

Construction of an Evaluation Index System for Talent Attraction in County-Level Characteristic Industrial Clusters

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Abstract: ***Objective:** This study aims to evaluate the talent attractiveness of county-level specialized industrial clusters and their influencing mechanisms, and to explore talent strategies for promoting county economic transformation and rural revitalization. **Methods:** Based on expert survey data, this study employs the Analytic Hierarchy Process (AHP) to construct an evaluation system comprising five dimensions—industrial agglomeration, innovation ecosystem, environmental support, policy services, and stakeholder adaptability—and 25 secondary indicators, in order to systematically assign weights and conduct comparative analysis of talent attraction in county-level characteristic industrial clusters. **Conclusions:** 1) Stakeholder adaptability and industrial agglomeration occupy a central position in the overall evaluation system, with institutional efficiency and policy continuity playing a significant role in reducing frictions in talent mobility. 2) Living environment and public services are key factors for long-term talent retention. 3) The innovation ecosystem has a crucial impact on the sustainability of talent attraction and the optimization of talent structure.*

Keywords: County-level characteristic industrial clusters; Talent attraction; Evaluation index system; Analytic Hierarchy Process (AHP).

1. INTRODUCTION

The report of the 20th National Congress of the Communist Party of China proposed to comprehensively advance the great rejuvenation of the Chinese nation through Chinese-style modernization. As a fundamental unit of the national economy, the high-quality development of county economies is crucial to the overall process of Chinese-style modernization [1]. Building industrial clusters to promote high-quality economic development has become a widely recognized strategy [2][3]. Industrial clusters not only serve as a key support for optimizing county-level economic structures and enhancing competitiveness but also act as an important vehicle for promoting comprehensive rural revitalization and achieving urban-rural integrated development [4]. Unlike general industrial clusters, county-level characteristic industrial clusters are rooted in the resource endowments and cultural traditions of specific regions, and their development logic lies in overcoming inherent resource constraints at the county level and enhancing the value chain through specialized division of labor and collaborative innovation [5].

Talent is the primary and core driving force behind the innovation and upgrading of industrial clusters. Endogenous growth theory posits that advanced production factors, represented by human capital, are decisive for achieving sustained regional growth [6][7]. The quantity and quality of talent, particularly their alignment with industrial demands, directly determine the knowledge spillover effects, technology absorption capacity, and ultimately the innovation performance of county-level industrial clusters. However, constrained by factors such as location, public services, and development platforms, counties face challenges including the inability to attract high-end talent, retain skilled workers, and cultivate local talent [8], which hinders the sustainable development of county-level characteristic industrial clusters.

Therefore, addressing the insufficiency of talent attraction is key to transforming the driving forces of county economies. To systematically tackle this issue, it is first necessary to scientifically define and measure the core concept of “talent attraction”. Existing studies have largely focused on the evaluation of talent attraction at the city or regional level [9][10], or on analyzing influencing factors from a single dimension, such as compensation or environment, lacking systematic research specific to county-level characteristic industrial clusters. In the county context, the structure of talent demand, mobility preferences, and the components of attractiveness all have unique characteristics. In this regard, the central question of this study is: how can an evaluation index system be constructed that comprehensively and accurately reflects the level of talent attraction in county-level characteristic industrial clusters? By developing such a system, this study aims to provide decision-making support and reference for government and industry-related departments, precisely identify gaps in attracting, cultivating, and retaining

talent, and thereby offer theoretical support and practical guidance for optimizing talent policies and enhancing the core competitiveness of county-level industries.

