DSI DATA SCIENCE AND INFORMETRICS
VOL.3, NO.3, AUG. 2023

RESEARCH ARTICLE

Research on the evolutionary characteristics of evaluation policies of Chinese science and technology talents

Xu Wang[a,b]*, Hongye Li[a]

a. School of Economics and Management, Yanshan University, Qinghuangdao, China
b. Research Center for Chinese Science Evaluation, Wuhan University, Wuhan, China

ABSTRACT

Science and technology talent evaluation is an important part of the talent development system and mechanism, and the state's emphasis on science and technology talent evaluation is reflected in the national policy. This paper takes 49 policy documents on science and technology talent evaluation issued by the state from 1978 to 2022 as the object, and uses policy text analysis, word frequency analysis and co-word network analysis to interpret the content of the policies. These policy texts are divided into four stages. 200 high-frequency words were extracted from the policies in each stage after word segmentation was made, and the co-word matrixes and co-word networks were constructed for each stage. The research draws the following conclusions: 1) The content of Chinese science and technology talent evaluation policies is gradually becoming concrete, and the concept of science and technology talent evaluation is gradually clear; 2) The policies have transitioned from "scientific and technological development" to "scientific and technological innovation"; 3) The distribution of policies with different strengths is uneven; 4) The cooperation between all departments involved in policy formulation is not enough.

KEYWORDS

Science and technology talent evaluation; Policy text analysis; Word frequency analysis; Co-word network analysis; Text mining

1 Introduction

New technology is changing the world. In recent decades, new scientific and technological knowledge has grown exponentially, creating ripe conditions for mankind to make significant progress (Park et al., 2023; Wang, 2022a). Over the past 40 years of reform and opening up, China has made a series of breakthroughs in science and technology. At the same time, as the main base of science research in China, colleges and universities actively carry out cooperation with international talents (Zhao, 2018), and attach great importance to talents, and science and technology talent evaluation also appears. In recent years, Chinese science and technology evaluation reform policies have been introduced one after another, and reforms

* Corresponding Author: 1542746344@qq.com

such as "breaking the four wickedness" and "circling the three evaluations" are in full swing. As an important part of science and technology evaluation, the development and innovation of science and technology talent evaluation policies affect the smooth progress of science and technology talent evaluation. On November 9, 2022, the Ministry of Science and Technology, together with seven other departments, including the Ministry of Education and the Ministry of Finance, issued a notice on the Work Plan for the Pilot Reform of Science and Technology Talent Evaluation. The notice pointed out that all relevant departments should coordinate the pilot work well and publicize and interpret the pilot reform. It can be seen that science and technology talent evaluation has gradually shifted from theoretical research to practical reform work, and a new look of science and technology talent evaluation in China can be expected soon. However, in recent years, there have been many problems in science and technology talent evaluation policies, such as unscientific standards for science and technology talent evaluation, irregular evaluation process of science and technology talents, immature supporting measures, insufficient supervision of policy implementation, etc. How to formulate science and technology talent evaluation policies reasonably has become a key issue that needs to be addressed.

In recent years, China has paid more and more attention to the evaluation of science and technology talent, which is embodied in the following two aspects: First, the science and technology talent evaluation policies in China have achieved certain development, and the policy system has been gradually formed. With the advancement of reform and opening up, various national departments have successively issued science and technology talent evaluation policies. For example, in 1999, the Ministry of Science and Technology and the Ministry of Education jointly issued "Several Opinions on the Code of Conduct for Science and Technology Workers". Article 5 explained the principles and guidelines that should be adhered to in the evaluation, reward, and evaluation of science research achievements, that is, "objectivity, impartiality and fairness, accuracy"; In 2018, the "Opinions on Deepening the Reform of Project Evaluation, Talent Evaluation, and Institutional Evaluation" issued by the General Office of the CPC Central Committee and the General Office of the State Council clearly stated the evaluation of science and technology talent, and pointed out that it is necessary to promote the evaluation of science and technology talent to be open, fair and just. The second is to set up various science research evaluation institutions across the country. The establishment of the Institute of Science and Technology Evaluation and the third-party science and technology achievement evaluation agency has provided a substantial boost for science and technology talent evaluation.

The research on science and technology talent evaluation by Chinese scholars mainly focuses on the following aspects: one is the construction of the evaluation system of science and technology talents in China (Sheng et al., 2016; Yang, 2018; Li et al., 2009), the second is the construction of the evaluation index system of science and technology talents (Zhang et al., 2020; Liu et al., 2017; Zhao et al., 2013; Wu, 2014; Zhang, 2013; Zhao et al., 2014; Tian & Zhang, 2007; Wang, 2012), the third is the system reform and problems of science and technology talent evaluation (Xing, 2021; Li & Hu, 2020; Li, 2014; Liu, 2021; Chen, 2021; Feng, 2007; Zhu et al., 2011; Chen & Fan, 2015), and the fourth is science and technology talent evaluation policy and literature research (Tan et al., 2022; Gan et al., 2022; Y. Tan et al., 2019; C. Tan et al., 2019; Li et al., 2021; Yang & Shi, 2021). It can be seen from the above research directions that academic research on science and technology talent evaluation is still in the stage of continuous deepening and supplementation, and more questions are waiting to be

discovered and raised. In addition, some Chinese scholars also draw lessons from the experience of foreign science and technology talent evaluation (Deng, 2020; Yang & Zha, 2020; Li & Xu, 2012), and summarize the strategies of science and technology talent evaluation that are beneficial to the development of Chinese science and technology through analysis.

Foreign articles have also attempted to explain and study various aspects of talent evaluation in depth: firstly, the construction of talent evaluation index system; Zhao and Nie's study (2007) combined qualitative and quantitative analysis and used hierarchical analysis to establish a talent evaluation index system; Sun (2012) focused on science and technology talents in computer field and used fuzzy mathematics to construct a new computer composite talent evaluation model and verified the scientific nature of the mode; Huang et al. (2020) tried to establish a talent identification index system for four age groups (11-12, 13-14, 15-16, 17-18) of male and female cross-country skiers. The second research direction is the validity demonstration and improvement of the talent evaluation system. Faber et al. (2015) examined the validity of the sport skill assessment program in the sports field and made suggestions for the improvement of the program; then, Qing and Cheng (2008) summarized the talent quality evaluation mechanism and proposed measures to improve the talent quality evaluation mechanism; Lan (2016) found that the evaluation mechanism, personnel policy, evaluation experts and evaluation indexes have obvious effects on evaluation validity, while interpersonal social relationship factors are completely ineffective on evaluation validity. The last aspect is the construction of talent evaluation system; Jost et al. (2002) proposed a longitudinal talent evaluation expert system to improve the science and accuracy of talent evaluation; Grigoriev and Mondrus (2002) developed and studied a data-driven human resource management framework to identify academic talent and measure performance, etc., while maximizing academic output.

The quality classification of talents should focus on the impact and overall achievement of each individual and how he is perceived in his own academic community (Zanotto, 2006). The analysis and evaluation of talents should not be monolithic, but diverse in perspective, and the analysis of inherent contradictions and problem areas can also be considered in terms of macro level, innovation subjects, research types, and micro individuals, so as to further enrich the theoretical system of science and technology innovation (Cao, 2020). The issue of talent has always been a continuous concern for scholars, whether it is the characteristics and nature of talent itself, or issues such as the optimization of talent allocation and how to judge the achievements of scientists, which has been the focus of research in the past and will certainly be a monument for all to look at in the future.

Through literature combing, it can be seen that not many scholars at home and abroad have conducted research on the evolution of science and technology talent evaluation policies from the perspective of social network analysis. Therefore, this paper will use word frequency statistics and co-word network analysis to grasp the evolutionary trends of science and technology talent evaluation policies in terms of content, and then summarize the hot trends of these policies to provide scientific decision-making suggestions for policy makers to optimize the policy system and content. Considering the national environment, and referring to the division of science and technology policy texts since the reform and opening up by Tan et al. (2019), the development of the science and technology talent evaluation policies is divided into four stages, namely the period of restoration and adjustment (1978-1999), the period of revision and consolidation (2000-2004), the period of deep development (2005-2013) and the period of continuous innovation (2014-2022). In order to study

the evolution characteristics of the science and technology talent evaluation policies, this paper mainly puts forward three questions: (1) What are the differences in the quantity and types of the science and technology talent evaluation policies in each stage? (2) For the text content of policies at different stages, what methods and tools are adopted to describe the changes in content? (3) How will the development of the science and technology talent evaluation policies be better carried out in the future? This study will help to deeply understand the changes of the science and technology talent evaluation policies in China, explore the existing problems in the policy formulation, and have a certain reference value for the policy measurement research.

