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Evaluation Study on Scientific and Technological Achievements of Enterprise Based on PDCA Cycle: Taking Tobacco Enterprises in Shaanxi Province as an Example

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Abstract: The scientific and technological evaluation plays an important role in the transformation, application and promotion of scientific and technological achievements. The establishment of the evaluation indicator system on scientific and technological achievements can accelerate the cultivation of new quality productivity of enterprises. The PDCA cycle was introduced into the process of evaluating the scientific and technological achievements of enterprise, which was specifically divided into four stages: the evaluation objectives and plan formulation stage (P), the evaluation indicators design stage (D), the scientific and technological achievements evaluation stage (C), and the evaluation effect improvement stage (A). The evaluation indicator system of scientific and technological achievements was designed from the dimensions of quality, performance and contribution. The results of reliability and validity test and entropy method analysis showed that the constructed evaluation indicator system was reliable and effective. Taking the scientific and technological projects of technological development type of tobacco enterprises as examples, the evaluation system on scientific and technological achievements was verified in order to provide new ideas and methods for the evaluation process management of scientific and technological achievements.

Keywords: Scientific and Technological Achievement; PDCA Cycle; Evaluation Indicator; Tobacco Enterprise; Entropy Method.

1. Introduction

The evaluation of scientific and technological achievements is one of the important links of scientific and technological projects management, and it is the follow-up stage of project acceptance evaluation. The evaluation of scientific and technological achievements of tobacco enterprise is mainly to evaluate the scientific and technological projects objectively and scientifically, so as to promote the transformation and application of scientific and technological project outputs and effectively improve the level of scientific and technological project management in the industry. The *Opinions on Deepening the Reform of Project Review, Talent Evaluation and Institutional Assessment* issued by the General Office of the CPC Central Committee and the General Office of the State Council of the People's Republic of China pointed out that evaluation should adhere to the problem orientation and pay more attention to quality, contribution and performance. Therefore, research on the evaluation of scientific and technological achievements of enterprise and the design of quality indicators, performance indicators and contribution indicators that can measure scientific and technological projects are helpful to enhance the quality of scientific and technological projects, enhance the ability of scientific and technological innovation, and promote the formation of new productivity of enterprises.

The existing research on science and technology evaluation mainly focuses on evaluation content, classification evaluation and evaluation methods. In terms of evaluation content, Gao pointed out that the quality evaluation of scientific and technological achievements with innovation and contribution as the core covers both internal and external quality, taking into account the needs of various stakeholders [1]. Lai et al. established the evaluation indicator system of scientific and technological achievements with clinical value, academic influence, achievement level and achievement benefit as the main evaluation contents [2]. By analyzing the problems existing in the management of scientific and technological projects, Wang et al. established the evaluation indicator system of the whole process management of scientific and technological projects from the aspects of project management, implementation process management, fund management, acceptance management and application management [3]. In terms of classification evaluation, due to the diversity of scientific and technological projects, the evaluation system of its achievements is also different. There are usually basic theoretical achievements, application technological achievements, soft scientific research achievements, etc., and there are obvious differences in content and expression forms of achievements [4]. Some scholars took the clinical scientific and technological achievements of traditional Chinese medicine as the research object, and established a multi-dimensional evaluation index system [2]. In terms of evaluation methods, the existing literature usually used analytic hierarchy process to determine different index weights and evaluate scientific and technological achievements [5, 6].

In summary, it can be seen that the existing research results have made useful explorations in the field of scientific and technological evaluation, which has important guiding significance for the management of scientific and

technological projects of enterprise. There are still the following deficiencies. First, the existing research is less based on the scientific and technological evaluation cycle to carry out the evaluation of scientific and technological achievements, ignoring the continuous improvement of the evaluation results in the time dimension of scientific and technological projects, and failing to respond in a timely manner to changes in the demand for scientific and technological achievements. Secondly, few scholars evaluate the scientific and technological achievements of enterprise from quality, performance and contribution, and fail to form an operational evaluation system. Third, the existing research is relatively lacking in the exploration of scientific and technological achievements evaluation methods, failing to effectively avoid the interference of subjective factors. Therefore, the paper introduces the PDCA cycle, designs the evaluation indicators on scientific and technological achievements of enterprise from three dimensions, and uses the entropy method to calculate the weight of each indicator, which provides scientific basis for the final evaluation results, so as to realize the evaluation objectives of scientific and technological achievements of tobacco enterprises.

2. Theoretical Foundation of Scientific and Technological Achievements Evaluation

The PDCA cycle theory refers to the continuous process of planning (P), doing (D), checking (C), and acting (A) in management activities, and a PDCA cycle can be divided into four stages according to the work process [7, 8]. The first is the planning stage. Develop a plan program based on the current status of management activities and set objectives and standards. The second is the doing stage. Mainly according to the plan implementation, orderly carry out the work, and reflect the implementation process. The third is the checking stage. Focus on the inspection, analysis, evaluation of the actual implementation of the effectiveness, to verify the realization of the objectives. The fourth is the acting stage. It is necessary to analyze and summarize the evaluation results, identify and improve the problems. The acting stage is both the end of the current cycle and the beginning of the next one. This process repeats itself, forming a progressively advancing relationship. It continuously improves all aspects of the cycle, driving it to spiral upward.

