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Optimization of University Scientific Research Performance Evaluation Management Based on Back-propagation Artificial Neural Network

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Public audits in universities have exposed fraudulent practices in scientific research expenditure, posing a significant obstacle to progress. To address this issue, it is imperative to conduct risk assessment and analysis, thereby improving fund control and advocating for standardized research cost management. Such measures are crucial in alleviating the burden on institutions and researchers, fostering a more effective and efficient scientific research environment. In this study, an analysis of the factors affecting scientific research performance yielded three key elements: external environment, individual researchers, and information platform. After applying the nonlinear mapping ability and adaptability of back-propagation artificial neural network (BP-ANN) reverse neural network and obtaining simulation results for the generalization function of discrete information, we established a model for research performance evaluation. Subsequently, research cases were selected to conduct training and fitting experiments, ultimately scoring research performance through a comprehensive evaluation process. The experiment showed that the prediction results obtained using the BP-ANN algorithm, following learning from preprocessed samples, exhibit high accuracy. Moreover, these results can be updated and adapted with new sample inputs, highlighting the strong feasibility of this method.

1. Introduction

In recent years, public audits conducted by universities have revealed that several scientific research departments have engaged in fraudulent practices related to the misrepresentation and false listing of expenditures for scientific research.(1) In the same way, the constant scientific research cost detection and multiple fund management requirements make scientific research institutions and researchers overwhelmed and tired of them. Therefore, it is of considerable

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significance to further improve the risk control of scientific research project funds and further promote the normative and reasonable progress of scientific research cost management by conducting risk assessment and analysis on the management of scientific research project funds, systematically analyzing the main risk factors in the scientific research cost management of the main undertaking departments, and determining the main risk control categories and methods.

According to the analysis of foreign scientific research plan fund management, the United States has consistently adopted a decentralized model and jointly undertaken the preparation of national science and technology policies, regulations, and plans through the establishment of research coordination departments. In contrast, countries such as Canada, Germany, Russia, Japan, and others are characterized by having a centralized model.(2) Through the joint cooperation of the national technical director and the scientific research coordination organization, relevant national scientific and technological plans and measures are formulated to reasonably and effectively allocate national financial scientific and technological funds. In terms of cost accounting of scientific research plans, the United States, Canada, and other developed countries have long adhered to the single-project system model. They persistently advocate for the conceptualization of the total cost of scientific research activities, wherein national scientific research funds are defined as encompassing both direct funds and indirect costs. This approach involves the implementation of full cost compensation.(3) Under government supervision, national and local governments, relying on sound laws and regulations on the supervision of scientific research funds and a strong integrity management system, implement the whole-process supervision of scientific research funds and strengthen the punishment capacity to increase the cost of violations.

2. Materials and Methods

2.1 Related works

Scientific research project evaluations in European and American countries can be categorized into two types: overall scientific research performance evaluation and classified scientific research performance evaluation. The evaluation content varies, with some emphasizing the assessment of scientific research achievements, while others also scrutinizing the scientific research process.(4) The United Kingdom (UK) first conducted scientific research performance evaluation in 1986 and structured its evaluation into three categories: science, humanities, and art. Subsequently, disciplines were further delineated on the basis of these categories. The evaluation contents include scientific research personnel information, input and output data, research environment, and research reputation.(5) Wang *et al.*(6) conducted an assessment of the technical and scale performance of over 100 UK universities. In contrast, several other European countries started with classified scientific research performance evaluation. Moreover, Shen(7) conducted a multifaceted evaluation of Hungary's scientific research activities, considering academic level, education, research and development capability, international engagement, and funding accessibility. The weight of each indicator is determined by an expert committee and a management committee. Chen(8) evaluated the performance of 108 scientific research institutions affiliated with the Italian National Research Commission. The input indicators used were the amount of public funds, the number of registered personnel, and the cost of scientific research expenditure, whereas the output indicators were the number of students trained, the number of domestic publications, and the number of international conferences organized. The institutions with high- and low-performance outputs were analyzed in detail. According to Wang *et al*., the evaluation of scientific research performance in the United States emphasizes the overall performance.[6] Xia *et al*.[9] and Wu [10] conducted an empirical study on the scientific research inputs and outputs of American universities, and analyzed the technical and scale efficiencies of these universities by comparing the relative efficiencies of American public and private universities. Dai[11] proposed that the characteristic factors of different scientific research projects should be considered when conducting scientific research evaluation and that classified evaluation should be implemented. Australia is among the early adopters of scientific research performance evaluation. Unlike European and American approaches, Australia established its evaluation indicators primarily through quantitative methods, and scientific research income accounts for a high proportion of the indicator system.[12]

