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Article

Compiling a Domestic Catalogue of Scarce Talent: Principles, Methods, and an Index System

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Abstract: Under China's strategy for building a strong talent base in the new era, regional imbalances between talent supply and demand have become increasingly pronounced. Drawing on a literature review, field research, and a mixed qualitative–quantitative design, this study defines three core concepts—talent shortage, the talent shortage index, and the degree of shortage—and develops an integrated model centered on the talent shortage index. Expert-panel consultation, a structured questionnaire, and the analytic hierarchy process are combined to establish the indicator set and criterion weights, enabling the shortage severity of each occupation to be graded consistently. The proposed framework identifies shortage levels across industries and provides a basis for dynamic workforce adjustment and strategic planning. Finally, the study offers policy recommendations, including stronger interdepartmental data sharing and a standardized mechanism for publishing index weights. Together, these measures can improve the validity and practical value of catalogue compilation and help governments and enterprises allocate regional human resources more effectively.

Keywords: talent shortage; talent shortage index; catalogue of scarce talent; expert-panel consultation; analytic hierarchy process; index system

1. Introduction

Under China's strategy for building a strong talent base in the new era, establishing major global talent centers and innovation hubs and refining the strategic distribution of talent have become key priorities. This distribution must keep pace with the integration of the new technological revolution and industrial transformation while identifying strategic priorities and critical bottlenecks. Such alignment is essential for optimizing human resources across regions, sectors, and industries. As a core driver of technological innovation and high-quality economic development, talent underpins the adoption and application of advanced technologies [1]. Local governments have increasingly shifted from broad talent-attraction policies toward specialized talent hubs and from broad-based recruitment toward targeted support for strategic industries [2]. Accordingly, talent planning must be integrated more closely with regional and industrial development strategies. However, industrial homogeneity and weak collaboration along the innovation chain continue to undermine systemic coordination in regions pursuing coordinated development. Consequently, government and market actors have difficulty assessing talent demand, evaluating talent development conditions, and designing evidence-based policies. It is therefore necessary to develop rigorous measures for identifying talent shortages, maintain systematic inventories of scarce talent, reflect industry-specific needs objectively, optimize human resource allocation, and promote the coordinated development of industry and talent. This study responds to that need by examining the methods, and index system used to compile a domestic catalogue of scarce talent.

2. Concepts, Theoretical Foundations, and Basic Principles

2.1. Defining Core Concepts

2.1.1. Talent Shortage

Talent shortage refers to a situation in which demand for a particular category of talent in a specific field or industry consistently exceeds supply, resulting in skill deficits and recruitment challenges [3]. The concept encompasses professional competencies, occupational categories, educational qualifications, and domain-specific experience. To enable systematic measurement, some national statistical and labor authorities have established formal definitions and operational criteria. One widely referenced framework distinguishes three related manifestations. First, a skill shortage occurs when vacancies remain unfilled despite prevailing market wages and working conditions over an extended period. Second, a skill gap or mismatch occurs when incumbent workers lack the qualifications, experience, or specialized capabilities required for emerging roles. Third, recruitment difficulty is characterized by prolonged vacancies and greater employer effort to source suitable candidates. In China, Ningbo City in Zhejiang Province pioneered the issuance of a local scarce talent catalogue; its definition emphasizes two core elements: temporal urgency—or immediate demand within a defined period—and quantitative imbalance—a demonstrable shortfall between required and available talent.

2.1.2. The Talent Shortage Index and Its Calculation

The talent shortage index is a dynamic relative measure of the state of talent resources [4]. It characterizes the overall talent situation within a country or region over a specified period and enables comparisons across regions and talent categories.

Two main methodological frameworks are currently used in China to quantify the talent shortage index. The first is grounded in labor-market supply–demand dynamics; it compares supply-side evidence, such as talent registrations and job applications, with demand-side evidence, such as newly posted positions, CV downloads, and instant messages, before applying a standardized algorithm to calculate the degree of scarcity during a defined period. Within this framework, a value above 1 indicates that demand exceeds supply, a value below 1 indicates that supply exceeds demand, and an upward trend signals intensifying competition for talent and greater recruitment difficulty [4]. The second approach constructs a weighted composite index with five dimensions: talent quantity, talent quality, talent supply capacity, the talent development environment, and industrial development capacity. Talent quantity and quality assess whether the existing talent stock meets current needs at the regional, industrial, or enterprise level, whereas the remaining dimensions capture how far policy support, industrial capacity, and the broader talent ecosystem can attract, absorb, and retain scarce talent.

