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An Investigation into Sichuan Province's Technological Innovation Talent Development Environment Using the AHP-FCE Methodology

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Abstract: The role of technology talent in driving technological innovation and sustainable development cannot be overstated. This paper aims to delve into the development environment of technology innovation talent, utilizing the AHP-FCE method for assessment. By analyzing Sichuan Province as a case study, it uncovers the overall trends and achievements in the development environment of technology innovation talent, with a particular emphasis on the pivotal roles of technological innovation conditions and the employment and entrepreneurship environment. To optimize the development environment for technology innovation talent, this study puts forth policy recommendations including strengthening ecological awareness, enhancing mechanisms for talent cultivation and attraction, fostering industry-academia-research collaboration, and bolstering policy support. Through this research, valuable insights are provided to drive technological innovation in Sichuan Province, stimulate economic advancement, and promote sustainable development.

Keywords: Analytic Hierarchy Process, Fuzzy Comprehensive Evaluation, High-Quality Development, Development Environment for Technology Talent.

1. Introduction

In this era of rapid technological advancements, the cultivation and development of technological talent have become crucial pillars for the progress of nations[1]. Technological talents are the linchpins of technical innovation and practice, playing an indispensable role in societal progress and prosperity. Ensuring an enabling environment for their education and growth is paramount. Arguably, the nurturing of technological talents and the propulsion of technological innovations are intertwined. The quality of the environment for the development of technological talents has a direct bearing on the vigor and outcomes of innovation. Hence, discerning the pivotal factors influencing the environment for technological talent development and seeking strategies for optimization to bolster technological innovation and socio-economic development is a pressing research priority in the contemporary "talent development" domain.

Technological talents represent the lifeblood of socio-economic evolution, with their innovative capabilities, professional skills, and leadership acumen being pivotal in bolstering the core competitiveness of regions and nations alike[2]. In today's context, the environment for the cultivation and development of technological talents is instrumental for technological innovation. As technological advancements accelerate and global competition intensifies, nations worldwide are increasingly recognizing technological talent development as a cornerstone of their strategic agendas, striving incessantly to foster a conducive environment for the same. Against this backdrop, in-depth examination and analysis of the crucial factors influencing the environment for technological talent development and the proposition of efficacious policies and measures are of paramount significance in augmenting technological innovation prowess and facilitating economic transformation.

This study seeks to delve into the environment for technological talent development using the AHP-FCE (Analytic Hierarchy Process-Fuzzy Comprehensive Evaluation) methodology. The aim is to attain a profound understanding of the multiple dimensions and elements affecting the development of technological talents and to assess and analyze them via the comprehensive evaluation model. Throughout this research endeavor, the multifaceted dimensions and elements pertinent to the environment for technological talent development will be the focal point. By thoroughly analyzing the interplay and impact of these elements, this study aspires to unearth the current scenario and potential challenges of the environment for technological talent development in Sichuan province and to propose strategies and measures for its optimization.

2. Literature References

The development environment for technological talents and its myriad implications have piqued the interest of numerous researchers. Tian Xingguo et al. (2017) delved into the challenges faced by the development of innovative technological talents in higher education institutions. They accentuated the pivotal roles of research incentives, promotion mechanisms, and financial support from governments and employers for technological projects[3]. Li Xin et al. (2018) further analyzed determinants of the environment for technological talent development, encompassing research milieu, assessment incentives, talent mobility systems, intellectual property rights protection, and innovative cultural setting. Notably, they discerned that the innovative cultural environment exerted a mediating effect amongst these determinants[4]. Xiao Mingzheng et al. (2019) posited that the environment for talent development encapsulates external determinants and objective conditions influencing talents' work, life, and growth trajectory. They emphasized the cardinal role of optimizing such environments for local socio-economic progress[5].

Other scholars have further enriched the discourse on evaluating the development environment for technological talents. For instance, Li Xuhui et al. (2020) crafted a dynamic evaluation system for talent development environment predicated on five developmental philosophies. They proffered policy recommendations to achieve balanced and coordinated progress[6]. Zhao Yuanbo (2021) assessed the competitiveness of technological talents across Chinese provinces, spotlighting regional disparities and underscoring the significance of resource allocation in bolstering technological talent competitiveness[7].

Furthermore, some researchers have delved specifically into talent development environments in particular regions or cities. Jin Sujing (2022) assessed talent development environments across Chinese cities, emphasizing the quintessential role of economic settings in enhancing these environments[8]. Zhang Baoyou et al. (2022) focused on the environment for innovative entrepreneurial talent development, offering pathways for optimization to buttress high-quality regional economic progress[9]. Xiao Mingzheng et al. (2022) conceptualized an evaluation metric system for regional talent development environments, employing Guangdong province as a case study for validation and assessment, followed by suggested enhancements[10].