The existing research in China employs both qualitative and quantitative evaluation methods to assess the performance of scientific research projects. Qualitative evaluation encompasses peer review and the Delphi method. Peer review, a methodological approach, involves experts within a specific field or related fields analyzing and assessing the academic merit of a research endeavor.[13] This method leverages the specialized knowledge of experts to appraise the value of scientific research achievements, placing a lesser demand on information and data.[14] Consequently, it is well suited for evaluating scientific research accomplishments that prove challenging to quantify. The Delphi method, also known as the expert inquiry investigation method, requires experts to make judgments based on their knowledge and experience, and constantly feed back and revise opinions to finally form the evaluation conclusion, which to some extent overcomes the impact of subjective factors on the evaluation conclusion, and the evaluation result is relatively objective.[15] Widely used quantitative evaluation methods include bibliometrics, an analytic hierarchy process, and data envelopment analysis (DEA). The bibliometric method uses mathematical and statistical methods to conduct a quantitative analysis of the literature and evaluate the achievements of scientific researchers or research institutions based on the number of scientific research papers, journal impact factors, and other indicators.[16] The analytic hierarchy process is mainly used for the construction and weight assignment of the scientific research performance indicator system.[17] Mao[18] started with the design of the performance indicators of each link of the scientific research special expenditure, constructed a systematic performance indicator system of the scientific research special expenditure, and used the analytic hierarchy process to carry out the weight assignment and empirical test. Dong[19] took the scientific research output as the core, built a performance evaluation index system, evaluated the scientific research performance of scientific and technological personnel, determined the index weight using the analytic hierarchy process, and established the scientific research personnel performance evaluation model. The DEA method relies on several input and output indicators, employing the linear programming method to evaluate the relative effectiveness of similar comparable units,[20] which has been widely used in the field of scientific research performance evaluation in recent years.[21] Dong[21] emphasized the time lag effect between the scientific and technological inputs and outputs of colleges and universities, and used the DEA method to conduct an empirical analysis of the scientific research performance of Chinese colleges and universities in 2015. He found that there were large regional differences in the scientific research performance of Chinese colleges and universities, with the largest in the East and the smallest in the West. On the data collected from 17 research institutions of the Chinese Academy of Sciences obtained from 2012 to 2015, Xiong *et al.*[22] used the dynamic DEA model to evaluate the R&D performance of universities and research institutions, and found that resource scale played an important role in affecting basic research. Cooper *et al.*[23] used DEA and stochastic frontier analysis to study the relative efficiency of China's science and technology research universities, using human, financial, and material resources as input indicators, and talent cultivation and scientific research achievements as output indicators. They found that if talent cultivation is considered as the only output, the efficiency of research universities is far lower than that of comprehensive universities. If the outputs of scientific research and social services are considered simultaneously, the efficiency of research universities significantly increases, even surpassing that of comprehensive universities.

2.2 Introduction of back-propagation (BP) neural network evaluation method

The BP neural network is a data processing system (DPS) formed by imitating the structure and performance of the human brain neural network, and uses the comprehensive training of experimental data to carry out nonlinear feedback from input to output, so as to further approach the evaluation process of any nonlinear function (Fig. 1). Because of its high fault tolerance, the BP neural network evaluation method primarily operates on the principle of converting the final problem into a constitutive nonlinear optimization process. The method employs the gradient