2.1.3. The Degree of Talent Shortage

The degree of talent shortage is determined by assigning the index to predefined bands. For example, values in [0, 0.2), [0.2, 0.5), and [0.5, 1] are classified as "generally scarce," "scarce," and "very scarce," respectively, with higher values indicating more acute shortages. For clarity, some cities use star ratings (for example, three to five stars) or red–orange–yellow color schemes to represent escalating levels of scarcity [5].

2.1.4. The Catalogue of Scarce Talent

The catalogue of scarce talent (hereinafter "the catalogue") is a systematically compiled reference document that summarizes current talent shortages across sectors [6]. Its core fields include region, industry, occupational category (including position title and core responsibilities), required qualifications (such as educational background, professional experience, academic discipline, and competencies), typical annual remuneration, shortage index, and shortage severity. Compiling and periodically publishing the catalogue clarifies concrete demand for scarce talent in strategic regional industries, thereby informing targeted strategies for talent development, recruitment, and retention. It serves as a reference for government agencies designing and

implementing talent-related policies, supports human resource planning in enterprises and public institutions, guides curriculum optimization within the education system, and assists professionals in career selection, employment decisions, and skill enhancement. Occupational entries follow the national occupational classification, which is revised periodically. The 2022 edition records 1,639 occupations, of which 97 are identified as digital occupations; catalogue codes must therefore be realigned whenever the classification is updated [16].

Compiling a catalogue of scarce talent therefore requires clear definitions of talent shortage, the talent shortage index, and shortage severity, as well as rigorous use of the index as the central quantitative measure.

2.2. Theoretical Foundations

Research on "shortage" derives from economic supply and demand theory, whereas research on "talent" and "positions" falls primarily within management. Compiling and publishing China's domestic catalogue of scarce talent therefore reflects an interdisciplinary integration of economics and management.

First, from a supply-and-demand perspective, the catalogue aims to redress imbalances between talent supply and demand. By systematically analyzing gaps across sectors, it identifies priority fields and industries affected by shortages, enabling more precise alignment of talent development, recruitment, and attraction efforts [7].

Second, human capital theory identifies human capital as a core driver of productive capacity, with its development, allocation, and investment directly supporting technological advancement and sustainable economic growth [8], [9]. Accordingly, targeted development of scarce talent, more efficient allocation, and stronger worker initiative provide the human-capital foundation for the catalogue.

Third, talent allocation theory suggests that a rational distribution of talent across industries and regions is essential for unlocking innovative potential, alleviating structural bottlenecks, and supporting high-quality economic development. The theory also informs the human resource development priorities reflected in the catalogue [10].

2.3. Basic Principles

2.3.1. Industry Orientation

Compilation is guided by industrial development. When compiling the catalogue for the Guangdong–Hong Kong–Macao Greater Bay Area, for example, the current economic conditions and industrial development plans of the nine Pearl River Delta cities are taken into account. The process focuses on Guangdong Province's "Double Ten" industrial clusters in order to direct the flow and aggregation of talent toward emerging pillar industries, including next-generation information technology, biotechnology, high-end equipment manufacturing, new materials, and new energy. This orientation supports the region's development into a global innovation hub and a major source of emerging industries.

2.3.2. Scientific Rigor

The compilation uses a mixed-methods approach—including policy analysis, field visits and expert-panel consultations, structured questionnaires, and big-data analytics—to map the current human resource structure across key industries and track talent demand. The foundational research draws on large-sample empirical analysis and comprehensive data infrastructure. Industry and occupational classification follows the national Standard Industrial Classification for National Economic Activities, supplemented by regional industrial cluster characteristics and local competitive advantages to determine enterprise sectoral affiliation. Scarce positions are further categorized according to the national Dictionary of Occupational Classification, strengthening methodological rigor and analytical consistency.

2.3.3. Practical Application

Compilation prioritizes the urgent talent demands of key industries. Respondent enterprises include high-tech firms, specialized, refined, distinctive, and innovative

(SRDI) firms, and enterprises above the designated size. The scope focuses on current human resource conditions in key regional industries and on positions facing acute talent shortages. General functional roles—including sales, administration, finance, and legal affairs—are excluded; only high-level and highly skilled personnel in strategic sectors are retained. This focus improves the practical relevance of the assessment to the Greater Bay Area's industrial talent landscape.