A holistic review of the aforementioned literature reveals a relatively rich array of studies on the evaluation of the development environment for technological talents, encompassing elements like research incentives, assessment mechanisms, talent mobility systems, intellectual property rights protection, and innovative cultural settings. However, there appears to be a lacuna in literature specifically employing the AHP-FCE (Analytic Hierarchy Process and Fuzzy Comprehensive Evaluation) methodology for a comprehensive evaluation of the development environment for technological talents.

Thus, this study intends to employ the AHP-FCE methodology to conduct an in-depth analysis and comprehensive evaluation of the environment for technological talent development in Sichuan province. By architecting a comprehensive evaluation metric system and model for the talent development environment, and quantitatively analyzing various factors like the innovation milieu, development setting, growth opportunities, talent cultivation, and attraction, this research aspires to provide a solid empirical foundation for governmental entities to formulate effective policies and measures for technological talents. Concurrently, this study also aims to provide profound insights into the macro, systemic evaluation of the talent development environment, offering valuable lessons and revelations for the cultivation and growth of technological talents.

3. Establishment and Analysis of the AHP-FCE Model

3.1. Construction of the Evaluation System for the Environment of Technological Talent Development

In this study, a literature analysis method was adopted. Aligning with the principles of sustainable and green high-quality development, relevant indicator systems were selected. To build an evaluation system for the environment of technological talent development, the authors thoroughly reviewed pertinent literature. Based on the results of the literature analysis and incorporating the policy text analysis of technological talent evaluation proposed by Gan Yuhui[11], three system levels were identified: Development Opportunities & Growth Space, Technological Innovation Conditions, and Talent Cultivation & Attraction. Using the three-level evaluation system for the environment of technological innovation talent development proposed by Cui Hongyi[1] as a foundation, seven element levels were determined: Innovation Support Environment, Achievement Transformation Environment, Regional Economic Environment, Employment & Entrepreneurship Environment, Living Security Environment, Regional Education & Culture Environment, and Policy Support Environment. Finally, utilizing the evaluation indicator system for technological innovation talent proposed by Zhang Yi[10], a new indicator level was constructed comprising basic qualities, innovative capabilities, and innovative achievements.

Furthermore, to validate the scientific and rational reliability of the selected indicators, an expert survey questionnaire was administered in this study. A total of 18 participants were invited, including experts in talent evaluation, university professors, and personnel from scientific research institutions. These experts filtered the preliminary indicators. Through the expert scoring method, indicators with lower scores, such as foreign trade export volume and infrastructure construction, were excluded. Factoring in the actual developmental conditions, evaluation indicators more suited to the actual environment of technological talent development in Sichuan Province were chosen. Ultimately, a research system for the environment of technological talent development was constructed, which includes one target level, three system levels, seven element levels, and 23 indicator levels, as shown in Figure 1.

3.2. Determination of Evaluation Indicator Weights

In this study, the Analytic Hierarchy Process (AHP) method was adopted to determine the weights of the established evaluation indicator system for the environment of technological talent development[12].

The AHP-FCE method is a comprehensive evaluation approach that combines the Analytic Hierarchy Process (AHP) with the Fuzzy Comprehensive Evaluation (FCE) method. This approach is employed for the qualitative and quantitative integrated evaluation of complex issues. In the context of evaluating the environment for technological talent development, the AHP-FCE method can systematically analyze and weigh the importance and impact of various factors, thereby offering a more holistic understanding and optimization of the factors and mechanisms influencing talent development.

3.2.1. Calculation of Indicator Scores

During a follow-up survey with the consulted experts in March 2023, the authors requested the experts to score each ultimate indicator based on its level of importance. A total of 24 questionnaires were distributed, of which 23 valid ones were successfully retrieved. By judging completion time, completion rate, and other criteria, the effective recovery rate reached 95.83%. The collected questionnaires were assigned values using a 5-level Likert scale. The percentages of "very important" to "very unimportant" obtained from the expert survey questionnaire were set as v1, v2, v3, v4, and v5, respectively, to measure the importance of each factor. Given that $\sum_{i=1}^{5} vi = 1$, the final score for an indicator can be calculated as v = v1×5+v2×4+v3×3+v4×2+v5×1. The scores for each factor, as determined from this calculation, are shown in the table below.