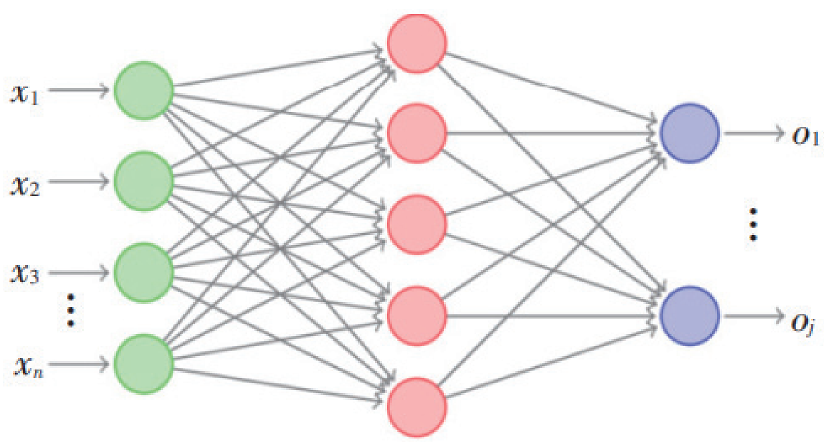

Fig. 1. (Color online) BP neural network principle.

dispersion reduction method, a commonly used optimization technique. According to the above principles, the method can completely approximate any complex nonlinear curve, and the evaluation objective does not need to follow the normal distribution completely independently. Moreover, because the algorithm has good self-exercise and adaptive ability, when there are fuzzy, incomplete, and unclear features in the evaluated data, after the training and testing of the method, the correct conclusion of the evaluation method can be quickly obtained.

The main constraints on the management of scientific research funds encompass multifaceted systems, including the macro-industrial technology strategy, enterprise management system, and micro-level management, operation, accounting, and supervision of scientific research institutions. On the basis of understanding the risk factors of scientific funding projects, the risk assessment of scientific funding projects refers to a relatively complex and intelligent process of comprehensive research and judgment that lacks a clear analysis process.

The feedforward BP neural network model has the characteristics of self-learning and self-assembly, which makes it “learn” the hidden information in the analysis and actual data, so as to approach the nonlinear analysis problem and then obtain the judgment and prediction data. Therefore, in this study, we mainly use the BP neural network to evaluate the risk of scientific research project fund use.

2.3 Risk factors affecting scientific research project fund management

The research department responsible for completing research work assumes the role of the market subject overseeing the management of research project funds. The problems it faces in fund management can be categorized on the basis of quality and cost problems. According to the cause of business risk, it can be divided into external and internal risks. We will systematically identify risk factors that may result in significant violations of laws and regulations, directly jeopardizing the efficiency and effectiveness of scientific research project funds. This assessment will consider both the external and internal aspects of the unit undertaking the research project. Subsequently, we will utilize risk factor indicators, developed through the integration of questionnaire data, to facilitate this analysis (Fig. 2).

2.3.1 External environmental factors

The external environmental factors affected by research project expenditure control mainly involve research project information, fund use, performance evaluation, and even relevant administrative accountability. At present, the state has formulated different expenditure control measures according to different major scientific planning (special, fund) research projects and made detailed requirements, for example, for the budget preparation, fund utilization, and financial completion acceptance of research projects. The confluence of research and practice is not only a smart practice of scientific and technological innovation, but it also confronts practical problems such as the “rigid” constraints imposed by funding limitations or deviations in cost-compensation ratio between funds. Some scientists “check” the funds that cannot be disbursed by the reimbursement of, for example, photocopying fees, transportation fees, and travel