2. RESEARCH METHODS

The Analytic Hierarchy Process (AHP) is a multi-criteria decision-making method developed by Thomas L. Saaty in the 1970s, initially designed to address complex plannings and prioritization problems [11]. It is now primarily used to conduct structured analyses of complex decision-making issues, systematizing, hierarchizing, and quantifying them [12]. In this study, the AHP method is employed to assign weights to the evaluation index system for talent attraction in county-level characteristic industrial clusters. This method allows for the systematic determination of the importance of each indicator by combining qualitative judgments with quantitative calculations. The specific steps are as follows:

2.1 Establishing the Hierarchical Structure Model

Based on the research objectives and the logical structure of the index system, the decision-making goal, criteria layer, and indicator layer are expanded hierarchically according to their affiliations to construct a three-level hierarchical structure model: goal layer – criteria layer – indicator layer. The goal layer represents the level of talent attraction in county-level characteristic industrial clusters; the criteria layer includes five dimensions: industrial agglomeration, innovation ecosystem, environmental support, policy services, and stakeholder adaptability; and the indicator layer is further detailed into 25 specific evaluation indicators.

2.2 Constructing the Pairwise Comparison Matrix

Through expert questionnaire surveys, scholars and experts in the fields of regional economy, industrial development, and talent policy were invited to conduct pairwise comparisons of indicators at the same hierarchical level with reference to Saaty's 1–9 scale (Table 1), thereby constructing the pairwise comparison matrix. The matrix elements represent the relative importance of one factor compared to another and satisfy the reciprocal principle, that is $a_{ij} = 1/a_{ji}$ [13].

Table 1: Saaty 1–9 scale

Scale	Meaning
1	Indicates that the two factors are equally important
3	Indicates that one factor is slightly more important than the other
5	Indicates that one factor is obviously more important than the other
7	Indicates that one factor is strongly more important than the other
9	Indicates that one factor is extremely more important than the other
2,4,6,8	Intermediate values between the adjacent judgments above
Reciprocal	If the judgment of factor i compared to factor j is a_{ji} , then the judgment of factor j compared to factor i is $1/a_{ji}$

2.3 Computing the Local Priority and Consistency Check

After obtaining the pairwise comparison matrix, the eigenvalue method is used to calculate the maximum eigenvalue and its corresponding eigenvector. The eigenvector is then normalized to obtain the weights of indicators at the same hierarchical level relative to the upper-level indicators, which constitutes the local priority results. Considering that expert judgments may contain deviations, a consistency check is required. The evaluation is conducted by calculating the consistency index (CI) and the consistency ratio (CR) as follows:

$$CI = \frac{\lambda_{\max} - n}{n - 1}, CR = \frac{CI}{RI} \quad (1)$$

In this formula, λ_{\max} is the maximum eigenvalue of the judgment matrix, n is the order of the matrix, and RI is the random consistency index. When $CR < 0.1$, the judgment matrix is considered to have satisfactory consistency, and the weight results are reliable; when $CR \geq 0.1$, the judgment matrix needs to be adjusted and recalculated [14].

2.4 Computing the Global Priority and Consistency Check

After completing the local priority calculations for each level, the weights are propagated layer by layer to obtain the global priority weights of all indicators relative to the goal layer. Specifically, the weights of the criteria layer are multiplied by the local weights of the indicator layer to calculate the comprehensive weights of the secondary indicators. Subsequently, a consistency check is performed on the global priority results, using the same method as for the local priorities. When $CR < 0.1$, the hierarchical structure model is considered to have reasonable consistency, and the resulting weight allocation can be accepted [15].

3. CONSTRUCTION OF THE EVALUATION INDEX SYSTEM FOR TALENT ATTRACTION IN COUNTY-LEVEL CHARACTERISTIC INDUSTRIAL CLUSTERS

3.1 Indicator System Framework

The construction of the evaluation index system for talent attraction in county-level characteristic industrial clusters is based on the theoretical frameworks of modern regional economics and talent geography, integrating the core concepts of Complex Adaptive Systems (CAS) theory. The development of this index system takes into account the characteristics of industrial clusters as open systems, in which elements within the system (enterprises, talent, institutions) interact nonlinearly to generate synergistic effects. From a theoretical perspective, this index system first upgrades the static analysis in traditional location theory to a dynamic adaptive analysis, capturing the continuous interaction between system agents (talent) and their environment; second, it overcomes the limitations of single economic indicators by establishing a comprehensive evaluation framework encompassing five dimensions: industry, innovation, environment, policy, and stakeholder adaptability; third, it innovatively translates the concept of “identity” from CAS theory into operational indicators, such as cultural identification [16].