2 Policy Text Analysis

2.1 Data acquisition and processing

In order to ensure the comprehensiveness and accuracy of the study, in the process of obtaining the text of science and technology talent evaluation policies, the scope of text search is locked in the policies publicly released by the Central Committee of the Communist Party of China, the State Council and relevant ministries and commissions, and the policies in this paper are mainly sourced from the Chinese government website, Peking University Magic Weapon, the CNKI database, where the Chinese government website is the official website of public policies, and Peking University Magic Weapon and the CNKI database can supplement the few policies that are difficult to be retrieved. In the search, the document time limit is 1978-2022, and the search time is June 2, 2022. Considering the relevance of the search terms to the evaluation of science and technology talents, this paper uses "science and technology talents", "talent evaluation", "science researchers". The keywords "science and technology talent evaluation" was used to retrieve a total of 92 policy texts. Considering that some of the policies are not very relevant to the evaluation of science and technology talents, 49 texts were obtained for analysis after manual checking and screening. The relevant information on some policies is summarized in Table 1.

Table 1 Summary table of China's science and technology talent evaluation policies from 1978-2022

No.	Policy Name	Writing time
1	Notice of the General Office of the State Council on soliciting comments on the "Medium and long–term science and technology development program (discussion draft)"	1990.02.05
2	Several opinions on strengthening the popularization of science and technology	1994.12.05
3	Notice of the General Office of the State Council on the issuance of the Ministry of Science and Technology functions and staffing requirements of the internal structure	1998.06.25
4	Notice of the State Council on the issuance of the outline of action for sustainable development in China at the beginning of the 21st century	2003.01.14
5	Notice of the General Office of the State Council forwarded the Ministry of Science and Technology and other departments on the promotion of counties (cities) of scientific and technological progress	2006.04.27
6	Notice of the General Office of the State Council forwarded the Development and Reform Commission and other departments on a number of policies of the promotion of independent innovation achievements in the industrialization	2008.12.15

No.	Policy Name	Writing time
7	Notice of the State Council on the issuance of measurement development plan (2013–2020)	2013.03.02
8	Implementation plan for deepening the reform of the science and technology system	2015.09.24
9	Guiding opinions from the General Office of the State Council on optimizing the academic environment	2015.12.29
10	Notice of the General Office of the State Council on the issuance of the implementation plan of the national action plan for the quality of science (2016–2020)	2016.02.25
11	Notice of the General Office of the State Council on the issuance of action plans to promote the transfer of scientific and technological achievements	2016.04.21
.....	.....	.....
44	The General Office of the CPC Central Committee and the General Office of the State Council issued the "Guidance on the reform of the classification and promotion of talent evaluation mechanism	2018.02.26
45	The General Office of the CPC Central Committee and the General Office of the State Council issued the opinions on deepening the reform of project evaluation, talent evaluation and institutional assessment	2018.07.03
46	Notice of the State Council on several measures to optimize research management and enhance research performance	2018.07.18
47	Notice of the General Office of the State Council on the implementation of the document on giving greater autonomy to scientific research institutions and personnel	2018.12.26
48	Guiding opinions from the General Office of the State Council on improving the evaluation mechanism of scientific and technological achievements	2021.07.16
49	The General Office of the CPC Central Committee and the General Office of the State Council issued the opinions on strengthening ethical governance of science and technology	2022.03.20

This paper first starts from the whole, analyzes the policy strength distribution characteristics and the number of issuing departments of science and technology talent evaluation policies, and then, from the perspective of stages, extracts policy regulations on science and technology talent evaluation from policy texts. Through word frequency statistics and semantic network analysis, this paper reveals the characteristics of science and technology talent evaluation policies in various stages with the adjustment of national strategies, summarizes the overall and local changes in Chinese science and technology talent evaluation policies, and provides guidance and suggestions for improving Chinese science and technology talent evaluation policy system. The research process of this paper is shown in Figure 1. Firstly, we retrieved 92 texts needed for the study from the Chinese government website, CNKI, and other websites using keywords, and then obtained 49 policy texts for data processing by manually checking the relevance of each text content to the study topic and deleting the texts with low relevance, copied all the text contents of each stage divided in advance into the same document, and used ROSTCM6 software to perform word segmentation operation on the document and output the word frequency lists of the separated words. Finally, we used UCINET software to convert the co-word matrices generated in ROSTCM6 into a co-word network graphs for co-word network analysis. Meanwhile, through statistics we can find out the characteristics of number, issuing departments and policy types of science and technology talent policies at each stage, which enables us to have a more comprehensive understanding of the evolutionary characteristics of science and technology talent policies.

The article concludes with a comparative analysis of the results at different stages to find out the characteristics of each stage and make suggestions for improvement.

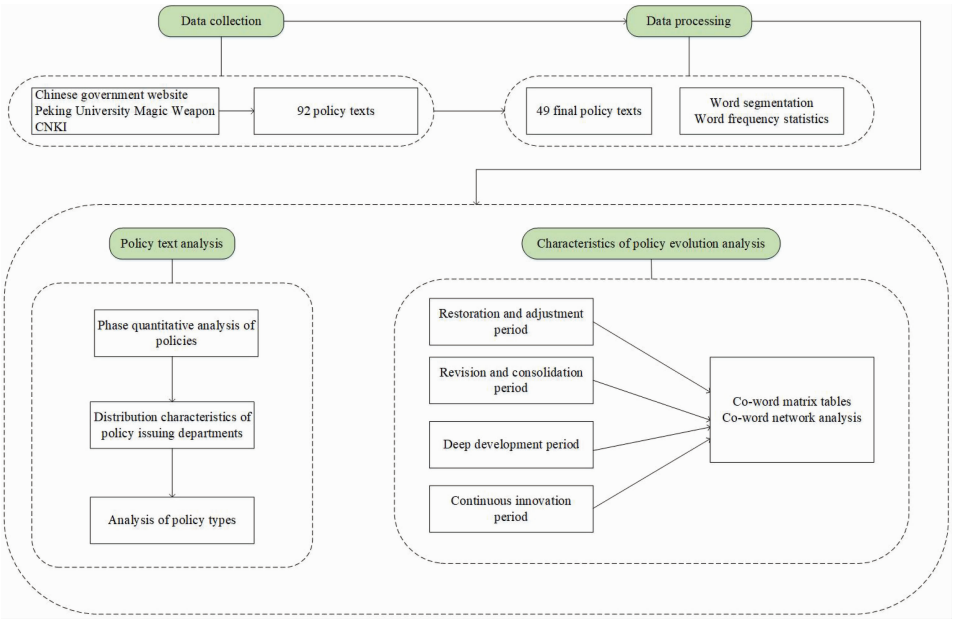

Figure 1 Research framework

2.2 Phase Quantitative Analysis of Policies

For each policy text, there is a problem that the time of writing, the time of release, and the date of implementation are not synchronized. According to the research problem of this paper, the writing time is proposed to delineate the development stage of the policies. In the past 40 years, China has developed rapidly in terms of economy and technology, which is closely related to the formulation and implementation of national policies. The development characteristics of a country in a certain period of time can be directly reflected by the real-time national policy content direction and hotspots. Therefore, considering the national environment, and referring to the division of science and technology policy texts since the reform and opening up by C. Tan et al. (2019), the development of the science and technology talent evaluation policies is divided into four stages, namely the period of restoration and adjustment (1978-1999), the period of revision and consolidation (2000-2004), the period of deep development (2005-2013) and the period of continuous innovation (2014-2022).

The quantitative distribution of science and technology talent evaluation policies in each period is shown in Figure 2. As can be seen from the data in the figure, the number of policies in the period of restoration and adjustment is 8, accounting for 16.33% of the total policies; there are only 2 policies in the period of revision and consolidation, accounting for the smallest proportion, accounting for 4.08%; the number of policies for science and technology talent evaluation in the period of deep development is 10, accounting for 20.41%; the continuous innovation period has the most policies, 29, and the number is significantly higher than the previous three stages, accounting for 59.18%, which shows that the innovation-driven development strategy proposed in the 18th National Congress of the Communist Party of China and the idea that "science and technology innovation is the strategic support

for improving social productivity and comprehensive national strength and must be placed at the core of the overall national development" has already begun in the policies issued by the state. The Party Central Committee's attention to science and technology has increased significantly, and the number of policies related to science and technology talent evaluation has also risen.