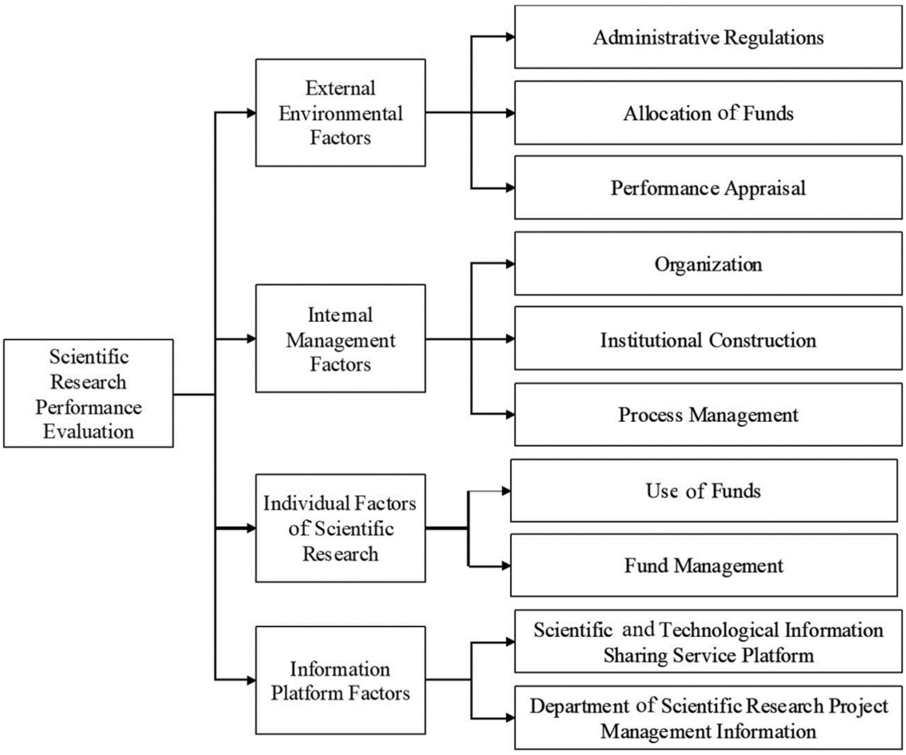

Fig. 2. Index system of the impact factors of scientific research project funds.

expenses, which leads to the false listing of costs and even touches the policy red line. However, the "Matthew effect" and "circle culture" phenomena in the use and management of research investment funds, such as performance assessment focusing on output impact, ignoring material benefits, the lack of unified standards for supervision and accountability, and the inconsistency between punishment methods and the strictness of audit requirements, all make the research fund management work of the scientific research project implementation department difficult.

2.3.2 Internal management risk

We determine the internal management risk factors associated with project fund management risks, typically encompassing aspects such as the organizational structure, construction processes, control procedures, costs, internal audit systems, incentives, and constraints. The establishment and operation of the organization undertaking the research project and the development and implementation of the fund management system affect the quality of the use and management of research project funds. We also examine the strategic alignment, target relevance, and cost rationalization in the execution of project fund budgeting. We assess the accuracy of the actual utilization of project funds, including correctness in both execution and financial accuracy. We evaluate the timeliness and accuracy of the project's final account inspection and monitor the achievement of objectives and the evolution of results. However, it is crucial to acknowledge the presence of numerous risk factors inherent in each stage of the process. Unclear, incomplete, and untrue cost accounting data of research projects, as well as the "walkthrough" of audit, and an imperfect scientific and reasonable incentive and restraint system will affect the smooth progress of scientific research activities and the effective and standardized management of scientific research project funds.

2.3.3 Individual factors of scientific research

The individual factors affecting the risk control of scientific research project funds can be categorized into the consciousness of self-discipline in the use of funds and the consciousness of risk control of funds. Some researchers in the scientific research project implementation department believe that the funds for scientific research projects are obtained through competition. As a result of this personal error and weak risk awareness of research project funds, it is easy for researchers to violate economic laws in the use of funds.

2.3.4 Information platform factors

The main information network platform components that study the management of project funds include the national science and technology information-sharing service network platform of China and the research project management network within international organizations. The science and technology information service systems of China and local governments are interconnected to avoid a repeated application of projects. The administrative network of the research project is integrated within the national organization to ensure the exchange and standardized operation of the research project information. Therefore, the main risk faced by the identical research project application and execution can be avoided.

2.4 Construction of BP neural network evaluation method model

This algorithm determines the index factors affecting the evaluation object. We determine the output target vector. The neurons in the output layer take the evaluation objects at different levels as the target quantity, calculate their risk values, and obtain quantitative results (Table 1). The BP network is determined as a three-layer network: an input layer, a hidden layer, and an output layer. We determine the neural network evaluation data of training test samples. Using input data, the neural network is trained and tested until the error does not occur (Fig. 3).