The evaluation of scientific and technological achievements is a process of continuous circulation and continuous improvement. With the help of the PDCA cycle, some problems are solved and some improvements are made through one cycle, and the next cycle is started with the unsolved problems [9]. And so on and so forth, it should be continuously improved so as to achieve the expected evaluation objectives of scientific and technological achievements. This continuous cycle of repetition, improvement, and enhancement ultimately helps to achieve the desired objectives for the evaluation of scientific and technological achievements. After the scientific and technological project passes the acceptance evaluation, a management process is formed based on the PDCA cycle theory and combined with the evaluation requirements of scientific and technological achievements of enterprise. This process covers four stages: the evaluation objectives and plan formulation stage (P), the evaluation indicators design stage (D), the scientific and technological achievements evaluation stage (C), and the evaluation effectiveness improvement stage (A), see Figure 1.

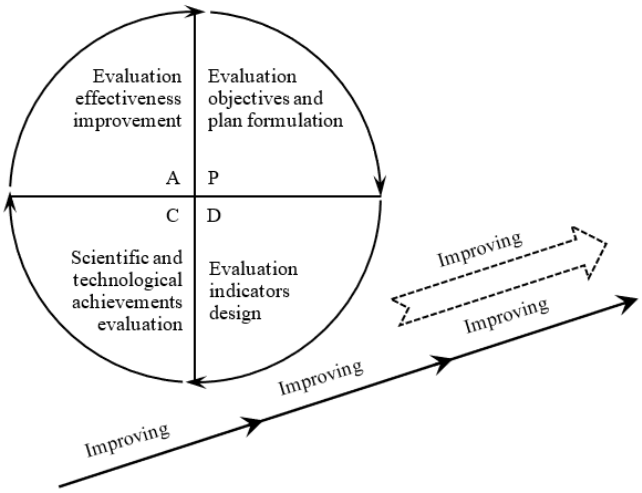


Figure 1. PDCA cycle for evaluation on scientific and technological achievements of enterprise

It can be seen from Figure 1 that the evaluation objectives and plan formulation stage focus on determining the overall objectives of the evaluation on scientific and technological achievements of enterprise, providing effective information for specific evaluation schemes, and forming a reasonable evaluation plan. In the evaluation indicators design stage, the characteristics of enterprise scientific and technological projects can be analyzed through field research, and the evaluation indicators on scientific and technological achievements can be designed by referring to relevant research results, and it can be refined and improved. In the scientific and technological achievements evaluation stage, based on the scores of evaluation indicators in different dimensions, scientific methods are used to quantify and sort, and scientific and technological achievements are evaluated regularly. The evaluation effectiveness improvement stage is the last stage of the PDCA cycle, which needs to judge the strengths and weaknesses of the scientific and technological projects and the corrective measures to be taken according to the evaluation results of enterprise scientific and technological achievements. The evaluation results not only provide an important basis for the follow-up development, but also guide the improvement of the next round of scientific and technological achievements evaluation objectives and plan.

3. Evaluation Objectives and Plan Formulation on Scientific and Technological Achievements of Enterprise

The planning stage (P) of the evaluation on scientific and technological achievements of enterprise is the beginning of the PDCA cycle and the end of the previous cycle. The evaluation objectives and plans of this cycle should be formulated on the basis of absorbing successful experience and analyzing the remaining problems. The formulation of evaluation objectives and plans is an important basis for the subsequent evaluation indicators design stage (D), the scientific and technological achievements evaluation stage (C), and the evaluation effectiveness improvement stage (A), and has a certain guiding role. According to the PDCA cycle process, the evaluation process of scientific and technological

achievements of enterprise is analyzed by means of fishbone diagram [10], and the evaluation objectives and planning process on scientific and technological achievements of enterprise are summarized, see Figure 2.

