage of elimination matching, both the team's assessed value of talent and the cost value of scientific and technological talent are considered. The larger the assessed value, the better the lower the cost value, so that the scientific and technological talent matched out by forming dual objectives is in line with the principle of maximizing benefits and will not be too costly, and the assessment factor and cost factor can be adjusted by weighting.

Sixth, in the second stage of selection matching, both the team's assessment value of the talent and the talent's ranking of the team are considered. The larger the assessment value, the better, and the smaller the ranking, the better, so as to form a double target matching out of the scientific and technological talent. The satisfaction of both sides is not too low, fully considering the psychological factors of both the team and the talent matching, and the assessment factor and the ranking factor are adjustable by weighting.

In summary, this study considers two stages of team and talent matching in new R&D organizations. The first considers the team's assessment of talent and the cost of talent introduction; the assessment considers historical reference points and desired reference points, the cost considers bottom-line reference points, and combines prospect theory with high assessment value and low cost to optimize the solution. The second stage considers the team's evaluation of the talent and the talent's satisfaction with the team. The evaluation still considers the historical reference point and the desired reference point, which considers the bottom-line reference point. This optimizes the solution based on high evaluation value and high satisfaction in combination with prospect theory, fully considering the psychological factors of decision makers. In real life, assessment values, ranking values, reference point values, etc., are decided by multiple participants, so these values mostly have uncertainty. The interval grey number possesses an independent algorithm that characterizes uncertainty but is simple to calculate. The method in this paper solves the problems of high cost and low satisfaction of talent introduction raised by HR directors of new R&D organizations and greatly improves the efficiency of team and talent matching. New R&D organization teams should comply with market changes, update personalized assessment indicators, dynamically assess scientific and technical talent, continuously build a reasonable talent ladder, identify talent deficiencies and train them, and adjust talent policies to promote output. Scientific and technological talent should strive to cope with the matching situation of the team of new R&D institutions, adjust their efforts according to the team's personalized assessment indicators in a timely manner, conduct scientific and technological work with the team's goals as the focus, create more scientific and technological achievements, and realize their self-worth. Since there is not much data acquisition, the author has selected only one new R&D institution for method calculation. The sample size is still small; therefore, it has some limitations. The current study only considers factors such as team's evaluation of talent, talent's cost, and talent's satisfaction with the team, which has some limitations. Later on, we can combine government factors, leadership factors of teams, self-motivation factors of talents, and project-based management factors with this study. The current study only considered static reference points. In the future, the author will also conduct research on bilateral matching of team and scientific and technological talents in new R&D institutions based on government supervision, re-research on bilateral matching of team and scientific and technological talents in new R&D institutions based on dynamic reference points, and research on trilateral matching of team-project-talent in new R&D institutions based on reference points.

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Data Availability Statement: The author obtained data from HR managers of the new R&D organization T for two phases of two-way team and talent assessment. For the new R&D organization T, these data are not publicly available and are not published in a publicly available dataset. These data are presented in the article. The focus of this paper is to demonstrate the validity of the method by simulating the data, and the data from the computation process are shown in detail in the paper.

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