Generally speaking, the number of science and technology talent evaluation policies from 1978 to 2022 generally showed a trend of growth over periods, especially in the period of continuous innovation. There are also peak years of policy release in each phase. Among them, the number of policies in 2016 reached the maximum, with 8.

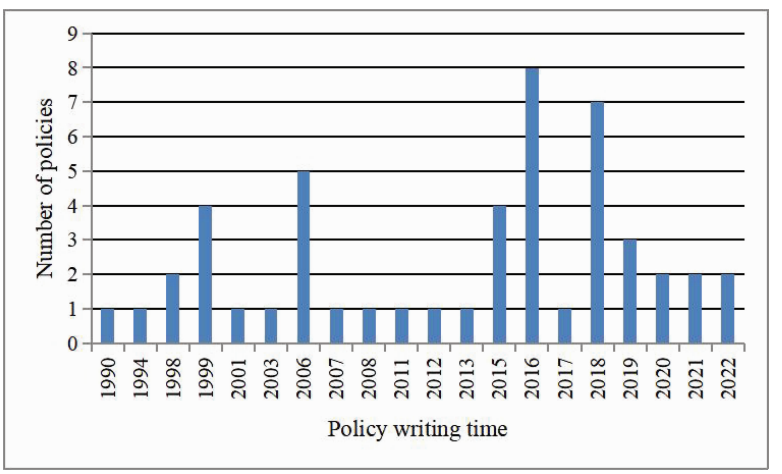

Figure 2 Annual statistics of Chinese science and technology talent evaluation policies from 1978 to 2022

2.3 Distribution characteristics of policy issuing departments

The number, complexity, and type span of departments involved in the formulation and release of policies on a certain topic can reflect the importance and development of policies to a certain extent. Based on the collected science and technology talent evaluation policy texts, the number and proportion of policies issued by various departments in each stage of the science and technology talent evaluation policies from 1978 to 2022 are counted, as shown in Table 2, where the numbers in parentheses are the proportion of the number of policies promulgated by each department in the corresponding stage.

According to the statistical data in the table and horizontal analysis, the Central Committee of the Communist Party of China, the State Council, the General Office of the Central Committee of the Communist Party of China, and the General Office of the State Council occupy a dominant position in the formulation and promulgation of science and technology talent evaluation policies, and the degree of dominance gradually deepens over time; the role of the Ministry of Science and Technology and the National Development and Reform Commission followed closely, which shows that science and technology talent evaluation policies is closely related to science and technology progress and national development, and the formulation of such policies should also be led by related departments; in addition, the role of the Ministry of Education and the Ministry of Finance in policy formulation should not be underestimated. The innovation and sound development of science and technology require high-quality education and a certain amount of capital investment, so as to cultivate a large

number of high-level science research talents with science literacy and knowledge reserves for all walks of life in the country, which is exactly in line with the strategy of strengthening the country through talents proposed by the party and the state. From a longitudinal perspective, the degree of participation of various departments has changed in different stages. During the restoration and adjustment period, the General Office of the State Council, the Ministry of Science and Technology, and the Ministry of Education participated in policy formulation to a greater degree, accounting for 26.34%, 10.53%, and 10.53% respectively. During the period of revision and consolidation, the State Council and the General Office of the State Council each accounted for 50% in the formulation of science and technology talent evaluation policies, and their forces were balanced. During the period of deep development, the State Council and the Ministry of Science and Technology played a pivotal role. During the period of continuous innovation, the CPC Central Committee, the State Council, the General Office of the State Council and the General Office of the CPC Central Committee are responsible for most of the issuance of science and technology talent evaluation policies. The high level of national leaders' attention to science and technology has reached an unprecedented level at this stage. There are a large number of participating departments in the restoration and adjustment period and the deep development period. Among them, 13 departments participated in the promulgation of policies during the restoration and adjustment period, and 16 departments participated in the deep development period. The department types span a wide range, and the combination of various departments provides a solid policy environment for promoting the in-depth development of science and technology.

Table 2 Number and proportion of science and technology talent evaluation policies promulgated by various departments from 1978 to 2022 n(%)

Department name	1978–1999	2000–2004	2005–2013	2014–2022	Total
Central Committee of the Communist Party of China	1 (5.26)	0 (0)	0 (0)	7 (17.95)	8
State Council	1 (5.26)	1 (50)	5 (15.625)	10 (25.65)	17
General Office of the CPC Central Committee	0 (0)	0 (0)	0 (0)	7 (17.95)	7
General Office of the State Council	5 (26.34)	1 (50)	0 (0)	13 (33.33)	19
Ministry of Science and Technology	2 (10.53)	0 (0)	4 (12.5)	0 (0)	6
Ministry of Education	2 (10.53)	0 (0)	2 (6.25)	0 (0)	4
Ministry of Personnel	1 (5.26)	0 (0)	1 (3.125)	0 (0)	2
Ministry of Finance	1 (5.26)	0 (0)	3 (9.375)	0 (0)	4
People´s Bank of China	1 (5.26)	0 (0)	2 (6.25)	0 (0)	3
State Administration of Taxation	1 (5.26)	0 (0)	1 (3.125)	0 (0)	2
State Administration for Industry and Commerce	1 (5.26)	0 (0)	0 (0)	0 (0)	1
Chinese Academy of Sciences	1 (5.26)	0 (0)	1 (3.125)	0 (0)	2
Chinese Academy of Engineering	1 (5.26)	0 (0)	1 (3.125)	0 (0)	2
China Association for Science and Technology	1 (5.26)	0 (0)	0 (0)	0 (0)	1
Development and Reform Commission	0 (0)	0 (0)	4 (12.5)	1 (2.56)	5
Intellectual Property Office	0 (0)	0 (0)	2 (6.25)	0 (0)	2
Ministry of Commerce	0 (0)	0 (0)	1 (3.125)	0 (0)	1

Department name	1978–1999	2000–2004	2005–2013	2014–2022	Total
Ministry of Foreign Affairs	0 (0)	0 (0)	1 (3.125)	0 (0)	1
Ministry of Industry and Information Technology	0 (0)	0 (0)	1 (3.125)	0 (0)	1
General Administration of Customs	0 (0)	0 (0)	1 (3.125)	0 (0)	1
Central Office	0 (0)	0 (0)	1 (3.125)	0 (0)	1
Ministry of Labor and Social Security	0 (0)	0 (0)	1 (3.125)	0 (0)	1
Chinese Academy of Social Sciences	0 (0)	0 (0)	0 (0)	1 (2.56)	1
Total	19	2	32	39	92

In terms of the number of documents issued jointly by departments, there are 18 policies jointly issued by departments, and 22 departments participated in the formulation and promulgation of such policies. Among them, the General Office of the Central Committee of the Communist Party of China, the General Office of the State Council, and the Ministry of Science and Technology contributed the most in the form of multi-departmental joint issuance, and each participated in 6 policies. Science and technology talent evaluation is an indispensable evaluation factor in science and technology evaluation, which is related to the comprehensive development of national science and technology. Therefore, the Ministry of Science and Technology is responsible for the formulation of such policies. The Central Committee of the Communist Party of China and the State Council contributed the next most, and each participated in 5 items in the joint document issued by the departments; in addition, the Ministry of Education, the Ministry of Finance, and the National Development and Reform Commission also made more prominent contributions compared with most departments, as shown in Figure 3.

The science and technology talent evaluation policies jointly issued by departments collected in this paper only account for 36.73% of the total amount of science and technology talent evaluation policies, which shows that in the formulation of science and technology talent evaluation policies, most documents are still issued by a single department, and there is a general lack of cooperation awareness among departments, and there is a phenomenon of poor information communication between different departments, which will directly affect the coordinated development and balanced application of science and technology talent evaluation in different industries and departments.

2.4 Analysis of Policy Types

The types of science and technology talent evaluation policies are composed of opinions, plans, outlines, regulations, notices, decisions and suggestions. The data in Table 3 shows the application of various policies in the four development stages, and the numbers in parentheses are the proportions of each type of policy in the corresponding period. It can be seen that notification is the most commonly used type of policy. It is mainly used to issue and communicate matters that require lower-level organs to implement and relevant units to know or implement. Its proportion in each period is quite high, such as 75% during the period of restoration and adjustment, 100% in the period of revision and consolidation, and 80% in the period of deep development, which shows that the science and technology talent evaluation policies as a whole tend to play an indicative role; opinion is the type of policy whose frequency of use is second only to notification, and the proportion generally shows an upward trend, that is, from 12.5% in the period of restoration and adjustment to 41.37% in the period of continuous innovation. It is interesting to note that although notices are the

most frequently used, the number in the continuous innovation stage is lower than that of opinion policies, which shows that the development of science and technology talent evaluation in the continuous innovation stage is not only in the strategic planning direction, moreover, it is gradually deepening in the direction that policies can be transformed and implemented, and the application of plans, outlines, decisions, and suggestions is gradually improving. In addition, in the period of restoration and adjustment, the period of revision and consolidation, and the period of deep development, the types of policies are relatively single, while the types of policies in the continuous innovation stage are rich, and the science and technology talent evaluation policies are gradually diversified.