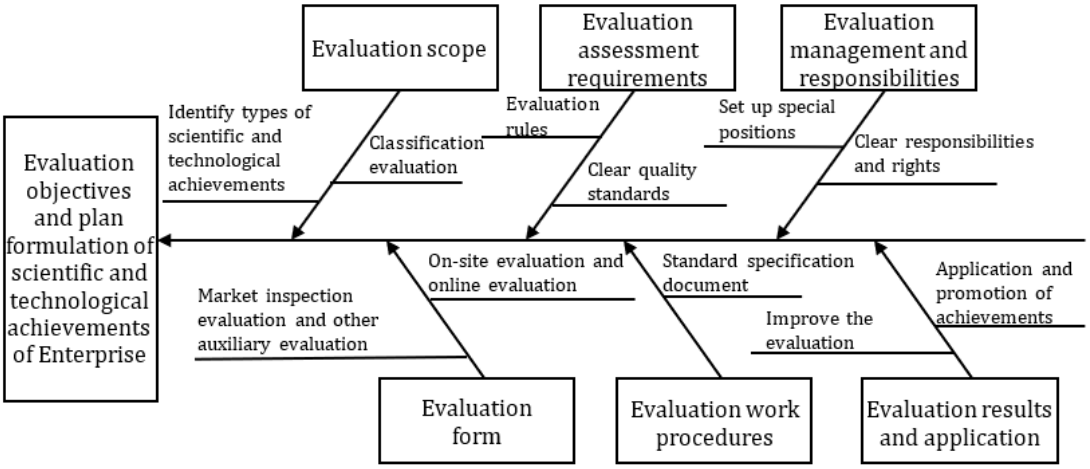


Figure 2. Analysis of the evaluation objectives and plan formulation stage on scientific and technological achievements of enterprise from the perspective of PDCA cycle

3.1. Objectives Formulation

The formulation of evaluation objectives on scientific and technological achievements of enterprise is a complex process to meet the development needs of technology research and development, product and service innovation, business development and market competition, with the core of promoting the transformation of achievements and expanding the use of achievements [9]. The formulation of evaluation objectives of scientific and technological achievements needs to analyze the returns and risks of scientific and technological projects of enterprise, understand the contribution to the industry, and provide reference and guidance for further research and development, promotion and application of scientific and technological projects, so as to improve the efficiency of scientific and technological project management.

3.2. Plan Formulation

The formulation of the evaluation plan of scientific and technological achievements is a pre-planning of the evaluation work. It should be based on the evaluation objectives and combined with the requirements of enterprises for the evaluation of scientific and technological achievements. It should clarify the scope of the evaluation, the form of the evaluation, the requirements of the evaluation, the management and responsibilities of the evaluation, the evaluation work procedures, the results of the evaluation and the application. There are differences in the evaluation focus of different types of scientific and technological achievements. The evaluation scope should be determined according to the types of scientific and technological achievements, and the classification evaluation of scientific and technological achievements should be carried out. According to the type of scientific and technological achievements, the purpose and needs of the evaluation, mainly adopting on-site evaluation and online evaluation as the main, a variety of evaluation forms combined comprehensive evaluation [11]. In order to achieve the expected evaluation objectives, the evaluation requirements need to clarify the basic rules of the evaluation work and the quality standards to be achieved, so as to ensure the scientific, comprehensiveness, objectivity and practicability of the evaluation results. The evaluation work procedures mainly clarifies the tasks and operation processes of each stage in the form of standard specification documents, and improves the procedure and standardization of the work execution in the subsequent stage of the cycle. The evaluation management process should set up the corresponding evaluation positions, clarify the responsibilities and rights of the staff, and record and monitor the work procedures. The evaluation results are mainly used to improve the next round of evaluation of scientific and technological achievements, to effectively promote the application and promotion on scientific and technological achievements of enterprise.

4. Design of Evaluation indicators system on Scientific and Technological Achievements of Enterprise

The design of evaluation indicators belongs to the doing stage (D) in the PDCA cycle of scientific and technological achievements evaluation of enterprise. Based on the design principles of scientificity, orientation and independence, the evaluation indicators of scientific and technological achievements are designed from different dimensions.

4.1. Design Principles of Evaluation Indicators

Drawing on existing results, the design of evaluation indicators on scientific and technological achievements of enterprise should satisfy the following three principles [12, 13]. First, the principle of scientificity. The indicators should be able to objectively reflect the level of enterprise science and technology projects, and the connotation of each indicator is clear. Second, the principle of orientation. The setting of the indicator system should be conducive to reflecting the objectivity, accuracy and authenticity of the evaluation on the scientific and technological achievements of enterprise, and screening the indicators of the evaluation on scientific and technological achievements of enterprise from multi-dimensional aspects. Third, the principle of independence. On the basis of clear connotation of the indicators, the indicators

should be independent of each other, and the connotation of the indicators in the same dimension should not overlap with each other. The indicators are not causal or contradictory to each other, and they can maintain a good independence.

4.2. Design of Evaluation Indicators System

Based on the *Opinions on Deepening the Reform of Project Review, Talent Evaluation and Institutional Assessment* (2018) issued by the General Office of the CPC Central Committee and the General Office of the State Council of the People's Republic of China, quality, performance and contribution are used as the first-level indicators for the evaluation on scientific and technological achievements of enterprise. According to the design principles of evaluation indicators, combined with the *General rules of science and technology research project evaluation* (GB/T 22900-2022) issued by the State Administration for Market Regulation and the National Standardization Administration, and the field research situation, the evaluation indicator system on scientific and technological achievements of enterprise is designed, which mainly covers 3 first-level indicators and 16 second-level indicators, see Table 1.