3.2 Framework of the Index System

Following the principles of systematicness, scientific rigor, and operability, a three-level progressive structure—goal layer, criteria layer, and indicator layer—was adopted, comprising five primary indicators and 25 secondary indicators.

The goal layer represents the level of talent attraction in county-level characteristic industrial clusters. The criteria layer includes five dimensions—industrial agglomeration, innovation ecosystem, environmental support, policy services, and stakeholder adaptability—covering the key factors for attracting talent. Specifically, industrial agglomeration is measured by five indicators: cluster scale, completeness of the industrial chain, industry specialization, leading enterprise driving effect, and market coverage; the innovation ecosystem is measured by R&D investment intensity, density of industry–university–research collaboration, quality of innovation carriers, technology market activity, and patent output efficiency; environmental support is measured by the completeness of production infrastructure, adequacy of living infrastructure, quality of public services, adaptability of living costs, and ecological environment quality; policy services are measured by precision of talent policies, administrative approval efficiency, level of digital governance, intensity of financial support, and policy continuity; stakeholder adaptability is measured by enterprise employment flexibility, talent mobility, learning and innovation capability, government–enterprise coordination, and cultural identification.

3.2.1 Industrial Agglomeration

Industrial agglomeration is a fundamental prerequisite for evaluating talent attraction. It reflects the scale, structure, and market influence of county-level characteristic industrial clusters, directly determining employment capacity, career pathways, and salary expectations for talent. A highly concentrated cluster with a complete industrial chain and leading enterprises can generate economies of scale and scope, providing ample high-quality positions for various types of talent, thereby forming the core material basis of talent attraction.

It is measured by five indicators: cluster scale, completeness of the industrial chain, industry specialization, leading enterprise driving effect, and market coverage.

3.2.2 Innovation Ecosystem

The innovation ecosystem is central to assessing the sustainability of talent attraction. It reflects a cluster's ability to transition from an "input-driven" to an "innovation-driven" model, determining the growth opportunities and value realization potential for talent, particularly high-level innovative talent. A dynamic innovation ecosystem can continuously stimulate creativity, facilitate the production, dissemination, and application of knowledge, and serve as a key mechanism for attracting talent and transforming it into core competitiveness.

It is measured by five indicators: R&D investment intensity, density of industry–university–research collaboration, quality of innovation carriers, technology market activity, and patent output efficiency.

3.2.3 Environmental Support

Environmental support is a necessary prerequisite for evaluating talent attraction. It encompasses both the hardware infrastructure and software-based public services required for work and daily life, serving as a critical factor in talent decisions on whether to stay. Compared with large cities, counties often face deficiencies in environmental support; therefore, improving this dimension is crucial for addressing the challenges of attracting and retaining talent.

It is measured by five indicators: completeness of production infrastructure, adequacy of living infrastructure, quality of public services, adaptability of living costs, and ecological environment quality.

3.2.4 Policy Services

Policy services are an important catalyst for evaluating talent attraction. They reflect the role and service orientation of local governments in talent-related work. Precise, effective, convenient, and stable policies and services can compensate for the shortcomings of counties in market-driven attractiveness, creating a favorable environment that values business and talent, and directly demonstrating the proactive role of government in talent competition.

It is measured by five indicators: precision of talent policies, administrative approval efficiency, level of digital governance, intensity of financial support, and policy continuity.

3.2.5 Stakeholder Adaptability

Stakeholder adaptability is a deep-seated driver for evaluating talent attraction. It goes beyond static environmental and policy factors, focusing on the dynamic interactions and co-evolution among key actors within the cluster, including talent, enterprises, and government. This dimension embodies the core principles of Complex Adaptive Systems (CAS) theory, measuring internal coordination efficiency, learning capacity, and cultural integration, and is critical for determining whether the cluster's attractiveness can be transformed from "external pull" into "endogenous motivation."