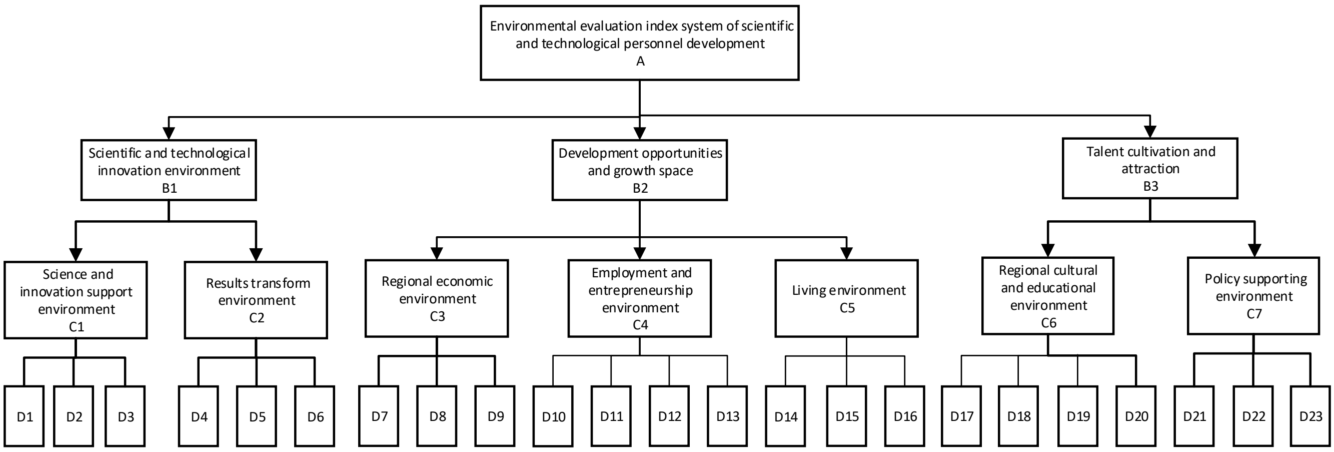

Figure 1. Framework for Evaluating the Development Environment of Technology Talent

D1: Proportion of R&D investment
D2:Talent support
D3:Innovation resource
D4:Intellectual property protection
D5:Enterprise innovation ability
D6:Application of technological innovation results
D7:Regional GDP
D8:Investment intensity
D9:Level of industrialization
D10:Employment opportunity
D11:Entrepreneurship support
D12:Talent quality
D13:Capital environment
D14:Social security
D15:Living cost
D16:Public service
D17:Educational resources
D18:Educational input
D19:Quality of educationD19
D20:Cultural atmosphere
D21:policy stability
D22:Policy effectiveness
D23:Policy flexibility

Table 1. Expert Scoring Table for the Evaluation Indicators of the Scientific and Technological Talent Development Environment

Objective Level	System Level	Scoring	Element Level	Scoring	Criterion Level	Scoring
A	B1	4.61	C1	4.59	D1	4.76
					D2	4.75
					D3	4.50
			C2	4.46	D4	4.50
					D5	4.25
					D6	4.38
	B2	4.45	C3	4.61	D7	4.38
					D8	4.51
					D9	4.12
			C4	4.20	D10	4.64
					D11	4.65
					D12	4.38
					D13	4.25
			C5	4.75	D14	4.64
					D15	3.99
					D16	4.12
	B3	4.74	C6	4.33	D17	4.64
					D18	4.66
					D19	4.76
					D20	4.25
			C7	4.78	D21	4.90
					D22	4.80
					D23	4.51

3.2.2. Establishing the Judgment Matrix

The purpose of constructing the judgment matrix is to evaluate the relative importance between the upper-level elements and their subordinate elements[13]. Using Saaty's 1-

9 scale method (as shown in Table 2) and combined with the results of expert scoring, various judgment matrices can be constructed. Based on Figure 1, the following judgment matrices are established: A-B, B1-C, B2-C, B3-C, C1-D, C2-D, C3-D, C4-D, C5-D, C6-D, C7-D. We will take the A-B judgment matrix as an example.

Table 2. Scale and Interpretation of the Judgment Matrix

Scaling	Meaning (where Δ represents the difference in scores between two factors)
1	Two factors are equally important when compared
3	Compared to the latter, the former is slightly more significant
5	Compared to the latter, the former is significantly more important
7	Compared to the latter, the former is markedly more important than the latter
9	Compared to the latter, the former is extremely more important than the latter
2,4,6,8	Indicating the intermediate value of the adjacent judgments mentioned above
Reciprocal	If the judgment value for comparing factor i with j is Sij, then the judgment value for comparing j with i is 1/Sij

The final constructed A-B judgment matrix is as follows:

$$\begin{pmatrix} 1 & 3 & 2 \\ 1/3 & 1 & 1/3 \\ 1/2 & 3 & 1 \end{pmatrix}$$

3.2.3. Hierarchical Single Ranking and Consistency Test

Using Matlab, we compute the eigenvalues and eigenvectors for each factor, followed by a normalization of the weight vectors. The judgment matrix undergoes a consistency test[14]. For instance, considering the judgment matrix A-B, we ascertain the maximum eigenvalue, K1, and the weight vector, WA:

K1 represents the maximum eigenvalue of the judgment matrix A-B, while WA denotes the weight vector of subsystems B1, B2, and B3 relative to the objective A. Additionally, to ensure the consistency of the judgment matrix, it's imperative to execute a consistency test. The consistency index, CI, is first determined as:

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{1}$$

In Equation (1), n denotes the number of judgment factors, and $\lambda_{\max}$ represents the maximum eigenvalue of the judgment matrix.