2.3.4. Prospective Development Guidance

Guided by market dynamics and aligned with the region's current talent landscape, the catalogue applies a talent shortage index evaluation system to provide forward-looking insights into demand for key positions and specialized talent and to forecast regional recruitment trends for the coming year [11]. These analyses directly support evidence-based decisions concerning talent attraction, development, deployment, and retention.

3. Methods for Compiling the Domestic Catalogue of Scarce Talent

The compilation of the domestic catalogue of scarce talent employs three primary research methods: literature review, field research, and integrated qualitative–quantitative analysis. The study reviewed official statistics, designed and distributed self-administered questionnaires, and conducted structured and unstructured interviews. All collected materials were analyzed using statistical and qualitative methods.

3.1. Literature Review

Compiling the catalogue requires extracting information on industries, talent, and positions from existing literature to develop a comprehensive and accurate understanding of national standards, official statistics, and related materials. These sources provide the basis for industrial classification, position evaluation, and construction of the talent shortage index system. For the Greater Bay Area catalogue, for example, the study reviewed the Outline Development Plan for the Guangdong–Hong Kong–Macao Greater Bay Area [17], the Outline of the 14th Five-Year Plan for National Economic and Social Development of Guangdong Province and the Long-Range Objectives Through the Year 2035 [18], the 14th Five-Year Plan for the High-Quality Development of Manufacturing in Guangdong Province [19], and the local five-year plans, specialized industrial plans, talent strategies, and related policies of the nine Pearl River Delta cities. This review provided the context for targeted research on 20 key industries.

3.2. Field Research

Field research primarily used questionnaires, telephone interviews, on-site visits, and structured discussions with relevant government departments and key organizations. For the Greater Bay Area catalogue, the questionnaire covered four dimensions: current enterprise conditions, current talent conditions, enterprise talent demand, and the talent ecosystem. An online reporting system was developed to collect responses, and a mixed sampling approach was used to survey urgent talent needs among enterprises in key industries across the nine Pearl River Delta cities. On-site visits and structured discussions deepened understanding of industrial development trends, enterprise talent requirements, the extent and causes of shortages, and recruitment challenges. They also captured practical feedback on talent policy and implementation, thereby complementing the quantitative survey data.

3.3. Combining Quantitative and Qualitative Methods

The catalogue integrates quantitative and qualitative research approaches. Valid survey data are analyzed alongside established frameworks of labor demand and supply and human capital development. A talent shortage index system was constructed around local priorities for scarce talent using three core dimensions: recruitment difficulty, recruitment urgency, and recruitment cycle. Analytical methods, including the analytic hierarchy process (AHP), principal component analysis, and regression analysis, were

implemented with Python-based tools. The analyses also incorporate aggregated, anonymized recruitment data from major online platforms. The final catalogue identifies key industries and specifies scarce occupational positions that require targeted policy attention.

4. Talent Shortage Model, Data Analysis, and Early-Warning System

Research on shortage-index construction indicates that provincial reports on scarce talent commonly follow five steps: selecting a foundational method; defining indicators for the shortage index; developing the model; determining weights through quantitative and qualitative methods; and classifying shortage severity (Figure 1).

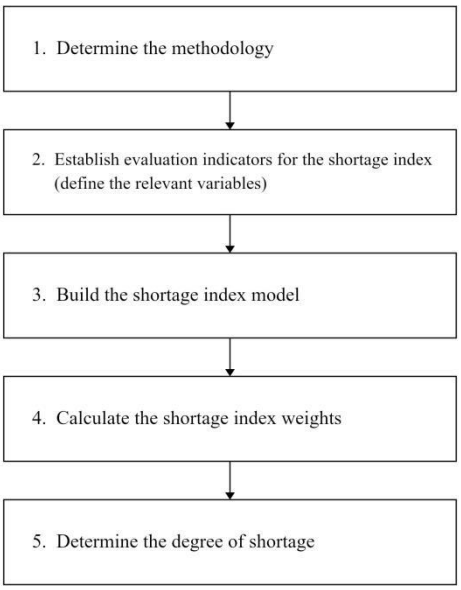


Figure 1. Steps in Constructing the Shortage Index System

Consistent with the mixed-methods framework outlined above, the index system uses quantitative forecasting as its primary analytical tool and expert-panel judgment as a complement [12], [13]. The following sections address the formulation of evaluation indicators, the development of the shortage index model, and the calculation of indicator weights.