It is measured by five indicators: enterprise employment flexibility, talent mobility, learning and innovation capability, government–enterprise coordination, and cultural identification.

Table 2: Evaluation Index System for Talent Attraction in County-Level Characteristic Industrial Clusters in Hebei Province

Goal Layer	Criteria Layer	Indicator Layer	Indicator Definition and Measurement Method
Level of Talent Attraction in County-Level Characteristic Industrial Clusters	Industrial Agglomeration A1	Cluster Scale B1	Number of Cluster Enterprises per County Area (enterprises/km ²)
		Completeness of the Industrial Chain B2	Proportion of Upstream and Downstream Supporting Enterprises (%)
		Industry Specialization B3	Location Quotient
		Leading Enterprise Driving Effect B4	Proportion of Leading Enterprise Output to Total Cluster Output (%)
		Market Coverage B5	Proportion of Products Sold Across Provinces (%)
	Innovation Ecosystem A2	R&D Investment Intensity B6	R&D Expenditure as a Proportion of Operating Revenue (%)
		Density of Industry–University–Research Collaboration B7	Number of University–Enterprise Joint Projects per Large and Medium-Sized Enterprise (projects/enterprise)
		Quality of Innovation Carriers B8	Number of Provincial-Level or Above R&D Platforms (units)
		Technology Market Activity B9	Technology Contract Turnover/GDP (10 ⁴ CNY/10 ⁸ CNY)
		Patent Output Efficiency B10	Number of Invention Patents per 10 ⁸ CNY Revenue (patents/10 ⁸ CNY)
	Environmental Support A3	Level of Production Infrastructure B11	Standardization Level of Industrial Parks (score 1–5)
		Adequacy of Living Infrastructure B12	Coverage of 15-Minute Living Circle (%)
		Quality of Public Services B13	Amount of Educational and Medical Resources per 104 People (units/104 people)
		Adaptability of Living Costs B14	House Price-to-Income Ratio (average housing price / per capita disposable income)
		Ecological Environment Quality B15	Proportion of Days with Good Air Quality (%)
	Policy Services A4	Precision of Talent Policies B16	Alignment of Policy Provisions with Industry Needs (expert score 1–5)
		Administrative Approval Efficiency B17	Average Processing Time of Government Service Items (working days)
		Level of Digital Governance B18	Online Processing Rate of Government Service Items (%)
		Intensity of Financial Support B19	Proportion of Talent-Specific Funds in Fiscal Expenditure (%)
		Policy Continuity B20	Duration of Stability of Core Talent Policies (years)
	Stakeholder Adaptability A5	Enterprise Employment Flexibility B21	Average Response Time for Key Position Adjustments (days)
		Talent Mobility B22	Annual Talent Inflow–Outflow Ratio (inflow/outflow)
		Learning and Innovation Capability B23	Average Annual Training Hours per Employee (hours/person)
		Government–Enterprise Coordination B24	Annual Number of Government–Enterprise Joint Talent Projects (units)
		Cultural Identification B25	Number of Inheritors of Characteristic Industrial Culture (persons)

4. DETERMINATION OF INDICATOR WEIGHTS IN THE EVALUATION SYSTEM BASED ON THE ANALYTIC HIERARCHY PROCESS (AHP)

The AHP method was applied to assign weights to the previously proposed evaluation index system for talent attraction in county-level characteristic industrial clusters. Decision goals, participating elements, and decision objects were organized hierarchically according to the “goal layer—criteria layer—alternative layer” sequence to construct a hierarchical structure model. In this model, indicators at the same layer belong to or influence indicators at the upper layer, while simultaneously governing or being affected by indicators at the lower layer.