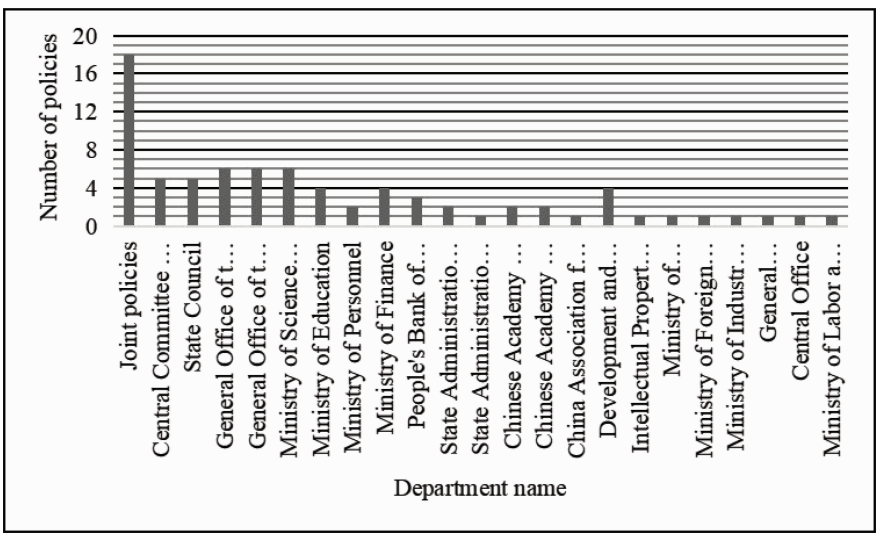

Figure 3 The number of Chinese science and technology talent evaluation policies issued by joint departments from 1978 to 2022

Table 3 Statistics on the number of types of Chinese science and technology talent evaluation policies from 1978 to 2022 n(%)

Type of policy	1978–1999	2000–2004	2005–2013	2014–2022	Total
Opinion	1(12.5)	0(0)	2(20)	12(41.37)	15
Plan	0(0)	0(0)	0(0)	2(6.9)	2
Outline	0(0)	0(0)	0(0)	1(3.45)	1
Regulation	1(12.5)	0(0)	0(0)	2(6.9)	3
Notice	6(75)	2(100)	8(80)	10(34.48)	26
Decision	0(0)	0(0)	0(0)	1(3.45)	1
Suggestion	0(0)	0(0)	0(0)	1(3.45)	1
Total	8	2	10	29	49

The number of administrative regulations in Chinese science and technology talent evaluation policies is the largest, with 31 items, accounting for 63.27%; the second largest number is the internal party laws and regulations, with 16 items, accounting for 32.65%; the last number is the departmental rules, with 2 items, accounting for 4.08%, as shown in Figure 4. The above data shows that the proportion of administrative regulations, internal party laws

and regulations, and departmental rules in Chinese science and technology talent evaluation policies is unbalanced, with departmental rules accounting for very little, and administrative regulations accounting for more than half. Generally speaking, the policy is high in intensity, authoritative and legal, and can provide a relatively stable foundation for the innovation and reform of science and technology talent evaluation, but it lacks a certain number of weak-intensity policies to supplement and harmonize.

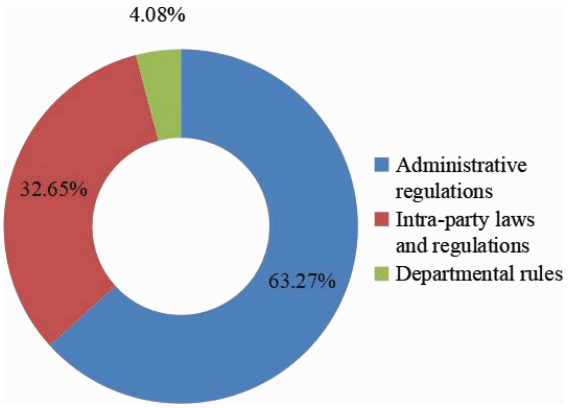

Figure 4 Proportion of Chinese science and technology talent evaluation policies from 1978 to 2022

3 The characteristics of policy evolution analysis

The co-word frequency analysis is used to count the frequency of the key topic pairs of the core content of the text in the text of a certain research field, and to determine the research hotspots and development trends in this field through the correlation degree of different topic pairs. This paper uses the text mining analysis software ROSTCM6 as the analysis tool, through word segmentation, keyword extraction, and word frequency analysis of the scientific and technological talent evaluation policy texts in each period, to get a preliminary understanding of the theme bias of the policies in each period, and finally generate a co-occurrence matrix vocabulary and co-word network through semantic network analysis, visualizing the results of co-word analysis, and further intuitively display the changes in hotspots for science and technology talent evaluation policies formulation, thereby revealing the characteristics of policy development trends. It is important to note that the software will automatically perform the operation of word segmentation and keyword extraction after inputting the obtained text content into ROSTCM6.

3.1 Restoration and adjustment period

Keyword extraction and word frequency statistics were conducted on the collected texts of science and technology talent evaluation policies from 1978 to 1999, and the top 20 high-frequency keywords were selected by eliminating the keywords with weak differentiation, and the statistical results are shown in Table 4. It can be seen from the table that the policies in this period focused on the development of science and technology, research and the construction of related institutions and departments. At the same time, it accompanies the transformation of science research achievements, economic construction, science research personnel, science research organizations, enterprise science research and other di-

rections.

On December 18, 1978, the Third Plenary Session of the Eleventh Central Committee of the Communist Party of China was held as scheduled. The Party Central Committee, with Deng Xiaoping as the leading core opened the road of reform and opening up and socialist modernization. After experiencing the serious mistakes of the Cultural Revolution, the Party Central Committee drew on the lessons of its predecessors and carried out a comprehensive set-up, including corrections to science and technology. On March 18, 1978, Deng Xiaoping expounded the thesis that "science and technology are productive forces" at the opening ceremony of the National Science Conference held in Beijing. This conference also became a great turning point for the revival of Chinese science and technology undertakings, and the development of Chinese science and technology undertakings has since entered a new stage. In 1990, the General Office of the State Council issued the "Notice on Soliciting Opinions on the Medium and Long-term Science and Technology Development Program (Discussion Draft)", and its annex "Medium and Long-Term Science and Technology Development Program (Discussion Draft)" clarifies the guidelines, policies and key areas of Chinese medium and long-term natural science and technology development, so as to guide the coordinated development of science and technology, economy and society in China from 2000 to 2020. The program clarifies the important position of science and technology talents in the development of the country, and proposes to vigorously cultivate science and technology talents, respect knowledge, respect talents, trust and rely on the science and technology team as an important part of the working class, and give full play to the ingenuity and enthusiasm of science and technology personnel, which is the fundamental starting point for doing a good job in science and technology work. Article 5 of the "Several Opinions on the Code of Conduct for Science and Technology Workers" jointly issued by the Ministry of Science and Technology and the Ministry of Education in 1999 explained the principles and guidelines that should be adhered to in the evaluation, reward, and evaluation of science research achievements, that is, "objectivity, impartiality and fairness, accurate", which is a moral constraint and norm for science and technology talent evaluation process. The policies of science and technology talent evaluation have begun to emerge, but it has not been fully developed. As can be seen from Figure 5, in this period, few policies were put forward for the science and technology talent evaluation, and the development of science and technology was just starting. The policy focus was on how to transfer the Party's work focus to the construction of socialist economy, while the regulations on various aspects of science and technology were not comprehensive and specific, which indicated that further refinement was needed in the formulation of policies.