Table 1. Evaluation indicators system on scientific and technological achievements of enterprise

Target layer	First-level indicators	Second-level indicators
Evaluation on scientific and technological achievements of enterprise (K)	Quality Evaluation (K_1)	Content completion (K_{11})
		Target realization (K_{12})
		Feasibility (K_{13})
		Reliability (K_{14})
		Difficulty of achievements (K_{15})
		Textual normativity (K_{16})
	Performance Evaluation (K_2)	Achievement innovation (K_{21})
		Number of innovation points (K_{22})
		Marked outcome level (K_{23})
		Efficiency of scientific and technological input (K_{24})
	Contribution Evaluation (K_3)	Advancement of achievements (K_{31})
		Industry contributions (K_{32})
		Application, promotion and transformation of achievements (K_{33})
		Value of achievements (K_{34})
		Economic, social and ecological benefits (K_{35})
		Radiation and driving effect of achievements (K_{36})

4.2.1. Quality Evaluation

In accordance with the *General rules of science and technology research project evaluation* (GB/T 22900-2022) and other relevant guidelines, the indicators of "content completion" and "target realization" are designed as second-level indicators. The former is used to measure the quality of completion of the research content on scientific and technological projects of enterprise. The latter is used to measure the quality of scientific and technological projects in realizing the expected research objectives. Drawing on existing research results, "feasibility", "reliability" and "difficulty of achievements" are designed as second-level indicators [14, 15]. Among them, the indicator of "feasibility" is used to measure whether the output achievements on scientific and technological projects of enterprise are applicable or operable. The indicator of "reliability" is used to measure the accuracy of the information and data required by the scientific and technological project, and the rigor of the relevant argumentation, etc. The indicator of "difficulty of achievements" measures the complexity or research difficulty of the outputs of the scientific and technological project. In addition, combined with the results of field research, in view of the non-standard phenomenon in the research reports on scientific and technological projects of enterprise, the indicator of "Textual normativity" is designed in the evaluation dimension of quality of scientific and technological achievements, which is used to measure the standardization degree of report writing related to scientific and technological projects of enterprise.

4.2.2. Performance Evaluation

With reference to the existing research results, two second-level indicators of "achievement innovation" and "number of innovation points" are designed to measure the innovation degree of the achievement of scientific and technological project [15, 16]. In order to avoid the bad tendency of emphasizing quantity and neglecting quality, and implement the *Guidance of the General Office of the State Council on Improving the Evaluation Mechanism of Scientific and Technological Achievements*, which puts forward the requirement of "Paying attention to high-quality intellectual property output, taking new technology, new materials, new processes, new products, etc. as the main evaluation indicators". In the evaluation of performance, the second-level indicator of "iconic achievement level" is designed to measure the output level on scientific and technological achievements of enterprise. In addition, in order to improve the performance of scientific and technological input and output of enterprises and improve the effectiveness of scientific and technological projects management, according to the relevant guidelines such as *General rules of science and technology research project evaluation*, combined with the results of field research, the indicator of "efficiency of scientific and technological input" is designed to measure the matching of funds input and output of scientific and technological projects.

4.2.3. Contribution Evaluation

The evaluation on scientific and technological

achievements of enterprise should pay attention to the actual contribution to the development of the industry, the discipline field and even the whole society, and guide the scientific and technological projects to solve the practical problems in the process of enterprise scientific and technological innovation. Referring to the existing research results [2, 6], the paper designs five second-level indicators of “advancement of achievements” “industry contribution” “application, promotion and transformation of achievements” “value of achievements” and "economic, social and ecological benefits”. Among them, the indicator of “advancement of achievements” is used to measure whether the achievements of scientific and technological projects are at an advanced level in the international, domestic or industry. The indicator of “industry contribution” is used to measure whether companies have discovered and solved major problems in the process of technology development or industry development, which mainly reflects the direct contribution of scientific and technological projects. The indicator of “application, promotion and transformation of achievements” is used to measure the actual application, promotion and transformation of the output achievements of projects in the industry, including the application field, promotion scope, transfer and industrialization of achievements. The indicator of “value of achievements” is used to measure the technical value and scientific value of the continuous formation of the output achievements of scientific and technological projects, including the value of promoting the development of industry and users. The indicator of "economic, social and ecological benefits” is used to measure the economic, social and ecological benefits realized by the achievements of scientific and technological projects. In addition, according to the *General rules of science and technology research project evaluation* the indicator of “radiation and driving effect of achievements” is designed to measure whether the scientific and technological achievements produced by enterprises through scientific research projects can form a demonstration effect, promote the efficient connection between the achievements and the practical application, and spur regional economic, cultural and scientific and technological synergistic development through technological diffusion and demonstration leadership.