When searching for the average random consistency index, RI, of the judgment matrix, refer to the specific values provided in the table[15]. RI serves as an indicator for assessing the consistency of the judgment matrix, and its precise value is related to the order of the judgment matrix. By matching the order of the judgment matrix to its corresponding value in the table, one can then compare the RI value with the computed consistency index to evaluate the consistency level of the judgment matrix[16].

Table 3. The Average Random Consistency Index (RI).

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.46

Finally, the formula for the Consistency Ratio (CR) is:

$$CR = \frac{\mathrm{CI}}{\mathrm{RI}} \tag{2}$$

According to formula (2), if CR⩽0.1, the consistency of the judgment matrix is acceptable. If CR⩾0.1, the judgment matrix should be revised. Moreover, when the number of judgment factors, n < 3, the judgment matrix always has complete consistency, that is, CI=0[17].

In this study, all the judgment matrices involved have passed the consistency test, and the specific consistency ratios can be found in Table 4.

Table 4. Results of the Consistency Test for Hierarchical Single Ranking of the Judgement Matrix.

Matrix	A-B	B1-C	B2-C	B3-C
CR	0.0462	0.0000	0.0252	0.0000

3.2.4. Total Hierarchical Ranking and Consistency Test

The total hierarchical ranking involves calculating the relative importance weights of all factors at a certain level in relation to the goal level. The process is conducted from top to bottom, from the highest to the lowest level[18]. The final weight scores are typically presented in tabular form, as shown in Table 5. Table 5 lists the weight scores of each factor relative to the goal level, reflecting their relative significance within the overall hierarchical structure.

In the hierarchical total sorting, consistency tests need to be carried out for each level, layer by layer from top to bottom. Suppose the comparison judgment matrix Cj-D (j = m, m+1,..., n) under the layer Bi (i = 1,2,3) has passed the consistency test in the hierarchical single ranking, resulting in a consistency indicator of Cij[19]. The weight value of Cj is aj, and its corresponding average random consistency index is RIj. Based on equation (3), the consistency ratio of the total ranking in layer Bi can be calculated.

$$CR_i = \frac{\sum_{j=m}^{n} a_j CI_j}{\sum_{j=m}^{n} a_j RI_j} \tag{3}$$

By the same logic, the consistency ratio for the total ranking at layer A can be derived, as illustrated in Table 6.

Table 6. Results of the Consistency Test for the Hierarchical Total Ordering of the Judgement Matrix

Matrix	B1	B2	B3	A
CR	0.0207	0.0190	0.0177	0.0049

CRTotal=0.0049 < 0.1. This suggests that the total ranking results exhibit satisfactory consistency, and the analysis outcome is thus accepted.

3.2.5. Analysis of Results

The evaluation reveals several critical points in the framework we've established for assessing the environment for the development of technological innovation talents in Sichuan province. At the systemic level, conditions for technological innovation dominate in terms of influence, surpassing talent cultivation, attraction, and opportunities for development and growth. This underscores the significance of technological innovation conditions in assessing and shaping the environment for the development of tech talents, suggesting our efforts should concentrate on this domain.

On the elemental level, the environments for result transformation and innovation support are identified as pivotal drivers for tech talent development. Specifically, the policy support environment plays a critical role in talent cultivation and planning. Additionally, providing a stable living security environment for tech talents can stimulate their technological innovative capabilities, enhancing the overall development atmosphere.

From the overall ranking perspective, the twelve most influential indicators include intellectual property protection, policy stability, application of technological innovation results, proportion of R&D investments, policy effectiveness, social security, talent support, corporate innovation capabilities, policy adaptability, investment intensity, innovative resources, and educational quality. These factors are central to fostering Sichuan's tech talent innovation environment and shape the development milieu, hence, they should be prioritized when planning the tech innovation talent development landscape.

Table 5. Weight Table for Evaluation Indicators of Science and Technology Innovation Talent Development Environment in Sichuan Province

Objective Level	System Level	Weight Values	Element Level	Weight Values	Criterion Level	Scoring	Weight values for D layer	Ranking
A	B1	0.5279	C1	0.3333	D1	0.5279	0.0929	4
					D2	0.3325	0.0585	7
					D3	0.1396	0.0246	11
			C2	0.6667	D4	0.5396	0.1899	1
					D5	0.1635	0.0575	8
					D6	0.2969	0.1045	3
	B2	0.1396	C3	0.3420	D7	0.3090	0.0148	14
					D8	0.5815	0.0278	10
					D9	0.1095	0.0052	19
			C4	0.0811	D10	0.3146	0.0036	20
					D11	0.4694	0.0053	18
					D12	0.1371	0.0016	22
					D13	0.0789	0.0009	23
			C5	0.5769	D14	0.7582	0.0611	6
					D15	0.0905	0.0073	17
					D16	0.1513	0.0122	15
	B3	0.3325	C6	0.1667	D17	0.1989	0.0110	16
					D18	0.2993	0.0166	13
					D19	0.4420	0.0245	12
					D20	0.0598	0.0033	21
			C7	0.8333	D21	0.5584	0.1547	2
					D22	0.3196	0.0886	5
					D23	0.1220	0.0338	9