4.1. Establishing Evaluation Indicators for the Shortage Index

Considering industrial development, the characteristics of the large-sample survey data, and the requirements of feasibility, effectiveness, and relevance, the research team used an expert-panel consultation to establish three primary indicators of shortage urgency for a position: recruitment difficulty, recruitment urgency, and recruitment cycle. The consultation comprised two expert-panel meetings and a subsequent structured questionnaire round. Because these indicators are closely tied to talent services, and drawing on theories of human motivation and workplace satisfaction, four secondary dimensions—working environment, living environment, talent policy, and government services—were included in theoretical and correlation analyses but excluded from the quantitative model. From a macro perspective, however, talent shortage also reflects a broader imbalance in systemic coordination. Sustainable alignment of regional talent supply and demand therefore depends on coordinated progress in talent development, technological innovation, and economic growth. Macro-level coordination indicators—including GDP, industrial R&D investment, and industrial output value—may therefore be useful as supplementary analytical references or early-warning signals in future research.

4.2. Building the Shortage Index Model

Two index models are currently used in Chinese research on scarce talent. The first determines the weights of first-level indicators through expert-panel consultation and a structured questionnaire. To improve the rigor of the AHP assessment, panelists received supplementary materials on local economic conditions with the questionnaire, enabling more informed judgments. Through theoretical analysis and empirical validation, the research team developed the hierarchical framework of comprehensive indicators for assessing urgently needed positions shown in Figure 2. The second model employs quantitative approaches—the distance-to-frontier method, correlation analysis, and five-level classification—to construct a talent shortage index comprising five first-level indicators (talent quantity shortage index, talent quality shortage index, talent supply shortage index, industrial development index, and talent development environment index), nine second-level indicators, and 35 specific metrics. The talent shortage index serves as the core analytical component of the scarce talent catalogue and functions both as an employment barometer and as a key measure of enterprise recruitment difficulty.

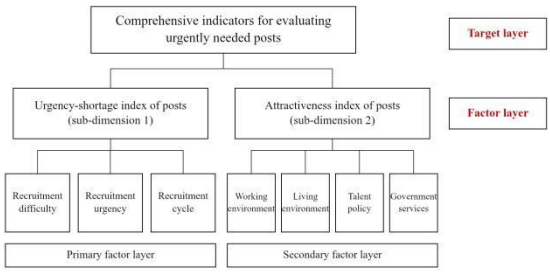


Figure 2. Hierarchical Model of Comprehensive Indicators for Assessing Scarce Positions

4.3. Calculating the Shortage Index Weights and Determining the Degree of Shortage

Pairwise comparisons at the first-level indicator layer were elicited using Saaty's nine-point scale, ranging from 1 (equal importance) to 9 (extreme importance), with reciprocal values assigned to reverse comparisons [12]. A panel of 12 specialists from the research team, government human-resource departments, and surveyed enterprises participated. The three first-level indicators had been established through two expert-panel meetings; a single structured questionnaire round was then used to collect the pairwise judgments. Panelists received a briefing on the current performance of the Guangdong economy to reduce information asymmetry and ensure that their judgments were based on a common evidence framework. The process yielded 12 complete 3 × 3 judgment matrices. Each matrix was checked for reciprocal consistency, and corrections supported by the original responses were applied before analysis. All 12 matrices subsequently satisfied the conventional consistency threshold of $CR < 0.10$: 11 were perfectly consistent ($CR = 0.000$), and one had $CR = 0.0007$. For $n = 3$, $RI = 0.58$; consequently, $CI = (\lambda_{max} - n)/(n - 1)$ and $CR = CI/RI$ [12], [13]. The 12 matrices were then aggregated using element-wise geometric means. The resulting group matrix remained internally consistent ($\lambda_{max} \leq 3.02$, $CI \leq 0.0099$, $CR \leq 0.017$) and produced principal-eigenvector weights of approximately 0.358, 0.517, and 0.126 for recruitment difficulty, recruitment urgency, and recruitment cycle, respectively. The values shown are rounded; the unrounded normalized weights sum to unity. For occupation i, the shortage index is $Y_i = w_D D_i + w_U U_i + w_C C_i$ (i = 1, …, N), where D, U, and C are the corresponding 1–9 scores. To apply the severity bands defined in Section 2.1.3, the weighted score is rescaled as $I_i = (Y_i - 1)/8$, so that generally scarce, scarce, and very scarce positions correspond to $0 \leq I < 0.2$, $0.2 \leq I < 0.5$, and $0.5 \leq I \leq 1$, respectively. Regional conditions differ. In another provincial model, the AHP produced the talent shortage index $G = 0.4286s + 0.4286z + 0.1428w$, where s denotes the quantity shortage index, z the