5. Evaluation Results on Scientific and Technological Achievements of Enterprise (C)

In the scientific and technological achievements evaluation stage (C), based on literature analysis and expert interviews, a questionnaire was designed to conduct field research on tobacco enterprises to collect relevant data and analyze them. These enterprises include Shaanxi Provincial Tobacco Company and all prefecture-level tobacco companies in Shaanxi Province (including Xi’an Tobacco Company, Baoji Tobacco Company, Ankang Tobacco Company, Yulin Tobacco Company, Yan’an Tobacco Company, Shangluo Tobacco Company, Hanzhong Tobacco Company, Weinan Tobacco Company, Tongchuan Tobacco Company, Xianyang Tobacco Company, Yangling Demonstration Zone Tobacco Company) and Xianyang Tobacco Redrying Co., Ltd.. In order to ensure the objectivity and reliability of the research results, the field research is mainly based on questionnaires and interviews. The respondents are limited to the management personnel of the tobacco company in Shaanxi Province and all prefecture-level tobacco companies and employees with experience in scientific research projects. A total of 280 questionnaires were distributed and 280 valid questionnaires were obtained, see Figure 3. The entropy method is used to empower the evaluation indicators, and the evaluation results are obtained accordingly.

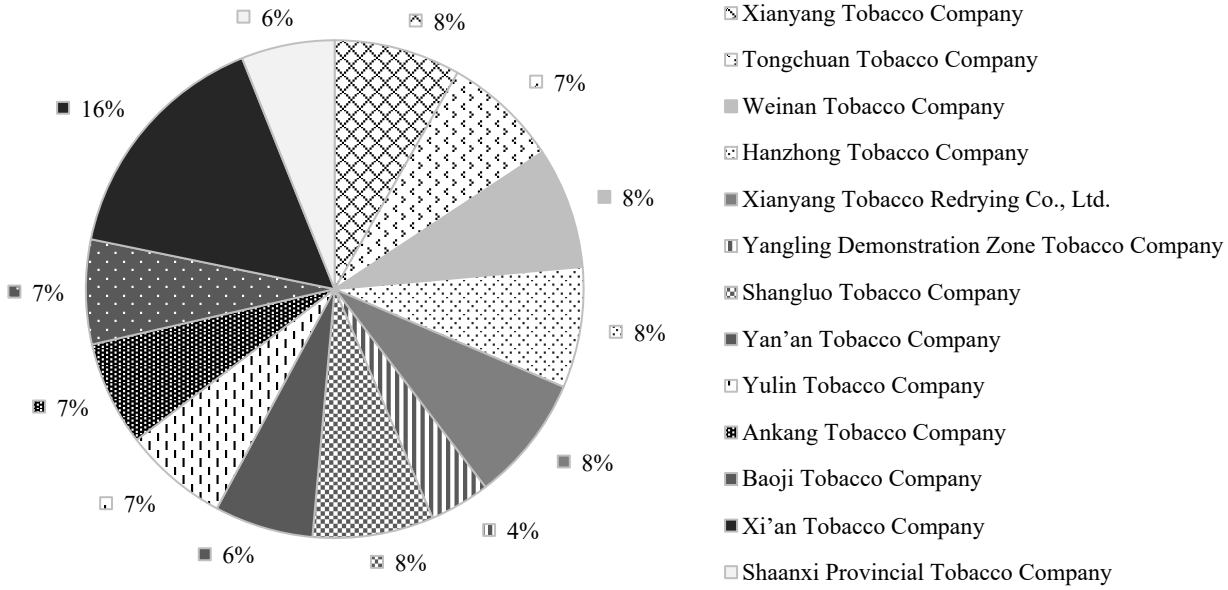


Figure 3. Distribution of questionnaires

5.1. Reliability and Validity Tests

In order to ensure the consistency and reliability of the indicator system, it is necessary to test the reliability of the scale, using Cronbach’s alpha, represented by α, and the threshold value is set to 0.7 [17, 18]. It is calculated that the overall reliability of the questionnaire for the evaluation on scientific and technological achievements of tobacco enterprises is 0.914, and the reliability of the three evaluation dimensions of quality, performance and contribution are 0.790, 0.749 and 0.853 respectively, which are all greater than 0.7, indicating that the questionnaire has high reliability and can ensure the reliability and consistency of the survey results.

The validity test is to analyze the validity of the survey data

and test the consistency between the questionnaire items and the research content. Generally, exploratory factor analysis is used to measure, and KMO value is used to judge [19]. It can be seen that the KMO values of the three dimensions of quality, performance and contribution are 0.803, 0.741 and 0.849, respectively, all greater than 0.7, and the Bartlett test is significant at the 1% level, indicating that the scale has good validity, see Table 2.