3.3. Fuzzy Comprehensive Evaluation Analysis

3.3.1. Establishing the Set of Factors and Evaluation Set

From the technological innovation talent development environmental evaluation system established through the hierarchical analysis, the 23 indicators in layer D serve as elements in the set of factors: U={U1, U2, …, Un} (n=23). Considering the current state of the environment for technological innovation talent development, the evaluation results are divided into five levels, and its evaluation set is defined as V={Excellent, Good, Average, Below Average, Poor}.

3.3.2. Individual Factor Judgment

By distributing questionnaires to researchers within institutes in Sichuan province, staff of tech companies, university faculty, upcoming and past university graduates, a total of 234 questionnaires were disseminated. We received 213 valid responses, judging by completion time and rate, resulting in a valid response rate of 91.02%. After data collation, initial quantified values relevant to the technological innovation talent development environment in Sichuan were obtained. After sorting and adjusting these according to weight scores, the evaluative matrix for the indicators was formed, as shown in Table 7.

3.3.3. Selection of Fuzzy Operator

This study utilizes the weighted average type operator, which accentuates the primary factors in the comprehensive evaluation, considering the contribution of each element to the assessment[20]. This method offers a relatively objective reflection of the overall status of the evaluated entity. In this approach, *pj* denotes the fuzzy comprehensive evaluation index, representing the degree of membership of the evaluated entity to the j-th element of the evaluation set. The calculation formula is as follows:

$$p_j = \min\left(1, \sum_{j=1}^{m} w_j r_{jk}\right), k = 1, 2, \ldots, n \quad (4)$$

In the formula, *wj* represents the weight of the j-th factor of the assessment subject, while *rjk* denotes an element within the fuzzy comprehensive evaluation matrix.

Table 7. Evaluation Results of the Sichuan Province's Technological Innovation Talent Development Environment Indicators

Question	Result				
	Excellent	Good	Average	Below Average	Poor
D1	0.19	0.43	0.15	0.18	0.05
D2	0.13	0.48	0.18	0.14	0.06
D3	0.21	0.42	0.17	0.15	0.05
D4	0.18	0.43	0.18	0.17	0.04
D5	0.15	0.53	0.12	0.15	0.06
D6	0.17	0.46	0.17	0.16	0.04
D7	0.17	0.40	0.23	0.16	0.04
D8	0.15	0.48	0.15	0.18	0.04
D9	0.16	0.48	0.16	0.14	0.05
D10	0.21	0.42	0.16	0.17	0.03
D11	0.16	0.45	0.17	0.19	0.03
D12	0.21	0.40	0.18	0.15	0.05
D13	0.19	0.41	0.20	0.15	0.04
D14	0.19	0.39	0.20	0.15	0.07
D15	0.17	0.46	0.16	0.15	0.06
D16	0.13	0.51	0.15	0.16	0.05
D17	0.17	0.47	0.15	0.15	0.07
D18	0.18	0.44	0.16	0.18	0.04
D19	0.14	0.50	0.15	0.16	0.05
D20	0.14	0.46	0.22	0.14	0.04
D21	0.17	0.42	0.21	0.15	0.04
D22	0.18	0.44	0.18	0.15	0.05
D23	0.15	0.46	0.17	0.18	0.02

3.3.4. Fuzzy Comprehensive Evaluation

Taking the scientific and technological innovation support environment (C1) as an example:

Its fuzzy comprehensive evaluation matrix is

$$RC1=\begin{pmatrix} 0.19 & 0.43 & 0.15 & 0.18 & 0.05 \\ 0.13 & 0.48 & 0.18 & 0.14 & 0.06 \\ 0.21 & 0.42 & 0.17 & 0.15 & 0.05 \end{pmatrix}$$

Weight vector:

$$WC1=\begin{pmatrix} 0.5279 & 0.3325 & 0.1396 \end{pmatrix}$$

Yielding the fuzzy comprehensive evaluation value of the innovation-supportive environment.

$$PC1=WC1\times RC1=\begin{pmatrix} 0.1728 & 0.4452 & 0.1628 & 0.1625 & 0.0567 \end{pmatrix}$$