In this study, the goal layer is “talent attraction in county-level characteristic industrial clusters”, the criteria layer comprises five dimensions—industrial agglomeration, innovation ecosystem, environmental support, policy services, and stakeholder adaptability—and the alternative layer consists of the specific secondary indicators under each dimension. During the construction of the judgment matrix, ten experts in regional economics, industrial clusters, and talent policy were invited to perform pairwise comparisons of the importance of indicators at each layer, using a 1–9 scale. Since judgments may vary among experts, the geometric mean method was applied to aggregate the ten experts’ evaluations, forming the final judgment matrix.

Let the set of indicators be $X = \{x_1, x_2, \dots, x_n\}$, and the corresponding judgment matrix $A = (a_{ij})_{n \times n}$ is constructed as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad (2)$$

In this formula, a_{ij} represents the importance of indicator x_i relative to x_j , satisfying $a_{ij} = 1/a_{ji}$, $a_{ii} = 1$. When m experts participate in the evaluation, the geometric mean of the matrix elements is calculated as follows:

$$a_{ij} = \left(\prod_{k=1}^m a_{ij}^{(k)} \right)^{1/m} \quad (3)$$

The resulting aggregated judgment matrix can more comprehensively reflect the opinions of the expert group [17].

Subsequently, the eigenvalue method was used to calculate the maximum eigenvalue of the judgment matrix and its corresponding eigenvector, thereby determining the weights of each indicator. The calculation steps are as follows:

Calculate the product of the elements in each row:

$$M_i = \prod_{j=1}^n a_{ij}, \quad (i = 1, 2, \dots, n) \quad (4)$$

Take the n -th root:

$$W'_i = (M_i)^{1/n} \quad (5)$$

Normalize:

$$W_i = \frac{W'_i}{\sum_{j=1}^n W'_j} \quad (6)$$

The resulting $W = (W_1, W_2, \dots, W_n)$ represents the weight vector of the indicators [18].

Table 3: Indicator Weights for Talent Attraction in County-Level Characteristic Industrial Clusters in Hebei Province

Goal Layer	Criteria Layer	Weight	Indicator Layer	Weight	Overall Weight
Level of Talent Attraction in County-Level Characteristic Industrial Clusters	Industrial Agglomeration A1	0.2272	Cluster Scale B1	0.1248	0.0284
			Completeness of the Industrial Chain B2	0.2713	0.0616
			Industry Specialization B3	0.1999	0.0454
			Leading Enterprise Driving Effect B4	0.1858	0.0422
			Market Coverage B5	0.2183	0.0496
			R&D Investment Intensity B6	0.2176	0.0421
	Innovation Ecosystem A2	0.1936	Density of Industry–University–Research Collaboration B7	0.2048	0.0396
			Quality of Innovation Carriers B8	0.1829	0.0354
			Technology Market Activity B9	0.2054	0.0398
			Patent Output Efficiency B10	0.1894	0.0367
			Level of Production Infrastructure B11	0.1377	0.0226
	Environmental Support A3	0.1641	Adequacy of Living Infrastructure B12	0.2345	0.0385
			Quality of Public Services B13	0.1717	0.0282
			Adaptability of Living Costs B14	0.2089	0.0343
			Ecological Environment Quality B15	0.2472	0.0406
			Precision of Talent Policies B16	0.1123	0.0205
			Administrative Approval Efficiency B17	0.2760	0.0505
	Policy Services A4	0.1829	Level of Digital Governance B18	0.2160	0.0395
			Intensity of Financial Support B19	0.1763	0.0322
			Policy Continuity B20	0.2193	0.0401
			Enterprise Employment Flexibility B21	0.1583	0.0368
	Stakeholder Adaptability A5	0.2322	Talent Mobility B22	0.2147	0.0499
			Learning and Innovation Capability B23	0.2285	0.0531
			Government–Enterprise Coordination B24	0.1982	0.0460
			Cultural Identification B25	0.2004	0.0465