Table 2. KMO and Bartlett tests

	Kaiser–Meyer–Olkin measure of sampling adequacy	Bartlett's test of sphericity		
		Approx. Chi-square	df	Sig
Quality	0.803	515.332	15	0.000
Performance	0.741	272.334	6	0.000
Contribution	0.849	678.031	15	0.000

5.2. Determination the Weight of Evaluation Indicators

The entropy method is used to analyze the data of the questionnaire survey to determine the indicator weight. There is n people involved in the questionnaire survey, m evaluation indicators, x_{ij} (i= 1, 2, 3... n; j= 1, 2, 3... m) represents the score of the *ith* person to the *jth* indicator, then the initial judgment matrix is:

$$X = (x_{ij})_{n\times m}\begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{pmatrix} \quad (1)$$

First, the original data is standardized. The larger the positive indicator, the better, the smaller the reverse indicator, the better. The indicators used in the paper are all positive indicators, and the range standardization method is used to transform the indicator data dimensionlessly. The standard values are between 0 and 1. Then, the standardized values are processed by data translation. Referring to the data processing method of the existing results [20], the y_{ij} is obtained by translating the data of 0.0001 after the standardization of x_{ij} positive indicator. Finally, by calculating the information entropy e and redundancy d, the entropy weight w is obtained, and the specific formulas are as follows: Formula (2), Formula (3) and Formula (4).

$$e_j = -\frac{1}{ln(n)}\sum_{i=1}^{n}\frac{yij}{\sum_{i=1}^{n}yij}ln(\frac{yij}{\sum_{i=1}^{n}yij}), 0 \le e_j \le 1 \quad (2)$$

$$d_j = 1 - e_j \quad (3)$$

$$w_j = \frac{d_j}{\sum_{j=1}^{m}d_j} \quad (4)$$

Using the above formula, the weight of the evaluation indicators on scientific and technological achievements of tobacco enterprises is finally calculated, see Table 3.

Table 3. Weight of the evaluation indicators on scientific and technological achievements of tobacco enterprises

First-level indicators	Weight	Second-level indicators	Weight
K_1	0.203	K_{11}	0.025
		K_{12}	0.023
		K_{13}	0.053
		K_{14}	0.025
		K_{15}	0.055
K_2	0.265	K_{16}	0.022
		K_{21}	0.091
		K_{22}	0.069
		K_{23}	0.085
		K_{24}	0.020
K_3	0.532	K_{31}	0.032
		K_{32}	0.036
		K_{33}	0.088
		K_{34}	0.105
		K_{35}	0.099
		K_{36}	0.172

5.3. Evaluation Results and Analysis

In order to make the evaluation method simple and operable, the following steps can be used for calculation. The final evaluation results are divided into four grades: excellent (90≤S≤ 100), good (70≤S≤89), qualified (60≤S≤69), and unqualified (S≤59).

Firstly, determine the highest score of each indicator. According to the weight of each indicator, the highest score A_j of the indicator is determined. The formula is as follows.

$$A_j = w_j \times 100 \quad (5)$$

Secondly, calculate the score interval of each indicator. The score interval of each grade of each indicator is determined by the percentage of the score interval of the interval grade to the full score of the evaluation table. The percentages of the four grade score intervals are Q_s (s=1, 2, 3, 4; indicating excellent, good, qualified, and unqualified): excellent

(90%≤ Q_1 ≤100%), good (70%≤ Q_2 ≤89%), qualified (60%≤Q_3≤69%), and unqualified (Q_4≤60%). The formula for calculating the score interval of each level of the indicator is as follows.

$$A_{js} = A_j \times Q_s \tag{6}$$

Thirdly, conduct expert scoring. The evaluation table on scientific and technological achievements of tobacco enterprises is formed by Formulas (5) and (6). The evaluation experts are invited to score the scientific and technological projects according to the evaluation table, and the scores of 16 second-level indicators are obtained. The scores and total scores of the three first-level indicators of quality, performance and contribution are calculated by adding the scores of the evaluation indicators on scientific and technological achievements of tobacco enterprises, and ranked. In the paper, the scientific and technological achievements of technological development of tobacco enterprises in Shaanxi Province in 2023 were evaluated. Based on the protection of scientific and technological project information, the specific names of each scientific and technological project were hidden. Considering the limitation and clarity of the evaluation score table, only the first-level evaluation indicator score results and final ranking were provided, see Table 4.

Table 4. Evaluation score on scientific and technological achievements of tobacco enterprises

Number	Project	Quality		Performance		Contribution		Total score	
		Score	ranking	Score	ranking	Score	ranking	Score	ranking
1	Project1	20	3	20	2	41	3	81	2
2	Project2	17	8	19	4	37	6	73	8
3	Project3	24	1	21	1	47	1	92	1
4	Project4	15	10	16	9	34	9	65	9
5	Project5	20	3	18	5	38	5	76	5
6	Project6	16	9	15	10	34	9	65	9
7	Project7	20	3	18	5	43	2	81	2
8	Project8	20	3	20	2	35	8	75	6
9	Project9	22	2	18	5	40	4	80	4
10	Project10	15	10	15	10	33	11	63	11
11	Project11	20	3	18	5	37	6	75	6

Fourthly, analyze the evaluation results. According to the evaluation score on scientific and technological achievements of technological development of tobacco enterprises in Shaanxi Province in 2023, there are 1 scientific and technological projects with "excellent" (90~100 points), 7 scientific and technological projects with "good" (70~89 points) and 3 scientific and technological projects with "qualified" (60~69 points), see Figure 4.