Applying the principle of maximum membership degree, the highest membership degree belonging to the category "Good" is the largest (p=0.4452). Therefore, it is determined that the innovation-supportive environment for technology talent development in Sichuan Province is at a "Good" level[21]. Following the outlined procedure, the fuzzy comprehensive evaluation values for each indicator at the system level are successively calculated, resulting in the construction of the fuzzy comprehensive evaluation matrix for the system level.

$$RB1=\begin{pmatrix} 0.1728 & 0.4452 & 0.1628 & 0.1625 & 0.0567 \\ 0.1721 & 0.4553 & 0.1672 & 0.1638 & 0.0416 \end{pmatrix}$$

$$RB2=\begin{pmatrix} 0.1573 & 0.4553 & 0.1758 & 0.1694 & 0.0422 \\ 0.1850 & 0.4306 & 0.1706 & 0.1751 & 0.0387 \\ 0.1791 & 0.4145 & 0.1888 & 0.1515 & 0.0661 \end{pmatrix}$$

$$RB3=\begin{pmatrix} 0.1579 & 0.4737 & 0.1572 & 0.1628 & 0.0484 \\ 0.1708 & 0.4313 & 0.1955 & 0.1537 & 0.0487 \end{pmatrix}$$

Similarly, by conducting calculations, the fuzzy comprehensive matrix for the objective layer is constructed as follows:

$$RA=\begin{pmatrix} 0.1723 & 0.4519 & 0.1657 & 0.1634 & 0.0467 \\ 0.1721 & 0.4298 & 0.1829 & 0.1595 & 0.0557 \\ 0.1686 & 0.4384 & 0.1891 & 0.1552 & 0.0487 \end{pmatrix}$$

Finally, the fuzzy comprehensive evaluation value of Sichuan Province's technological innovation talent development environment (A) is obtained as follows:

$$PA=WA*RA=\begin{pmatrix} 0.1710 & 0.4443 & 0.1759 & 0.1601 & 0.0486 \end{pmatrix}$$

The assessment indicates that the level of technological innovation talent development environment in Sichuan Province is categorized as "Good".

3.3.5. Comprehensive Evaluation Results and Analysis

The evaluation criteria set V={Excellent, Good, Average, Below Average, Poor} were assigned corresponding values, specifically 5, 4, 3, 2, 1. This generated a summarized table of the current assessment results for the development status of the technological innovation talent environment in Sichuan Province.

Table 8. Consolidated Table of Evaluation Results for the Current Development Status of Technological Innovation Talent Environment in Sichuan Province

Objective Layer	Evaluation Value	System Level	Evaluation Value	System Level	Evaluation Value
A	3.5287	B1	3.5397	C1	3.5149
				C2	3.5525
		B2	3.5031	C3	3.5240
				C4	3.8964
				C5	3.4890
		B3	3.5230	C6	3.5299
				C7	3.5218

Subsequent to the evaluation and analysis of the current development status of the technological innovation talent environment in Sichuan Province, it can be observed from the data in Table 8 that the evaluation values of various factors in Sichuan Province are relatively close, reflecting an overall well-developed and commendable state of the technological innovation talent environment. This conclusion aligns with relevant information available online. As a significant economic hub in the western region of China, Sichuan Province has made remarkable progress in technological innovation and talent cultivation.

At the systemic level, the evaluation value of technological innovation conditions is notably high, indicating substantial support from the Sichuan provincial government and society for technological innovation. This support is evident not only in research funding and the establishment of technological infrastructure but also in the introduction of a series of policies and incentives to attract exceptional technological talent to the region. These efforts contribute to the enhancement of technological innovation capabilities and levels, further propelling the continuous development of the regional economy.

On the elemental level, the evaluation value of the employment and entrepreneurship environment stands out, underscoring the considerable significance that technology talent places on their personal employment and entrepreneurial conditions. Sichuan Province possesses abundant technological resources and substantial development potential, offering expansive employment and entrepreneurial opportunities for technology talent. The region hosts a multitude of technological enterprises, universities, and research institutions that provide platforms and resources, fostering an environment that encourages technology talent to flourish in innovation and entrepreneurship.

Nevertheless, apart from these prominent factors, attention should also be directed toward other pivotal elements such as the enhancement of technological education and the diversification of talent cultivation. Strengthening technological education is integral to nurturing innovative technological talent, as bolstered technological education can elevate the comprehensive qualities and innovative capabilities of technology talent. This aids in cultivating more internationally competitive technological talent, thereby fostering breakthroughs in technological innovation. Simultaneously, diversified talent cultivation is equally crucial. This entails not only focusing on research-oriented talent but also addressing engineering and practical technical talent across diverse fields, meeting the developmental demands of various sectors. These viewpoints are also corroborated by prior research [1].

4. Management and Practical Implications

Overall, the environment for the development of scientific and technological talents in Sichuan Province is in a favorable state of progress. There's significant attention and investment in technological innovation conditions, and the entrepreneurial employment landscape is also quite advantageous. Nonetheless, further improvements in technological education and diversification in talent cultivation are imperative. An objective and rigorous attitude should be maintained to offer reliable contributions to optimizing the environment for technological talent development, thus actively contributing to the goals of the innovation-driven development strategy.