quality shortage index, and w the stability shortage index. This framework supports systematic assessment and grading of talent shortage severity across targeted industries.

4.4. Data Collection and Analysis

Surveys of scarce talent generally select samples based on local socioeconomic conditions, strategic industrial planning, and sectoral priorities. Data-collection mechanisms for identifying scarce talent fall broadly into three categories. The first relies on routine government data collection, typically conducted by statistical bureaus through periodic enterprise reporting. The second is coordinated by regional human-resources departments, which work with relevant commissions, offices, and leading enterprises in key industries to design scientifically grounded sampling strategies; representative enterprises and institutions then complete structured questionnaires or participate in on-site investigations, thereby capturing current talent stock, demand profiles, and shortage severity. The third uses digital recruitment platforms and broader labor-market data. For example, the 2026 edition of the catalogue of in-demand skilled occupations issued in Hangzhou lists 35 occupations, including 23 emerging and 12 retained traditional occupations. Among the emerging occupations are artificial-intelligence trainers, industrial vision system operators, and unmanned aerial vehicle operators; part of the underlying data is generated through automated web-based aggregation [20], producing large-scale, detailed, and timely information.

Data analysis begins by mapping the distribution of scarce positions. First, industries experiencing the most acute talent shortages are identified using industry-oriented catalogues. Second, core occupational labels are extracted from scarce-position profiles to determine the most critically underserved job categories and functional roles. Third, the educational backgrounds, disciplinary domains, and specific academic majors required for these positions are examined. Finally, a comprehensive profile is established for each scarce position, including distributions of educational attainment, skill requirements, and salary levels.

4.5. Shortage Early-Warning Analysis

The index quantifies talent shortages by industry and occupation and provides the basis for an early-warning system. Research on talent-shortage early warning in China remains limited. At the application level, Ningbo became the first city in China to publish a city-level scarce talent index system and attach a red–orange–yellow warning signal to it in 2007 [14]. In that system, the index analysis and alarm subsystem was one of five components, alongside the indicator, data collection, index measurement, and policy subsystems. Scarcity was classified into five levels, with warning signals triggered according to the composite index value.

Causal analysis of persistent high-level warnings in fields such as integrated circuits and artificial intelligence suggests that insufficient talent supply alone does not explain them. Drawing on the composite-system coordination model proposed by Meng and Han [15], which measures the degree of coordination among the subsystems of a composite system, the principal cause lies in misalignment among economic development, technological innovation, and talent cultivation. Rapid local economic development raises demands on technological advancement, while university and enterprise training systems have not adapted sufficiently, producing a structural mismatch between workers' skill profiles and the requirements of industrial innovation. This systemic mismatch cannot be resolved in the short term through market-based recruitment alone; it requires government-led strategic coordination to remove barriers across the relevant subsystems.

5. Recommendations for Compiling the Domestic Catalogue of Scarce Talent

5.1. Selecting and Dynamically Adjusting Shortage Indicators

Existing domestic talent shortage index systems broadly capture supply–demand conditions across talent domains, yet they respond slowly to changing conditions.

Regional industrial development strategies vary considerably, producing pronounced differences in talent scarcity across locations and sectors. At the city-cluster level, as in the Chengdu–Chongqing Economic Circle, conventional frameworks are of limited use in compiling a targeted catalogue of talent demand. A more granular, context-sensitive approach to index construction is therefore necessary to represent current talent shortages across diverse regions and industries. Given persistent regional heterogeneity and inconsistent industrial classifications, indicator selection should explicitly account for variations in talent supply and demand across geography, sector, and occupation. Priority should be given to indicators that are comprehensive, representative, and comparable while minimizing redundancy and overlap, and occupation codes should be realigned whenever the national occupational classification is revised [16]. Moreover, subjective judgment in indicator selection, weighting, and interpretation can undermine objectivity. Standardized analytical and assessment tools should therefore be integrated systematically into index development.