Table 4 Keywords frequency statistics of Chinese science and technology talent evaluation policies from 1978 to 2022

Serial number	Keyword	Word frequency	Serial number	Keyword	Word frequency
1	Science & technology	423	11	Personnel	80
2	Develop	217	12	Institution	80
3	Research	176	13	Organization	78
4	Construct	124	14	Society	78
5	Country	111	15	Science	76

Serial number	Keyword	Word frequency	Serial number	Keyword	Word frequency
6	Manage	89	16	Strengthen	70
7	Achievement	87	17	Enterprise–s	66
8	Economy	84	18	Guidelines	63
9	Science popularization	84	19	Foundation	59
10	Improve	80	20	Policy	56

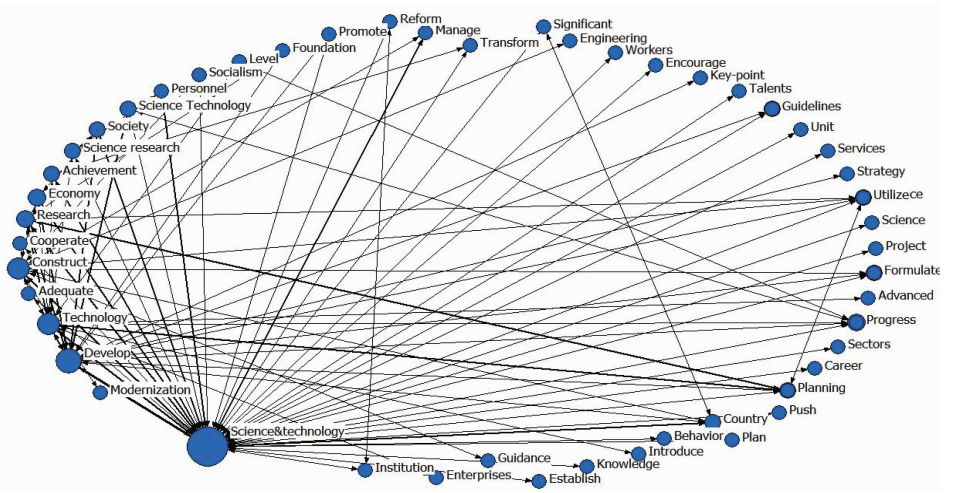

Figure 5 Co-word Network of Chinese Science and Technology Talent Evaluation Policies in 1978-1999

3.2 Revision and consolidation period

There are two policy texts about of science and technology talent evaluation collected from 2000 to 2004. The word segmentation and word frequency analysis of these two policies are carried out, and the top 20 high-frequency keywords were selected by eliminating the keywords with weak differentiation, and the statistical results are shown in Table 5. During this period, the formulation of Chinese science and technology talent evaluation policies was mainly carried out around enterprises, schools and other science research entities. At the same time, sustainable development has become a problem that China should have in the early 21st century to ensure the smooth realization of the third-step strategic goal of national economic and social development.

By consulting the two policies on science and technology talent evaluation from 2000 to 2004, we can find that: First, in 2001, in the policy document "Guiding Opinions on the Pilot Program of Regulating the Management System of School-run Enterprises at Peking University and Tsinghua University" jointly issued by the Office of the Institutional Reform Commission and the Ministry of Education, in order to promote the industrialization of science and technology achievements in colleges and universities and the healthy development of teaching and science research, regulate the management system of school-run enterprises, the policy decided to use Peking University and Tsinghua University as experimental sites, and to provide guidance for the pilot work; Second, the "State Council Notice on Printing and Distributing Chinese Action Plan for Sustainable Development in the Early 21st Century", which was written in 2003, forwarded the "Chinese Action Plan for Sustainable Development in the

Early 21st Century". The plan put forward the principle of "rejuvenating the country through science and education, and constantly innovating", which shows that science and technology innovation is playing an important role in the new situation.

From the above points and combined with Figure 6, it can be concluded that the policies on science and technology talent evaluation in the revision and consolidation period are more refined than those in the recovery and adjustment period, and the science research subject is more clear. The policies emphasize accelerating the development of Chinese science and technology by establishing a corresponding incentive evaluation mechanism for the science and technology talents existing in specific science research subjects. Although the term "science and technology talent evaluation" is not directly displayed in the policies, it undoubtedly created a precedent for the revision of the content of the science and technology talent evaluation policies, and established a reference entity for the later creation of the science and technology talent evaluation policies.

Table 5 Keywords frequency statistics of Chinese science and technology talent evaluation policies from 2000 to 2004

Serial number	Keyword	Word frequency	Serial number	Keyword	Word frequency
1	Enterprises	90	11	Resource	21
2	Schools	64	12	Technology	21
3	Assets	59	13	Science research	20
4	Operate	47	14	Surroundings	19
5	Sustainable development	37	15	Economy	18
6	School–run	34	16	Population	16
7	Develop	31	17	Regulate	16
8	Manage	27	18	Ecology	16
9	Improve	24	19	State–owned	16
10	Society	22	20	Establish	15

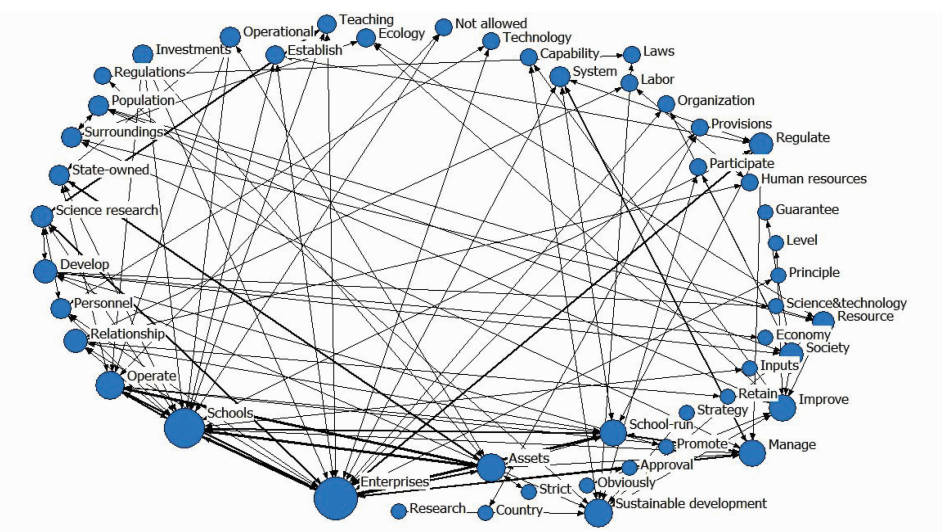

Figure 6 Co-word Network of Chinese Science and Technology Talent Evaluation Policies in 2000-2004

3.3 Deep development period

This paper collects 10 policy texts on science and technology talent evaluation from 2005 to 2013, and analyzes the word frequency of the policies. The word frequency statistics of the top 20 high-frequency keywords by eliminating the keywords with weak differentiation are shown in Table 6. It can be roughly seen that in the deep development period, the hot directions of policies related to science and technology talent evaluation are concentrated on science and technology innovation, technology development, and innovation capacity building.

Obviously, the policies of this period are completely different from the previous two periods. It began to focus on the independent innovation and development of science and technology, and continued to deepen the system reform of science and technology, which includes gradually improving the science and technology talent evaluation and talent incentive system, in order to encourage the majority of science research workers to actively exert their subjective initiative and creativity in science research, thereby driving the development of the industry and economy. This is because the idea of an innovation-driven development strategy was put forward at the National Science and Technology Innovation Conference held by the Party Central Committee and the State Council in July 2012. Soon after, this strategy was also clearly written into the report of the 18th National Congress of the Communist Party of China and became a new content in the spirit of the 18th National Congress of the Communist Party of China. As can be seen from Figure 7, the policies of this period have not yet clearly defined the term "science and technology talent evaluation", but there are many provisions on talent evaluation and incentive in the policies. For example, in 2006, the "Opinions on Promoting County (City) Science and Technology Progress" jointly issued by the Ministry of Science and Technology, the Central Office, the Ministry of Finance and the Ministry of Personnel pointed out that it is necessary to improve and innovate talent policies and measures, and establish a long-term mechanism to motivate science and technology personnel to work at the grassroots level, and at the same time the policy explained specific incentive and evaluation measures; in 2008, the National Development and Reform Commission, the Ministry of Science and Technology, and the Ministry of Finance jointly issued "Several Policies on Promoting the Industrialization of Independent Innovation Achievements", which pointed out that science researchers are encouraged to carry out the industrialization activities of independent innovation achievements. Colleges and universities and science research institutions should take the industrialization of independent innovation achievements carried out by science researchers as an important evaluation content in professional and technical job evaluation. In addition, the improvement of the science and technology opening mechanism also requires talents to gradually internationalize, form good international science and technology cooperation, and requires country to establish an international science and technology talents team, and improve the quantity and quality of talents.