Table 3 presents the AHP weight results for talent attraction in county-level characteristic industrial clusters. At the criteria layer, stakeholder adaptability and industrial agglomeration dominate, indicating that the conditions for industrial development and the career growth pathways of talent together form the core drivers of talent attraction. Although innovation ecosystem, policy services, and environmental support rank slightly lower, they play critical supporting roles in innovation-driven development, institutional guarantees, and living conditions. At the indicator layer, factors such as completeness of the industrial chain, administrative approval efficiency, ecological environment quality, and learning and innovation capability stand out in terms of weight, reflecting that job quality, institutional efficiency, living environment, and talent development expectations are key variables determining talent recruitment and retention. Overall, the evaluation results reveal a multi-dimensional structure of county-level talent attraction, characterized by industry and stakeholders as core drivers, institutions and environment as necessary supports, and innovation as a sustaining force, providing a scientific basis for subsequent empirical research and policy optimization.

5. RESEARCH CONCLUSIONS

This study constructed an evaluation index system for talent attraction in county-level characteristic industrial clusters based on the AHP method. Through expert scoring and hierarchical weighting, it systematically reveals the multi-dimensional composition and mechanisms of talent attraction. The main conclusions are summarized in the following four aspects:

First, the interaction between industry and stakeholders forms the core support for talent attraction. At the criteria layer, industrial agglomeration and stakeholder adaptability have the highest weights, indicating that the level of industrial development and the intrinsic motivation of talent play decisive roles in attracting and retaining talent. At the indicator layer, factors such as completeness of the industrial chain, market coverage, enterprise flexibility in employment, learning and innovation capability, and talent mobility stand out. This suggests that to enhance talent attraction at the county level, it is necessary to extend and optimize industrial chains, increase market openness, and simultaneously stimulate the flexibility and learning capacity of both enterprises and talent, thereby creating a mutually reinforcing cycle between industrial development and talent growth.

Second, institutional provision and policy implementation efficiency are key guarantees for talent mobility. Although the policy services dimension ranks below industry and stakeholders, indicators such as administrative approval efficiency, policy continuity, and digital governance carry relatively high weights. This indicates that in the county-level talent attraction context, the convenience and stability of institutions can significantly reduce the costs of talent mobility and enhance a sense of belonging and long-term commitment. This suggests that county governments, in attracting talent, should not only formulate policies but also ensure their precision, efficient execution, and sustained stability.

Third, living environment and public services are long-term factors determining whether talent can be retained. Although the environmental support dimension has a relatively low overall weight, indicators such as ecological environment quality, completeness of residential infrastructure, and affordability of living costs rank highest within this dimension, highlighting that the comfort of the living environment and the level of public services are critical considerations for talent's long-term decisions. If counties continuously improve infrastructure, enhance public services, and adjust living costs, they can help transform the situation of "easy to attract, hard to retain" talent.

Fourth, the innovation ecosystem is a deep-seated driver shaping the sustainability of talent attraction. The prominence of indicators such as R&D intensity, activity in the technology market, and patent output efficiency reflects that the innovation environment not only affects the recruitment of high-level talent but also influences the optimization of the overall talent structure and the formation of long-term competitiveness. Counties that establish comprehensive innovation platforms and promote deep integration of industry, academia, and researches can continuously enhance their attractiveness to innovative talent through knowledge spillover effects.

In summary, the formation of talent attraction in county-level characteristic industrial clusters depends not only on the "hard support" provided by the interaction between industry and talent, but also on the "soft guarantees" of policy and environment, ultimately achieving endogenous enhancement through innovation-driven development. This conclusion reveals a systematic pathway for improving county-level talent attraction: industry as the foundation, stakeholders as the core, institutions as the guarantee, environment as the support, and innovation as the driving force. The study provides methodological support for the quantitative evaluation of talent attraction at the county level and offers practical insights for local governments and industrial cluster managers to optimize talent recruitment strategies and promote high-quality county economic development.

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