Following a comprehensive assessment and analysis of Sichuan Province's environment for scientific and technological talent development, this study found that the region generally fares well in this aspect, but still faces challenges and areas for enhancement. Based on these observations, this study suggests the following strategies and recommendations:

4.1. Enhance Ecological Awareness and Sustainable Development

Governmental bodies and relevant institutions should emphasize ecological protection and sustainable development when planning and funding scientific research projects. Technological innovators should be encouraged to participate in projects related to environmental conservation, improving resource utilization efficiency, and clean energy. In educating and training these innovators, the emphasis should be on instilling a sense of responsibility and awareness about environmental issues[22].

4.2. Strengthen Cultivation and Recruitment Mechanisms for Technological Innovators

There's a need to construct a holistic system for the cultivation of technological innovators. Design and implement overarching plans and policies for their development, and establish a comprehensive, multi-tiered system for their training. Platforms for their development and collaboration should be introduced. Efforts should be geared towards attracting top-level domestic and international technological innovators to rural regions, infusing new energy into rural revitalization initiatives[23].

4.3. Boost Policy Support to Ensure an Optimal Development Environment

Policies that foster the growth of technological innovators, including recruitment, training, evaluation, and incentive mechanisms, should be formulated. An environment that's proactive, open, and inclusive is vital for their development[11]. Encourage interdisciplinary training to produce innovators with multifaceted skills. Intensify international exchanges and collaborations, forge partnerships with renowned international universities and research entities, and attract leading global tech innovators. This would widen the perspectives of local innovators and foster academic innovation[24].

5. Conclusion and Prospect

This study aimed to explore the environment for the development of science and technology personnel based on the AHP-FCE (Analytic Hierarchy Process-Fuzzy Comprehensive Evaluation) methodology. By delving into multiple dimensions and elements that influence the development of science and technology personnel and conducting rigorous data analysis, this work provides a scientific foundation and decision-making support for their training and development. The evaluation of Sichuan Province's environment for the development of science and technology personnel reveals both the strengths and deficiencies of the region, offering valuable insights for the government's formulation and implementation of related policies.

During the investigation, the AHP-FCE approach was employed to systematically assess the systems and elemental levels of the environment for the development of science and technology personnel. According to the evaluation, the overall environment in Sichuan Province is commendable, with ratings predominantly exceeding 3, especially in terms of technological innovation conditions and entrepreneurial employment scenarios. Nevertheless, there are evident shortcomings in technological education reforms and diversification of talent cultivation, which warrant attention[25]. This concurs with perspectives from various scholars[6].

The comprehensive assessment and analysis of Sichuan's environment for technological innovation talent development clearly identifies the impact and relative importance of key indicators. Factors such as technological innovation conditions, results conversion environment, and innovation support milieu emerged as pivotal elements influencing the region's setting for the growth of science and technology talent. These findings not only offer strategic references for Sichuan's efforts in cultivating innovative talents but also present a benchmark for other regions to evaluate their respective environments.

With the rapid advancements in technology and the deepening trend of globalization, the weightage of these core indicators might undergo changes. Especially propelled by emerging technologies like artificial intelligence and big data, strategies to cultivate and attract innovative talents need to be recalibrated and updated, further refining policies and measures to ensure a conducive and competitive environment for their growth.

In conclusion, while Sichuan Province boasts a relatively conducive environment for the development of science and technology talents, there exist challenges and room for improvement. Through this comprehensive research, scientific rationales and decision-making support are furnished for Sichuan's science and technology talent development, also offering insights for other regions. It is anticipated that Sichuan continues to intensify efforts in optimizing its technological innovation milieu, fostering the training and development of its talents, and contributing significantly to achieving the objectives of innovation-driven development strategies.

References

[1] Cui Hongyi, Pan Mengqi, Zhang Chao. Analysis on the development environment of science and technology innovation talents in Shenzhen based on principal component analysis [J]. Science and Technology Progress and Countermeasures, 2020, 37(7): 35-42.

[2] Wang Shao. Status, compliance and essential requirements of scientific and technological talent evaluation [J]. Scientific Management Research, 2019, 37(4): 142-145.

[3] Tian Xingguo, LV Jianqiu, HUANG Junyan, et al. A study on the cognition and reform intention of university teachers on the development environment of innovative scientific and technological talents: Based on an empirical survey of 61 universities in China [J]. Science and Technology Management Research, 2017, 37(6): 106-111.

[4] Li Xin, FAN Mingjie, Yang Zoli,et al. Environmental factors affecting the development of science and technology talents based on Structural equation model [J]. China Science and Technology Forum, 2018(8): 147-154.