Generally speaking, in deep development period, various departments have been paying more and more attention to science and technology talents and science and technology talent evaluation, and the content of science and technology talent evaluation in policies has also begun to propose more specific solutions, gradually showing its complete head.

Table 6 Keywords frequency statistics of Chinese science and technology talent evaluation policies from 2005 to 2013

Serial number	Keyword	Word frequency	Serial number	Keyword	Word frequency
1	Construct	433	11	Country	242
2	Science&technology	430	12	Services	224
3	Develop	414	13	Establish	219
4	Innovation	383	14	Manage	211
5	Strengthen	333	15	Complete	209
6	Metering	293	16	System	206
7	Enterprises	292	17	Independent	202
8	Capability	266	18	Labor	182
9	Guarantee	262	19	Foundation	170
10	Society	246	20	Mechanism	164

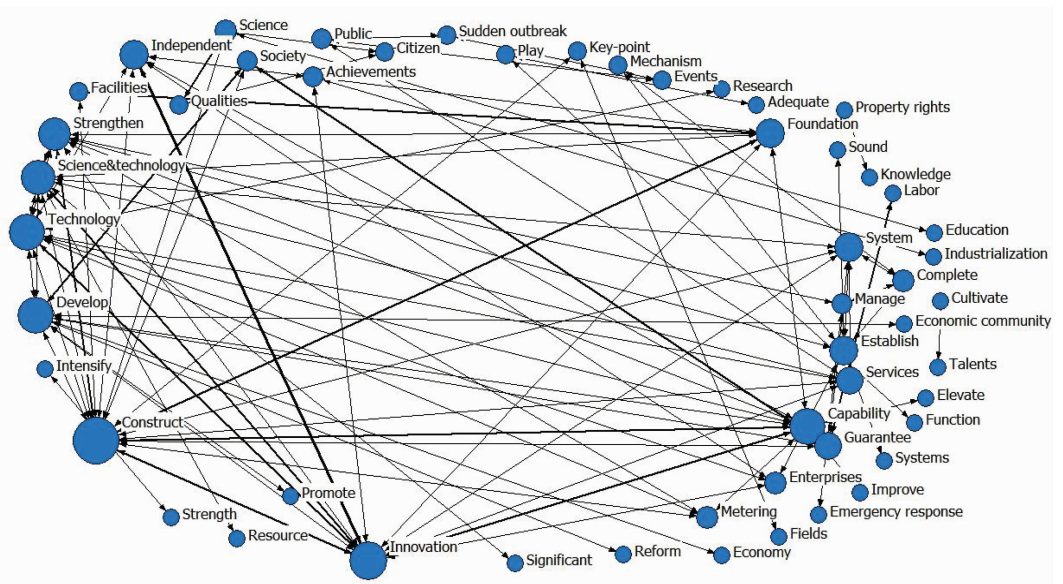

Figure 7 Co-word Network of Chinese Science and Technology Talent Evaluation Policies in 2005-2013

3.4 Continuous innovation period

29 policy texts for science and technology talent evaluation from 2014 to 2022 were collected in this paper, and word frequency analysis was performed on these policies. The word frequency statistics of the top 20 high-frequency keywords by eliminating the keywords with weak differentiation are shown in Table 7. It can be seen that in the continuous innovation period, the hot content of science and technology talent evaluation policies is still science and technology innovation, technology innovation, and innovation capacity building.

One detail that needs to be noted is that from the co-occurrence relationship of words

shown in Figure 8, it can be found that the term "science and technology talent evaluation" officially appeared in the policies of this period, and the country has attached unprecedented importance to science and technology talent evaluation. At the same time, most of the policies in this period were jointly issued by multiple departments. In a sense, science and technology talent evaluation has indeed received great attention from all parties. Among these policies, the "Opinions on Deepening the Reform of Project Evaluation, Talent Evaluation, and Institutional Evaluation" issued by the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council in 2018 is one of the most historically significant policies for science and technology talent evaluation. Among them, the article on improving the methods of science and technology talent evaluation points out that it is necessary to promote the openness, fairness and justice of science and technology talent evaluation by coordinating the plans of science and technology talents, scientifically setting up talent evaluation indicators, and establishing a correct orientation for the use of talent evaluation. It reflects the true meaning of science and technology talent evaluation.

With the development of the times, science research results have sprung up like mushrooms after a spring rain. During this period, a series of problems will inevitably arise in various links. The same is true of the science and technology talent evaluation system, such as irregular talent evaluation procedures, lack of scientific evaluation standards, and low evaluation quality and many more. These are all areas that need to be continuously repaired and strengthened by the state, and the science and technology talent evaluation policies in this period can be said to have emerged as the times require. Following the trend of national development, it has made better norms and constraints on science and technology talent evaluation, injecting new impetus into Chinese new journey of building socialist modernization in an all-around way, contributing Chinese wisdom, Chinese solutions, and Chinese strength to the world's talent evaluation construction.

Table 7 Keywords frequency statistics of Chinese science and technology talent evaluation policies from 2014 to 2022

Serial number	Keyword	Word frequency	Serial number	Keyword	Word frequency
1	Innovation	2024	11	Science research	611
2	Science&technology	2019	12	Enterprises	592
3	Develop	1236	13	Manage	591
4	Construct	870	14	Establish	583
5	Mechanism	776	15	Services	572
6	Complete	770	16	Achievements	564
7	Reform	726	17	Push forward	561
8	Strengthen	718	18	Push	536
9	Systems	708	19	Evaluation	520
10	Talents	685	20	Conduct	453

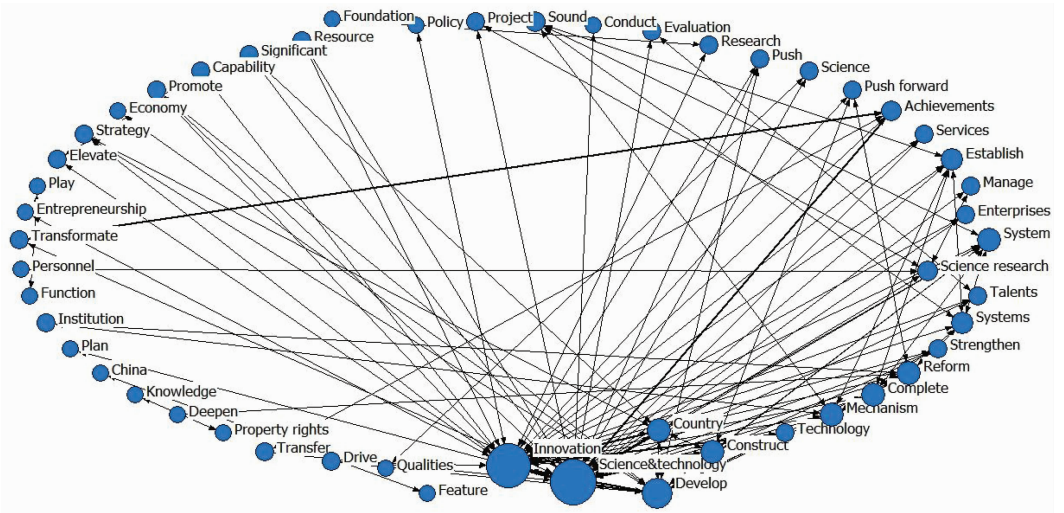

Figure 8 Co-word Network of Chinese Science and Technology Talent Evaluation Policies in 2014-2022

4 Conclusions and discussions

4.1 Conclusions

4.1.1 The content of the policies

Different stages of science and technology talent evaluation policies tend to have different themes, but in general, policies are formulated around how to develop Chinese science and technology undertakings. With the advancement of time, a series of drawbacks will appear one after another in the development of science and technology. In order to eliminate these drawbacks, the focus of policy content will also change. The science and technology talent evaluation policies have existed for more than 40 years, and its content has become more and more abundant. The policy system of science and technology talent evaluation has been gradually improved in a systematic and hierarchical direction. The term "talent evaluation" has clearly appeared in the policies in recent years, which shows that science and technology talent evaluation has received the attention of national leaders. The establishment and implementation of science and technology talent evaluation is imminent, and the policies have played a unique guiding role and control function in it. Therefore, the quality of the policies will directly affect whether the science and technology talent evaluation can be done well, for a long time, and steadily.