5.2. Data Acquisition and Processing: Strengthening Data Sharing

Data-collection protocols and statistical methods vary across regions and administrative units, resulting in inconsistent data quality and reliability. Integrating multiple datasets is operationally challenging and requires rigorous validation to ensure accuracy, consistency, and completeness.

To strengthen data sharing, public authorities should broaden access to official datasets and establish a demand-driven, targeted, and inclusive data-sharing framework for identifying scarce talent. As stewards of public data infrastructure, government agencies are primarily responsible for transparent, timely, and equitable data dissemination.

Government departments should broaden the scope and geographic coverage of surveys, increase sample sizes, and analyze talent-demand signals across administrative and sectoral datasets in greater depth. This approach can support more granular and actionable insights into talent scarcity. Relevant institutions should also safeguard data integrity, impartiality, and methodological transparency, ideally by publicly documenting indicator calculation procedures and data-sourcing channels.

5.3. Determining and Disclosing Index Weights

The determination of weights strongly affects the accuracy and credibility of the index. Because different weight configurations can change rankings and conclusions, weights require careful justification based on each indicator's relative importance and influence. Analytical methods should therefore be used to derive and document weights transparently, with sensitivity analyses where feasible. A government-coordinated, multisource data-sharing mechanism should also be established to support periodic assessment and monitoring of the talent shortage index. This mechanism should regularly update and publicly disclose index weights, thereby supporting evidence-informed decisions by government agencies, enterprises, and labor-market participants and strengthening alignment between talent supply and industrial innovation needs.

5.4. Limitations and Future Directions

The multidimensional evaluation system developed in this study has limitations, including a restricted indicator scope and delayed responsiveness to changing conditions. Future frameworks should strengthen the coverage and timeliness with which they capture supply–demand dynamics; provide reliable references for policymakers, employers, and individuals; support more efficient talent allocation and matching; and contribute to sustainable economic and social development.

6. Conclusion

This study examined how China's catalogue of scarce talent is compiled and articulated the conceptual foundations, design principles, and methods on which such

catalogues depend. It makes three contributions. First, it clarifies the conceptual chain linking talent shortage, the talent shortage index, and the degree of shortage, and demonstrates that the index—rather than any single indicator—should serve as the central quantitative measure in catalogue compilation. Second, it shows that a workable catalogue requires a mixed-methods design: literature review and field research define its industrial and occupational scope, while structured surveys and expert-panel judgments provide the data and criterion weights needed for measurement. Third, it identifies three structural constraints that currently limit the usefulness of these catalogues: lagging indicator adjustment, fragmented data sources, and opaque weighting procedures.

The practical implications follow directly from these findings. A catalogue is only as useful as the data behind it and the transparency of its method. Reporting indicator weights, consistency diagnostics, and data-sourcing procedures would enable users to assess the reliability of the results and, where necessary, contest them on an informed basis. For policy, the priority is therefore not a more elaborate index but a more open and governable one, supported by interdepartmental data sharing, common metadata standards, and a standing mechanism for periodic revision.

Several limitations temper these conclusions. The quantitative model covers three recruitment-related dimensions and does not incorporate environmental or institutional factors into the composite index, while its reliance on periodically collected data limits its responsiveness to rapidly changing conditions. The derived weights are also contingent on the composition of the expert panel, and their stability across regions and industries has yet to be established. Future research should test the index against longitudinal recruitment data, compare expert-panel judgments with alternative weighting and aggregation methods, and conduct sensitivity analyses. It should also examine how macro-level signals—including GDP, industrial R&D investment, and industrial output value—can supplement the index for early-warning purposes, and whether catalogues compiled at the city-cluster level require an indicator structure different from that used for individual cities. Taken together, these extensions would move catalogue compilation from periodic enumeration toward a reproducible and adaptive system of labor-market intelligence.