[5] Xiao Mingzheng, Han Chaochu. Analysis and Optimization Suggestions of China's talent development Environment [J]. Chinese Talent, 2019(8): 42 -- 43.

[6] Li Xuhui, Xia Wanjun. An empirical study on dynamic evaluation of talent development environment based on Five development concepts: A case study of National Independent Innovation Demonstration Zones [J]. Journal of Beijing Institute of Technology (Social Sciences Edition), 2020, 22(2): 60-69.

[7] Zhao Yaobao. Evaluation on the competitiveness of Regional Science and Technology Talents in China from 2016 to 2018 [J]. Science and Technology Management Research, 2021, 41(20): 52-59.

[8] Jin Sujing, Zhong Ruoyu, Construction of urban talent development environment index and comparison of regional differences [J]. Statistics and Decision, 2022, 38(19): 31-35.

[9] Xiao Mingzheng, Zhu Yuhuilan. Research on Regional talent development Environment Index: Based on survey samples of 21 cities in Guangdong Province [J]. Executive Forum, 2022, 29(3): 131-138.

[10] Zhang Yi, Ni Jihui. Construction of evaluation index system for scientific and technological innovation talents [J]. Statistics and Decision, 2022, 38(16): 172-175.

[11] Gan Yuhui, HOU Shengchao, Zou Lijun. An analysis of the policy text of Chinese science and technology talent evaluation from the perspective of policy tools [J]. Science Research Management, 2022, 43(3): 55 -- 62.

[12] Wang H, Cheng M, Zhang S, et al. Optimization of irrigation amount and fertilization rate of drip-fertigated potato based on Analytic Hierarchy Process and Fuzzy Comprehensive Evaluation methods[J]. Agricultural Water Management, 2021, 256: 107130.

[13] Gangsø K, Aspvik N P, Mehus I, et al. Talent Development Environments in Football: Comparing the Top-Five and Bottom-Five-Ranked Football Academies in Norway[J]. International Journal of Environmental Research and Public Health, 2021, 18(3): 1321.

[14] Yang Yao, WANG Chuan. Analysis of agricultural and tourism integration degree based on AHP-Fuzzy comprehensive evaluation method: A case study of Enshi Gong Shuibai Pomelo industry [J]. Chinese Journal of Agricultural Resources and Regionalization, 2021, 42(1): 220-230.

[15] Thomas C E, Abbott G, Gastin P B, et al. Construct validity and reliability of the Talent Development Environment Questionnaire in Caribbean youth track and field athletes[J]. PLOS ONE, 2020, 15(1): e0227815.

[16] Yanwen W, Peng C, Chen F. Security Assessment of Coal Mine Power Grid Voltage Based on an Improved AHP-FCE[J]. Mathematical Problems in Engineering, 2022, 2022: 1-12.

[17] Li C, Martindale R, Sun Y. Relationships between talent development environments and mental toughness: The role of basic psychological need satisfaction[J]. Journal of Sports Sciences, 2019, 37(18): 2057-2065.

[18] Zhu Y, Zhong S, Wang Y, et al. Land Use Evolution and Land Ecological Security Evaluation Based on AHP-FCE Model: Evidence from China[J]. International Journal of Environmental Research and Public Health, 2021, 18(22): 12076.

[19] Xu S, Sun Y. Research on Evaluation of Green Smart Building Based on Improved AHP-FCE Method[J]. Computational Intelligence and Neuroscience, 2021, 2021: 1-11.

[20] Han Li, Mei Qiang, Lu Yumei, Ji Min. Analysis and Research of AHP-Fuzzy Comprehensive Evaluation Method [J]. China Safety Science Journal, 2004(7): 89-92+3.

[21] Li W, Xu G, Zuo D, et al. Corporate Social Responsibility Performance-Evaluation Based on Analytic Hierarchy Process-Fuzzy Comprehensive Evaluation Model[J]. Wireless Personal Communications, 2021, 118(4): 2897-2919.

[22] Song Wei, Dai Lei. Construction of environmental evaluation index system for Cultivating scientific and technological Innovation talents in Jilin Province [J]. Industrial Technical Economics, 2011, 30(8): 39-42.

[23] Cui Y. Research on Policy environment evaluation of scientific and technological innovation talents based on fuzzy comprehensive evaluation: Data from Henan Province. Science and Technology Management Research, 2013, 33(11): 83-87.

[24] Si Jiangwei, Chen Jingjing. Study on 《Five-in-one》 Environmental Evaluation Index System for Talent Development [J]. Science and Technology Management Research, 2015, 35(2): 27-30+57.

[25] Wang Huijie, BI Fanfan, Dong Zhanfeng. Performance evaluation of ecological compensation policy in Xin ’an River Basin based on AHP-Fuzzy comprehensive evaluation method [J]. Acta Ecologica Sinica, 2020, 40(20): 7493 -- 7506.