4.1.2 From "technology development" to "technology innovation"

In the early days of reform and opening up, Deng Xiaoping emphasized that "science and technology are the primary productive forces", and the revitalization of science and technology aimed at liberating and developing social productive forces, improving comprehensive national strength and Chinese status in the world. At this time, science and technology only stayed at the level of imitating foreign advanced technology, and "science and technology development" was the theme of the field of science and technology during this period. Over the past 40 years, with the joint efforts of the majority of science researchers and the correct leadership of the Party Central Committee, Chinese science and technology undertakings

have achieved a huge leap from "follow-up" to "three-run coexistence". A series of major strategies proposed by national leaders have provided strong support for the gradual transition of science and technology development to enhancing independent innovation capabilities. Technology self-reliance and self-improvement has become the most resounding science and technology slogan in China today, and "science and technology innovation" has naturally become an important guarantee for China to deepen science and technology reform and become the forefront of innovative countries. The transformation from "science and technology development" to "science and technology innovation" is reflected in the science and technology talent evaluation policies, which also shows that the science and technology talent evaluation also needs to closely follow the pace of Chinese science and technology progress, and gradually transform into a science and technology talent evaluation system that can match the current level of science and technology and conform to Chinese characteristics in the new era.

4.1.3 Unequal distribution of policies with different strengths

The number of administrative regulations in Chinese science and technology talent evaluation policies ranks first, and the second and third are the internal party laws and regulations and departmental rules, and the difference in the number of the three is relatively large, which shows that the science and technology talent evaluation policies of different strengths account for unbalanced ratio (Gan et al., 2022), unbalanced distribution or even lack of policies with different strengths will affect the overall and systematic development of Chinese science and technology talent evaluation, so it needs to be adjusted to a certain extent. In addition, policies of different official document types also need to be properly used in Chinese science and technology talent evaluation policies system. Because of their different properties and uses, they can be effective within their respective scope of application.

4.1.4 Lack of cooperation between departments

It can be seen from the above analysis that the General Office of the Central Committee of the Communist Party of China, the General Office of the State Council, and the Ministry of Science and Technology have contributed the main force in the publication of Chinese science and technology talent evaluation policies of joint departments, but the number of joint publications is relatively small, the inter-governmental cooperation is insufficient (Y. Tan et al., 2019), and there is a lack of timely communication and information sharing. The proportion of the number of joint policy documents on a certain topic can reflect the degree of perfection of the national policies on the topic. The multi-departmental joint documents can enhance the level, system, and rationality of the policy content, and reduce the one-sidedness and unscientific nature of policies, such as measures and opinions. Therefore, the lack of multi-departmental cooperation in the formulation of the science and technology talent evaluation policies will undoubtedly hinder the improvement of the science and technology talent evaluation policy system.

4.1.5 Comparison of the policy characteristics of every period

The science and technology talent evaluation policies in the period of restoration and adjustment are mainly characterized by loosening and unclear pointing, in this period, science and technology talent evaluation does not appear in the form of a clear concept, but is reflected in fragmentary fragments of relevant thematic policies. The policies in this period mainly emphasize the initial development of science and technology, the work specification of scientific researchers and the rectification of the scientific research team, and the policy makers are not fully aware of the importance of science and technology talent evaluation;

with the arrival of the period of revision and consolidation, the joint development of enterprises and schools, innovation and sustainable development become the main tasks of this stage. During the years when sustainable development strategy and science and education strategy were elevated to national strategy, compared with the previous period, the state's attention to science and technology innovation increased significantly, and the relevant policies were more detailed than the previous period, and the main subjects of scientific research were mainly schools and enterprises, and the corresponding incentive evaluation system was established for the scientific and technological talents within the two, which laid the foundation for the improvement of incentive evaluation in the later periods; the content of science and technology talent evaluation policies in the period of deep development mainly reflects the characteristics of independent innovation in science and technology, and further improves the talent evaluation and talent incentive system, and the content of science and technology talent evaluation is more specific; at the same time, the internationalization and cooperation of science and technology innovation are also emphasized in this period, and the development of science and technology shows an open and inclusive trend; the most significant feature of the period of continuous innovation is that the most distinctive feature of the period of continuous innovation is that the term "science and technology talent evaluation" formally appeared in the evaluation policies of scientific and technological talents during this period, which shows that Chinese policy makers attach great importance to this event. A careful observation shows that many of the policies in this period were jointly formulated by multiple departments, which indicates that the joint efforts and testimonies of all parties and industries are necessary to promote the development of the evaluation of scientific and technological talents (Wang et al., 2023; Wang & Feng, 2022), and the continuous optimization of the evaluation of scientific and technological talents is inevitable.

4.2 Recommendations

4.2.1 Establish a multi–dimensional policy system

There are still many deficiencies in the content of Chinese talent evaluation policies. For example, it still requires time and constant policy reform to break the "Four-only", and talent evaluation objects and talent evaluation methods need to be further accurately calibrated. With the deepening of the concept of science community, the development of science and technology can no longer be completed by independent individuals, and science and technology talents are more in the form of groups, which are the main body of science activities. Therefore, when evaluating science and technology talents, it is necessary to consider setting different evaluation standards and methods for individual talents and talent groups. Team benefits and individual contributions need to be included in the science and technology talent evaluation system. At the same time, the single evaluation standard of science and technology talents should be avoided (Li & Hu, 2020; Wang, 2022b). It is necessary to implement diversified evaluation methods according to factors such as the type of science and technology talents, and adopt various methods such as assessment, review, performance measurement, etc. The number of papers, professional titles, and funding cannot simply be used as the only criteria for the science and technology talent evaluation, and a multi-dimensional system of science and technology talent evaluation policies should be established to enrich the connotation of science and technology talent evaluation, and give science and technology talents more development potential.

4.2.2 Improve the supporting policies

The science and technology talent evaluation is a long process of dynamic, continuous development and progress, so it is not a scientific approach to fix the existing evaluation standards. Science and technology talents are followers of the times and have their own development laws. Set a reasonable period of talent evaluation and assessment, constantly track the effect of science and technology talent evaluation, grasp science and technology research hotspots, implement dynamic talent evaluation, and establish a science and technology talent tracking and evaluation system. It helps to unify the science and technology talent evaluation system with the growth law of science research personnel and exert the best effect of talent evaluation. In addition, improving the science and technology talent evaluation and feedback system is an inevitable way to optimize the science and technology talent evaluation. Evaluation feedback standards such as science and technology output income and science and technology innovation achievements should be established to dynamically adjust the content of science and technology talent evaluation policies.

4.2.3 Policy formulation moves closer to multi–departmental coordination

The formulation of science and technology talent evaluation policies lacks inter-departmental cooperation, and science and technology talent evaluation requires the joint efforts of multiple departments (Y. Tan et al., 2019). The science and technology talent evaluation involves many aspects, such as fund allocation, industry standard formulation, science and technology development, education reform, etc. Therefore, the participation of relevant departments is also required when formulating relevant policies, so as to make the content of policies more reasonable and avoid mistakes, which can reduce the effect of policy implementation in the process of practice. In addition, after a policy is implemented, an effective supervision system can track the implementation of the policy and give praise or punishment. The upper and lower departments should maintain information communication and enhance interaction at any time, so the superiors issue policies and orders on time, and the subordinates need to implement them correctly and report to the superiors.

5 Implications and future research

Through the analysis of science and technology talent evaluation policies, this paper explores the evolution process of Chinese science and technology talent evaluation policies in recent years, so as to improve the construction and reform of science and technology talent evaluation theory, which has positive theoretical implications. Through data collation and analysis, we can understand the current situation of Chinese science and technology talent evaluation policies, and find out the shortcomings of Chinese science and technology talent evaluation policies, such as the absence of policy-making departments, low number of policies, scattered policy themes, unclear content, etc. Accordingly, we put forward corresponding suggestions, which will help policymakers to formulate more feasible plans and allocate resources reasonably. It also provides a fulcrum for the science and technology talent evaluation workers to understand the national policies. This has positive practical implications.

Due to the limitation of space, there are few policy texts selected in this paper, and more policies will be studied in the future. In addition, the deficiency of the policies can be analyzed and explained from the perspective of the regional implementation situation and feedback effect of the policies, and a comparison of the characteristics and content of domestic and international policies also allows for a more comprehensive critique and correction of domestic policies.

Acknowledgements

This research is funded by Hebei Social Science Foundation Project (grant no. HB23TQ009).

References

Cao, Q. W. (2020). Contradiction between input and output of Chinese scientific research: A multidimensional analysis. *Scientometrics, 123* (1), 451–485.