2.4.1 Establishing BP neural network evaluation model

Step 1: Determination of input layer. The input layer refers to the main objective factors that affect the achievement of the evaluation objectives. The analysis is also different for each type of risk assessment objective. Our main evaluation content is the management of funds for scientific research projects. The research is divided into four types, namely, external reasons, internal management reasons, research individual factors, and platform reasons, with a total of 14 specific affecting factors.

Table 1
Evaluation index weights.

First-level indicators	Secondary indicators	Weight	Tertiary indicators	Weight
Scientific research performance evaluation	External environmental factors	0.25	Administrative regulations	0.007
			Allocation of funds	0.092
			Performance appraisal	0.122
	Internal management factors	0.34	Organization	0.258
			Institutional construction	0.005
			Process management	0.077
	Individual factors of scientific research	0.15	Use of funds	0.149
			Fund management	0.095
	Information platform factors	0.26	Scientific and technological information sharing service platform	0.025
			Department of scientific research project management information	0.170

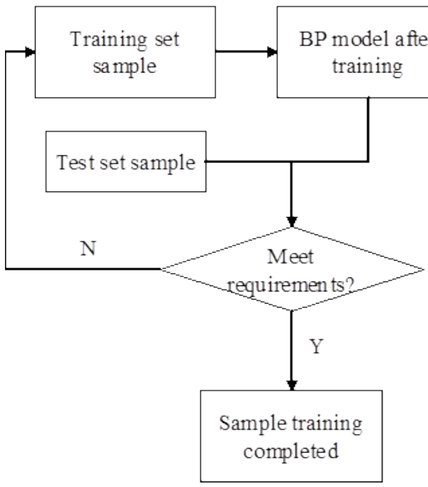

Fig. 3. Training and testing of neural network.

Step 2: Determination of output layer. The output layer refers to the conclusions obtained and analyzed using the evaluation object. The risk level of scientific project fund management, as investigated, reflects the evaluation conclusion pertaining to the risk level induced by various factors in the management of scientific project funds. Generally, the number of neurons in the output layer is defined according to the idea of the model. In this paper, the output layer is represented by a neuron.

Step 3: Determination of hidden layer. The number of neurons in the hidden layer has no statistical value and lacks certain technical requirements. The dimensions of the fitted or optimized surface increase with the number of neurons in the hidden layer. As the storage capacity of computing power increases, too much fitting may occur, and the number of errors in computation increase. The smallest network neuron that can match the given training sample is used in the design scheme. In general, the hidden layer node is set to 75% of the number of input layer nodes.

2.4.2 Determination of network hierarchy

The entry and exit layers of the reverse neural network are often associated with the specific analysis object, which has practical significance. The hidden layer is generally defined according to the complexity of the actual problem (Fig. 4).

3. Results

3.1 Assessment process analysis

(a) Determination of risk input layer for scientific research project fund management.
The specific input parameters of risk factor indicators that affect the management of scientific research project funds are shown in Fig. 2.
(b) Determination of risk output level of scientific research project fund management.
In this paper, the output layer of a neural network is represented by a neuron, which reflects the risk status of the total risk system of scientific research project fund management.
(c) Determination of hidden layers of risk in fund management of scientific research projects.
According to the above determination principles of the hidden layer, the number of hidden layer nodes in this paper is determined.
(d) Training samples of reverse neural network model.
The input values of all training samples in this paper are evaluated by experts. A questionnaire survey was conducted for 21 experts in the laboratory, relevant management and support departments of the Institute, and the scientific research management and financial management departments of an Institute in China. Through the survey, the risk status of the scientific research project fund management of the institute was assessed. The experts give