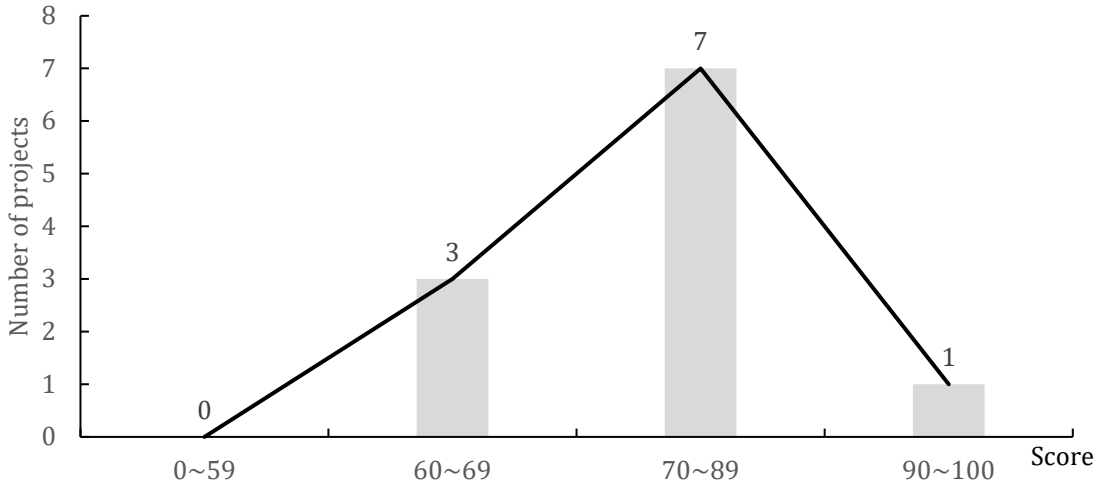


Figure 4. Evaluation results on scientific and technological achievements of tobacco enterprises

The horizontal comparison of the evaluation scores on scientific and technological achievements of tobacco enterprises shows that the total score of Project3 is the highest, among which the evaluation results of quality, performance and contribution are 24 points, 21 points and 47 points respectively, ranking first. The quality and performance evaluation results of Project8 are both 20 points, ranking in the top 3, but the contribution evaluation result is 35 points, ranking behind. The quality, performance and contribution evaluation results of project 10 scored the lowest, 15 points, 15 points and 33 points, respectively, ranking 11th. To sum up, the evaluation process on scientific and technological achievements of tobacco enterprises effectively avoids the interference of subjective factors. The evaluation results are generally normal distribution, which is basically consistent with the expected results. It verifies that the evaluation indicator system on scientific and technological achievements of enterprises proposed in the paper has good scientific,

objectivity and operability.

6. Evaluation Effectiveness Improvement on Scientific and Technological Achievements of Enterprise (A)

The evaluation effectiveness improvement stage (A) is the final stage of the PDCA cycle for the evaluation on scientific and technological achievements of enterprise. It mainly analyzes and applies the evaluation results of scientific and technological achievements in order to effectively improve the evaluation effectiveness. On the one hand, by analyzing the evaluation results on scientific and technological achievements of enterprise, the strengths and weaknesses of scientific and technological projects are judged, which points out the direction of improvement for the subsequent transformation, application and promotion of achievements, and also provides experience and attention for the industry to undertake and carry out scientific and technological projects. On the other hand, the evaluation results are applied to the next round of scientific and technological achievements evaluation process. It mainly includes summarizing the problems in the evaluation process and the corrective measures taken, and formulating an improved evaluation plan for scientific and technological achievements, and testing whether the indicators can effectively measure the quality, performance and contribution on scientific and technological achievements of enterprise. Revise the evaluation indicators in a timely manner with the changes in the needs of tobacco enterprises, and scientifically adjust the weights of the indicators. According to the feedback, the evaluation effectiveness on scientific and technological achievements of enterprise will be continuously improved.

7. Conclusion

The paper introduces the PDCA cycle theory into the evaluation system on scientific and technological achievements of enterprise, and divides the evaluation process into four stages that run in a cycle week after week: the evaluation objectives and plan formulation stage (P), the evaluation indicators design stage (D), the scientific and technological achievements evaluation stage (C), and the evaluation effectiveness improvement stage (A), which contributes to the standardization and systematization of the scientific and technological achievements evaluation system. Designing and refining the evaluation indicators of scientific and technological achievements from three dimensions of quality, performance and contribution solves the problem of insufficient clarity of the current scientific and technological evaluation orientation of enterprise to a certain extent. We obtain relevant data through field research, carry out reliability and validity tests, adopt entropy value method to calculate indicators weights, evaluate and classify the scientific and technological achievements of technological development of Shaanxi Province tobacco enterprises. It aims to provide scientific basis for tobacco enterprises to carry out evaluation of scientific and technological achievements, prompt the evaluation effectiveness to show a gradual upward trend with the increase in the number of cycles, and effectively enhance the ability of scientific and technological innovation, to achieve the goal of high-quality development of enterprises.