Chen, B. L., & Fan, L. H. (2015). How to innovate the evaluation mechanism of scientific and technological talents. *Chinese Talents, 485* (17), 24–25.

Chen, H. N. (2021). Practice and reflections on the reform of scientific and technological talent evaluation: Taking the Chinese Academy of Agricultural Sciences as an example. *Science and Technology Talents of China, 57* (01), 53–58.

Deng, Z. L. (2020). International experience and enlightenment of German scientific and technological talent development and assessment. *Chinese Personnel Science, 32* (8), 49–58.

Faber, I. R., Nijhuis–Van der Sanden, M. W. G., Elferink–Gemser, M. T., & Oosterveld, F. G. J. (2015). The Dutch motor skills assessment as tool for talent development in table tennis: A reproducibility and validity study. *Journal of Sports Sciences, 33* (11), 1149–1158.

Feng, T. Y. (2007). The status quo of the scientific and technical talents´ evaluation with the innovation and choice of evaluation methods. *Science Research Management, 147* (S1), 30–34.

Gan, Y. H., Hou, S. C., & Zou, L. J. (2022). An analysis of the texts of China´s policies for S&T talents evaluation from the perspective of policy tool. *Science Research Management, 43* (3), 55–62.

Grigoriev, A., & Mondrus, O. (2002). Managing academic performance by optimal resource allocation. *Scientometrics, 127* (5), 2433–2453.

Huang, X.Z., Wang, G., Chen, C., Liu, J.S., Kristiansen, B., Hohmann, A., & Zhao, K.W. (2020). Constructing a talent identification index system and evaluation model for cross–country skiers. *Journal of Sports Sciences, 39* (4), 368–379.

Jost, B., Pustovrh, J., Ulaga, M., & Leskosek, B. (2002, September). Expert system for talent evaluation from the longitudional aspect. In *Proceedings of the 3rd International Scientific Conference on Kinesiology New Perspectives* (pp. 190–198). CNKI.

Lan, L. (2016, May). Analysis on the factors influencing the validity of quality talents evaluation. In *Proceedings of the 2016 6th International Conference on Applied Science, Engineering and Technology* (pp. 340–344). CNKI.

Li, F., & Hu, J. F. (2020). The status quo and consideration of the evaluation of scientific and technological talents in China. *China Medicine and Pharmacy, 10* (20), 237–240.

Li, J. F. (2014). We will deepen the reform of the mechanism for evaluating scientific and technological talents in universities. *China Higher Education, 529* (18), 53–55.

Li, L. A., Qu, L., & Liu, W. (2021). Research on the evaluation of science and technology talents based on bibliometrics. *Journal of Library and Information Science, 6* (4), 72–79.

Li, S. H., Luo, J. L., & Tian, R. X. (2009). The thought of the construction of the evaluation and selection of science and technology talents. *Science & Technology Progress and Policy, 26* (14), 148–150.

Li, Y., & Xu, P. Y. (2012). Research on the quantitative evaluation methods of academic impact of science and technology talents both in China and abroad. *Journal of Medical Intelligence, 33* (8), 38–43.

Liu, H. (2021). Discuss on several key initiatives of the reform of evaluation about scientific and technological talents. *Science and Technology Talents of China, 57* (1), 18–23.

Liu, Y. J., Pan, Y. T., & Zhao, X. Y. (2017). Research on establishment of multiple indices system of high–level technological talents. *Science and Technology Management Research, 37* (24), 61–67.

Park, M., Leahey, E., & Funk, R.J. (2023). Papers and patents are becoming less disruptive over time. *Nature, 163,* 138–144.

Qing, J., & Cheng, S.C. (2008, October). Thinking on talent quality evaluation in human resource management. In *Proceedings of the 3rd International Conference on Product Innovation Management* (pp. 409–412). CNKI.

Sheng, N., Meng, F. X., Jiang, B., & Li, W. Z. (2016). A research on the establishment of S&T talents evaluation system from the perspective of innovation driven strategy. *Science Research Management, 37* (S1), 602–606.

Sun, W. (2012, December). Research of evaluation of new computer complex talents. In *Proceedings of Pacif–ic–Asia Conference on Knowledge Engineering and Software Engineering* (pp. 63–68). CNKI.

Tan, C. H., Liang, Y. L., Wei, W. J., Diao, P., & Chen, X.Q. (2022). The text measurement and optimization of China´s science and technology personnel evaluation policy based on the four–dimensional analytical angles. *Information Science, 40* (3), 63–71.

Tan, C., Wang, Y., & Zeng, Y. (2019). Policy text analysis of agricultural informatization from the perspective of policy instrument. *Journal of Information Resources Management, 9* (4), 101–111.

Tan, Y., Wu, X., & Li, M. (2019). Research on change of evaluation and incentive policy of scientific and techno–logical talents: Based on the analysis of the policy text of 1978–2018. *Science & Technology and Economy, 32* (5), 66–70 .

Tian, Y., & Zhang, M. Q. (2007). The evaluation index system of scientific & technology talent in military enter–prise and demonstration study. *Science and Technology Management Research, 176* (10), 92–94.

Wang, R. (2012). Establishment of evaluation index system for logistics enterprise innovative sci–tech talents. *Logistics Technology, 31* (13), 259–261.

Wang, X. (2022a). Research on the discourse power evaluation of academic journals from the perspective of multiple fusion: taking Medicine, General and Internal journals as an example. *Journal of Information Sci–ence,* 01655515221107334.

Wang, X. (2022b). Characteristics analysis and evaluation of discourse leading for academic journals: Perspec–tives from multiple integration of altmetrics indicators and evaluation methods. *Library Hi Tech, Vol. ahead–of–print No. ahead–of–print*. https://doi.org/10.1108/LHT–04–2022–0195

Wang, X., & Feng, X. (2022). Research on the relationships between discourse leading indicators and citations: Perspectives from altmetrics indicators of international multidisciplinary academic journals. *Library Hi Tech, 2022*. https://doi.org/10.1108/LHT–09–2021–0296

Wang, X., Feng, X., & Guo, K. (2023). Research hotspots and prospects of ethics education of science and technology in China based on bibliometrics. *Library Hi Tech, 41* (2), 454–473.

Wu, X. (2014). Research on the evaluation index system of high–level innovative talents. *Journal of Information Resources Management, 4* (3), 107–113.

Xing, X. X. (2021). The dilemma and countermeasures of the evaluation reform of scientific and technological talents in colleges and universities : Based on the perspective of evaluation index reconstruction. *Chinese University Science & Technology, 396* (8), 36–39.

Yang, Y. K. (2018). Construction and implementation of multi–evaluation system for innovative scientific and technological talents. *Economic Forum, 580* (11), 90–95.

Yang, Y. K., & Zha, Y. (2020). Enlightenment and reference from the experience of foreign scientific and tech–nological talents: A study based on Britain, the United States and Germany. *Scientific Management Research, 38* (1), 160–165.

Yang, L. H., & Shi, L. (2021). Policy evolution and typical case study of China´s scientific and technological tal–ents classification and evolution reform. *Science and Technology Talents of China, 57* (1), 24–29.

Zanotto, E. D. (2006). The scientists pyramid. *Scientometrics, 69* (1), 175–181.

Zhang, X., Jia, Y. F., Song, Y. J., & Zhao, B. (2020). Research on the construction of the classified evaluation index system of scientific and technological talents from the perspective of innovation chain. *Science and Management, 40* (6), 51–56.

Zhang, X. J. (2013). Research on the index system of industry oriented scientific and technological talents eval–uation. *Science & Technology Progress and Policy, 30* (12), 137–141.

Zhao, L., & Nie, G. H. (2007, December). Synthetic evaluation of technical talents´ performance based on blur theory. In *Proceedings of the 4th International Conference on Innovation and Management* (pp. 2443–2446).

CNKI.

Zhao, Q. (2018). Electromobility research in Germany and China: Structural differences. *Scientometrics, 117* (1), 473–493.

Zhao, W., Bao, X. H., Qu, B. Q., & Lin, F. F. (2013). Building of classification evaluation index system of innovative scientific & technical talents. *Science & Technology Progress and Policy, 30* (16), 113–117.

Zhao, W., Bao, X. H., Qu, B. Q., & Lin, F. F. (2014). Building of evaluation index system of innovative scientific & technical talents in basic science research field. *Science & Technology and Economy , 27* (1) , 81–85.

Zhu, Z. Z., Su, W. Z., & Wang, Y. S. (2011) . An opinion on the problems of evaluation of Chinese science and technology talents. *Science and Technology Management Research, 31* (15) , 132–135.