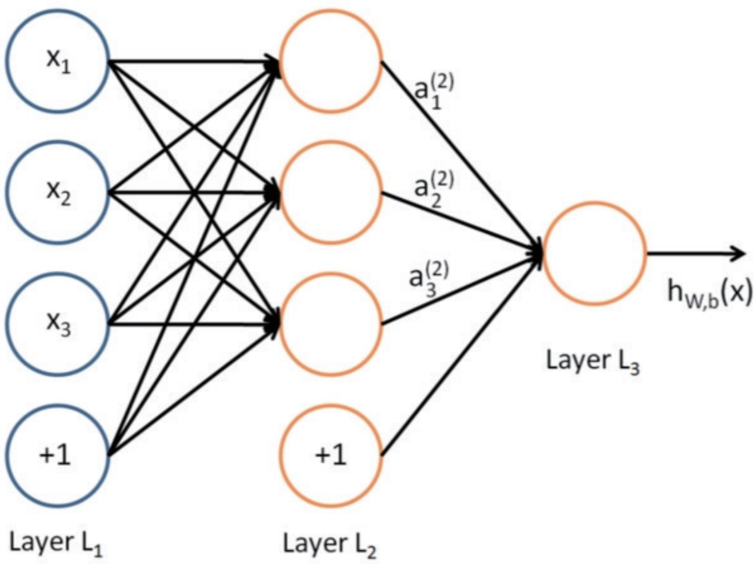

Fig. 4. (Color online) Hierarchical structure of reverse neural network.

specific values according to the management status of scientific research project funds of the Institute. The scoring range is between 1 and 5, indicating the risk status of each evaluation index, that is, 1 is poor (high risk), 2 is poor (high risk), 3 is medium (moderate risk), 4 is good (relatively safe), and 5 is good (safe). The evaluation score given by experts can be a decimal between two states.

3.2 Basic overview of Institute

The Institute is a national strategic high-tech research institute that organically combines basic and applied research and development, focusing on energy consumption, power resources, environmental science, and other application fields. At present, the Institute has formed an expense management system. At the macro level, expense management is centered around the financial department of the Institute, with a primary focus on coordinating and managing the scientific research work costs across the entire institute. At the micro level, cost management is conducted on a laboratory-by-laboratory basis. The laboratory has a research and development financial assistant, which is an important bridge between the grand and micro cost management of the Institute. The Institute is based on the information system of the National Science and Technology Information Program (ARP) of the United States and is the basic system used for the national research funding plan. The database system includes a project fund information database, a financial accounting database, a talent information database, and small- and medium-sized enterprise database. The Institute has carried out the whole process management of scientific research projects, led by the technical personnel who undertook the project management in the budget preparation, and the on-site scientific research financial assistant and the head of the financial department have formulated the plan in the form of collaborative work according to the principles of policy matching, budget relevance, and cost rationalization. In the stage of fund management, the method of two-level management of laboratories and management support institutions has been adopted to improve the internal management structure and realize the independent accounting of scientific research projects. The funds are earmarked for specific purposes. However, the problems of the expenses of in-service staff and the subsidies for the roundabout expenses have not been solved. In terms of scientific evaluation, the college links the implementation and acceptance results of scientific research projects with the year-end evaluation and promotion of posts and ranks. On the basis of the situation of the Institute, we evaluated the management of the research project funds of the Institute.

3.3 BP neural network case evaluation calculation

The BP network model of the external environment impact subsystem is as follows.

$$\begin{aligned} &I_i^{(1)} = x_i, \quad i = 1, 2 \\ &O_{ij}^{(1)} = I_{ij}^{(1)}. \quad i = 1, 2;\ j = 1, 2, ..., n \end{aligned} \tag{1}$$

The input and output of training test data include information on external environmental conditions provided by experts. In this study, we use the DPS and big data analysis method to obtain the evaluation data through the training and measurement analysis of the BP neural network.

$$I_i^{(2)} = \frac{\left(O_{ij}^{(2)} - \alpha_{ij}\right)^2}{\beta_{ij}^2}, \quad i = 1, 2;\ j = 1, 2, \ldots, n$$
$$O_{ij}^{(2)} = \exp\left(I_{ij}^{(2)}\right). \qquad i = 1, 2;\ j = 1, 2, \ldots, n \tag{2}$$

With the operation parameter input, training test results showed that Y1=3.2221. The result of the BP neural network model is represented by the model over-fitting residual error curve diagram. The over-fitted residual error of the BP model is affected by external factors. The BP network model is used to evaluate affecting factors. Internal management element B, research individual factor C, and information platform element D refer to the above methods to obtain the results after the test. Using the BP network and the analysis and evaluation of external environmental factors A, internal control factors B, scientific and individual factors C, and information system factors D, the overall risk system of scientific research project funds is evaluated. The input and output amounts of the sample are determined through the evaluation score calculated by experts according to the evaluation items of the scientific research project funds, and the evaluation and assessment analyses of the BP neural network are carried out through the algorithm of the DPS. The evaluation weights of indexes are presented in Table 1.