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References

[1] H. Gao: The time and space transformation of knowledge production and the paradigm transformation of evaluation model of scientific and technological achievements, Science & Technology Progress and Policy, Vol. 39 (2022) No. 2, p. 121-127.

[2] H.H. Lai, J.J. Guo, L.L. You, et al. Research on evaluation index system of scientific and technological achievements in traditional Chinese medicine clinical research, Chinese General Practice, vol. 27 (2024) No. 4, p. 3403-3410.

[3] Z.Z. Wang, X.Z. Zheng, C.F. Yu, et al. Evaluation of whole process management of tobacco R&D projects, Acta Tabacaria Sinica, Vol. 21 (2015) No.1, p. 107-111.

[4] X.A. Yang, Y. Xing and Y. Chen: Development practice and countermeasures of third-party evaluation of scientific and technological achievements in China, Science and Technology Management Research, Vol. 43 (2023) No. 4, p. 55-61.

[5] Z.J. Wang, M.P. Zhang, L.X. Tao, et al. Research on performance evaluation index system of scientific research projects in tobacco industry in Hubei Province based on analytic hierarchy process entropy weight method, Science Technology and Industry, Vol. 22 (2022) No. 6, p. 163-169.

[6] L.B. Li: Discussion on the improvement of the evaluation mechanism of scientific and technological achievements in colleges and universities, China University Science & Technology, (2021) No. S1, p. 24-27.

[7] Z.Y. Chen, J. Luo: Application of PDCA model in the whole-process quality management of science and technology programs: Taking key-area R&D program management in Guangdong Province as an example, Science and Technology Management Research, Vol. 42 (2022) No. 22, p. 169-176.

[8] M. Cao: Management mode of scientific research projects based on PDCA, *2016 International Conference on Management Science and Management Innovation* (Guilin, China, August 13-14, 2016). p. 128-130.

[9] Y. Zhang, Y.P. Liu, L.H. Chen, et al. Application and prospect of PDCA in evaluation of medical research achievements, Modern Hospital Management, Vol. 17 (2019) No. 4, p. 59-62.

[10] R. Sha, G. Wu: Application of PDCA cycle in quality improvement of science and technology projects, Science and Technology Management Research, Vol. 41 (2021) No. 6, p. 161-165.

[11] Information on http://www.hubei. gov.cn/zfwj/ ezbf/ 202112/ t20211221_3925755.shtm.

[12] B.K. Dong, Y. Yuan, X.K. Guo, et al. Quantitative study on market state evaluation system of new domestic cigarettes, Acta Tabacaria Sinica, Vol. 29 (2023) No. 2, p. 105-110.

[13] Q.H. Cai, R. Tao, Y.S. Zhang, et al. Construction of the theoretical foundation of value evaluation of public science and technology achievements, Science and Technology Management Research, Vol. 43 (2023) No. 3, p. 53-59.

[14] X.Z. Gao, C.C. Liu: Research on the performance evaluation indicator system of scientific and technological achievements

transformation project based on government perspective, Science & Technology Progress and Policy, Vol. 31 (2014) No. 12, p. 129-134.

[15] X. Wang, H. Shu, A.h. Hu, et al. Research on the construction of scientific and technological achievements management index system, Procedia Computer Science, Vol. 221 (2023), p. 81-85.

[16] F. Sun: Establishment of evaluation index system of applied scientific and technological achievements, China University Science & Technology, (2017) No. 4, p. 71-72.

[17] Y.F. Zou, Z.W. Xiao: Research on the formation mechanism of the pro-environmental behavior of enterprises in ecological advantage area, Journal of Statistics and Information, Vol. 37 (2022) No. 11, p. 117-128.

[18] T.S. Ruan, X.H. Li, Y. Gu: Value co-creation perception experience, digital platform interaction scene and disruptive innovation, Journal of Statistics and Information, Vol. 39 (2024) No. 5, p. 115-128.

[19] J. Zhou: *Questionnaire Data Analysis: Cracking Six Types of Analysis Ideas of SPSS (2nd Edition)* (Publishing House of Electronics Industry, China 2020), p. 50.

[20] H.F. Zhu, P.F. Shi, X.Y. Yu: Spatial adaptation analysis of digital village and high-quality development of rural tourism in Guizhou, Geography and Geo-Information Science, Vol. 40 (2024) No. 3, p. 143-150.