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References

1. R. R. Nelson and E. S. Phelps, "Investment in humans, technological diffusion, and economic growth," The American Economic Review, vol. 56, no. 1/2, pp. 69–75, 1966.
2. M. Latukha, T. Pitubaeva, D. Khasieva, A. Kriklivetc, and K. Yan, "External mentoring as a talent attraction tool in the talent shortage context," BRICS Journal of Economics, vol. 6, no. 1, pp. 163–183, 2025.
3. A. Trost, Talent Relationship Management: Competitive Recruiting Strategies in Times of Talent Shortage. Berlin, Germany: Springer, 2014.

4. K. Dychtwald, T. J. Erickson, and R. Morison, Workforce Crisis: How to Beat the Coming Shortage of Skills and Talent. Boston, MA, USA: Harvard Business School Press, 2006.
5. P. Holland, C. Sheehan, and H. De Cieri, "Attracting and retaining talent: Exploring human resources development trends in Australia," Human Resource Development International, vol. 10, no. 3, pp. 247–262, 2007.
6. P. Wójcik, "Shortage of talents—A challenge for modern organizations," International Journal of Synergy and Research, vol. 6, p. 123, 2017.
7. R. S. Schuler, S. E. Jackson, and I. Tarique, "Framework for global talent management: HR actions for dealing with global talent challenges," in Global Talent Management, H. Scullion and D. G. Collings, Eds. New York, NY, USA: Routledge, 2011, pp. 33–52.
8. G. S. Becker, Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. Chicago, IL, USA: University of Chicago Press, 1964.
9. T. W. Schultz, "Investment in human capital," The American Economic Review, vol. 51, no. 1, pp. 1–17, 1961.
10. R. S. Schuler, S. E. Jackson, and I. Tarique, "Global talent management and global talent challenges: Strategic opportunities for IHRM," Journal of World Business, vol. 46, no. 4, pp. 506–516, 2011.
11. C. W. Worth, "The future talent shortage will force global companies to use HR analytics to help manage and predict future human capital needs," International Journal of Business Intelligence Research, vol. 2, no. 4, pp. 55–65, 2011.
12. T. L. Saaty, "A scaling method for priorities in hierarchical structures," Journal of Mathematical Psychology, vol. 15, no. 3, pp. 234–281, 1977.
13. T. L. Saaty, The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation. New York, NY, USA: McGraw-Hill, 1980.
14. Ningbo to release the scarce talent index for the first time (in Chinese), CCTV News, Sep. 22, 2007. [Online]. Available: https://news.cctv.com/china/20070922/100562.shtml
15. Q. S. Meng and W. X. Han, "Study of the coordinating measurement model with respect to composite system," Journal of Tianjin University, vol. 33, no. 4, pp. 444–446, 2000. (in Chinese)
16. Ministry of Human Resources and Social Security, State Administration for Market Regulation, and National Bureau of Statistics, "Occupational classification dictionary of the People's Republic of China (2022 edition)" (in Chinese), Doc. MOHRSS [2022] No. 68, Sep. 27, 2022. [Online]. Available: https://www.mohrss.gov.cn/SYrlzyhshbzb/rencairenshi/zcwj/RCDWJSzonghe/202211/t20221103_489285.html
17. Central Committee of the Communist Party of China and State Council of the People's Republic of China, "Outline development plan for the Guangdong–Hong Kong–Macao Greater Bay Area" (in Chinese), Feb. 18, 2019. [Online]. Available: https://www.gov.cn/gongbao/content/2019/content_5370836.htm
18. The People's Government of Guangdong Province, "Outline of the 14th five-year plan for national economic and social development of Guangdong Province and the long-range objectives through the year 2035" (in Chinese), Doc. Yuefu [2021] No. 28, Apr. 6, 2021. [Online]. Available: https://www.gd.gov.cn/zwgk/wjk/qbwj/yf/content/post_3268751.html
19. The People's Government of Guangdong Province, "14th five-year plan for the high-quality development of the manufacturing industry in Guangdong Province" (in Chinese), Doc. Yuefu [2021] No. 53, Jul. 30, 2021. [Online]. Available: https://gdii.gd.gov.cn/attachment/0/498/498395/4000137.pdf
20. Hangzhou Municipal Human Resources and Social Security Bureau, "Catalogue of in-demand skilled occupations (2026 edition)" (in Chinese), Mar. 19, 2026. [Online]. Available: https://hrss.hangzhou.gov.cn/col/col1229196651/art/2026/art_d323732e95574ae398fb95d3843f09fa.html

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