3.4 Analysis of evaluation results

The risk score of the general system for the safety management of research project funds in the Institute is 3.4454 (equivalent to 3.4454 in the 100-point system) × 100 = 68.91); the hazard level is medium. In the risk score of various impacts, except for the score of scientific research individual impact of 4.0 points (converted into more than 80 points), the risk grade is relatively safe; the risk score of factors is less than 3.5 points (converted into less than 70 points) and the risk grade is medium. According to the risk score, the key application fields of risk are e-commerce, environment, internal company, and research individuals (Table 2).

Regarding the data platform, scholars commonly observe that the ARP database information system at the Institute fails to deliver real-time and accurate information on the expenditure and balance status of scientific and technological research funds. Additionally, there is a noted deficiency in the audit mechanism for fund reimbursement within the fund application process. The discrepancy between financial accounting and project expenditure data in the ARP database information system of the Institute has led to problems in the use of funds for scientific research projects. In addition, the ARP database information system did not complete the online internal control authorization review, resulting in the failure of project, finance, fixed asset, and plan control, which seriously affected the effectiveness and standardization of scientific research project fund control. There are different degrees of risks in the four aspects of the external

Table 2
Output results of internal management factors, individual factors of scientific research, and information platform factors.

No.	Internal management factors	Individual factors of scientific research	Information platform factors
1	3.22	3.86	3.40
2	3.39	3.92	3.47
3	3.07	3.34	3.31
4	3.38	3.48	3.39
5	4.00	3.24	3.76
6	3.22	3.12	3.47
7	3.73	3.57	3.32
8	3.61	3.65	3.80
9	3.01	3.54	3.26
10	3.91	3.05	3.49
11	3.40	3.70	3.71
12	3.58	3.49	3.63
13	3.33	3.49	3.86
14	3.16	3.48	3.08
15	3.25	3.47	3.51

environment, namely, policies and regulations, the use of government funds, performance evaluation, and relevant administrative accountability. Among them, in terms of policies and regulations, technicians and scientific research fund managers are faced with the problem of a low proportion of indirect expenditures and the unreasonable compensation of expenditures in direct engineering costs. They have to make up in disguised form by means of “bills”, even occupying horizontal funds, resulting in the staggered use of vertical and horizontal funds, non-compliance in the use of scientific research project funds, and inaccurate accounting data. In terms of internal management, in addition to clearly understanding China’s financial policies and regulations, corresponding research fund management methods, and basic knowledge of financial management, the research financial assistants should also have professional knowledge and historical background in the corresponding field, be familiar with grasping the corresponding scientific research content, and correctly grasp the development of research projects. Such talents often require years of exploration and experience to mature and develop. The quality of academic and financial assistants in the Institute is far from meeting the requirements of the above positions. The internal audit system of the Institute has not played a substantive role. The incentive mechanism or multiple constraints of R&D project management at least have a negative impact on the management of R&D project funds of the Institute to a large extent and then have a serious negative impact on the standardization of R&D project fund management, including efficiency.

The improved algorithm proposed in this paper achieves the required convergence with fewer iterations, which is nearly three times faster than the unimproved reverse neural network algorithm (Table 3). The error accuracy of the improved reverse neural network algorithm is one order of magnitude higher than that of the standard BP algorithm. In terms of the recognition rate of test samples, the improved reverse neural network algorithm is the best (nearly 98%), which is actually the standard BP algorithm (about 90%). The fitting degree between the output

Table 3
Comparison of different algorithms.

Algorithm	Iteration Steps	Error of training 1000 times	Test sample recognition rate
Standard reverse neural network algorithm	1850	0.008	95.04
Improved reverse neural network algorithm	305	4.5951×10^{-11}	98.98

value of the improved reverse neural network and the real value has been improved considerably. The experiment shows that the improved reverse neural network algorithm proposed in this paper can be used to evaluate the project with fast convergence and high accuracy, and can better meet the actual needs.

4. Discussion

This study enriches the theories and methods of scientific research project achievement evaluation, deepens the research on the factors affecting scientific research project performance output, and provides new evidence through empirical analysis. In practice, it provides a basis for the project funding institutions to better conduct scientific research management, strengthen project funding, evaluate project results, and improve the output of project scientific research results, and provides suggestions for the scientific research management activities of the funding institutions. The inadequacy is that only general projects of the Information Science Department are used for research, which fails to fully consider the large variety of scientific research projects and the large differences in discipline characteristics. The conclusion drawn may have certain limitations and is subject to further expansion for different types of scientific research projects in the future. This paper signifies an enhancement from the initial chaos in weight values and weighted optimization, demonstrating the collaborative optimization achieved through algorithms such as the reverse network and combined prediction. The improved reverse network is used to comprehensively evaluate the scientific research projects of colleges and universities, determine reasonable evaluation indicators at all levels, and compare the scientific research projects according to the output of the reverse neural network. The example shows that the artificial intelligence algorithm represented by the reverse neural network is simple and practical in the evaluation and analysis of scientific research projects, effectively eliminates the effects of subjective factors, and provides a scientific and reliable evaluation standard for the evaluation of scientific research projects in colleges and universities. According to the above research results, the information technology platform, external environment, and internal management system of the Institute can be improved in the following aspects in terms of the main problems.

4.1 Optimize the construction of scientific research project information system

The ARP network system has been improved, and a comprehensive and interactive information base has been established to realize the comprehensive control of all components of scientific research activities, including scientific research funding plans, financial management accounting, instrument and equipment allocation, water and gas heating fuel power supply, housing management, and environmental orthogonal resource protection information. The preset function is suitable for the network conditions of the local area network (LAN) and wide area network (WAN), and the external port is set to facilitate the expansion and update of the system. It is necessary to submit all data of research project application, implementation, and inspection, including research project fund management, internal control organization setting, business handling, and other data, so as to provide key data information for scientific researchers to master relevant research project information from the system and managers to understand the implementation and control status of research projects.

4.2 Improve the management method of scientific research project funds

The repeatability and unpredictability of the process of scientific research should be fully considered, and the method of combining total amount restriction and quantitative contracting should be adopted to authorize scientists to have the right of independent choice in specific fields. The independent supervision of the use of scientific research funds should be combined with the supervision and evaluation of the integrity of scientific research work and the process of work conclusion, so as to further loosen the rigid constraints on the scientific research work plan and liberate the innovative potential of scientists.

4.3 Improve the internal management mechanism of scientific research project funds

It is necessary to clarify the functions of macro- and micro-level fund management, in order to construct a research fund management system in China that is responsible for coordinating fund management at various levels. Among them, the internal functional institutions engaged in the research of enterprise economics should focus on the management of scientific projects, technical and economic activities, and other main contents of research, and establish a mechanism for the management of research funds of national departments, so as to reasonably allocate scientific funds for enterprises as a whole, and implement the whole-process control over the development of research activities. The research room is the micro-control organ of the national department, which focuses on the management of declared scientific research projects, the implementation of scientific research, the promotion of research and production, and the overall management of the research costs of the laboratory.

5. Conclusions

In this study, we aimed to analyze the evaluation factors of scientific research performance and establish a research performance evaluation model using the BP artificial neural network (BP-ANN) reverse neural network. Through the analysis of evaluation factors, four key factors were identified, namely, external environment, internal management, scientific research individual, and information platform. The model was trained and tested on research cases, and the results showed that the BP-ANN algorithm produced highly accurate prediction results being trained with large data. The model was also found to be adaptable and feasible for updating with new sample inputs. Overall, this study provides a valuable contribution to the field of scientific research performance evaluation by providing a reliable and accurate method for evaluating research performance.

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