Scholar Publishing Group
Machine Learning Theory and Practice
https://doi.org/10.38007/ML.2022.030409
ISSN 2790-0983 Vol. 3, Issue 4: 69-79

University Scientific Research Management based on Decision Tree Algorithm Evaluation

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Keywords: Decision, Tree Algorithm, University Scientific Research, Scientific Research Management, Management Evaluation Research

Abstract: The evaluation of scientific research(SR) management in China started late, but developed rapidly. It was not until the 1980s that we began to really pay attention to SR projects and carry out substantive management evaluation activities. However, the state and various ministries and commissions have successively issued rules and regulations on SR management, which has played an important role in standardizing the national scientific and technological evaluation activities, building evaluation institutions, and promoting the development of SR management and evaluation in Colleges and Universities(CAU). This paper studies the evaluation of SR management in CAU based on decision tree algorithm(DTA). In this paper, the process evaluation research of SR project management is carried out. Combining the actual situation and existing problems of university SR management(USRM) evaluation, the DTA is applied to the evaluation of USRM, and the dynamic implementation of the project plan is effectively controlled by the process. Adjust the management strategy of project progress in real time according to the feedback information of project progress, and strive to ensure that the project is completed as expected. The successful implementation of SR management evaluation in CAU based on DTA will help the SR work in CAU to rise to a higher level, which has great practical significance.

1. Introduction

The implementation of SR project plan is a dynamic process. The project establishment evaluation at the beginning of the project and the performance evaluation(PE) at the end of the project are not involved in the dynamic process of project implementation, so it is difficult to ensure the implementation of the project to achieve the established plan. The content of the project

involves a wide range of professional fields, and only the overall evaluation of the project by the SR project manager is not enough. The self-assessment of project process by project implementers should be carried out comprehensively to build effective project implementation process control and realize reasonable project process assessment. In this paper, the DTA is introduced to study the evaluation of USRM.

A lot of research has been done on the theory, methods and application of evaluation at home and abroad. Some have formed relatively perfect evaluation procedures and methods, and many achievements have been made in SR evaluation. Since the 21st century, the world economy has gradually changed from a labor-intensive and capital intensive dominated economy to a knowledge and technology dominated economy [1]. The core feature of the development of science and technology is innovation. Innovation and creativity are important signs to measure a country's competitiveness and comprehensive national strength. Therefore, the study of this problem has certain research and application value [2].

This paper focuses on how to improve the SR level and innovation ability of CAU. Starting from the analysis of university management and PE, this paper studies and analyzes the evaluation of USRM combined with DTA, applies it to the PE of SR management, and puts forward a complete evaluation method. This paper attempts to introduce PE methods, establish a reasonable PE index system, and form a certain quantitative assessment standard in the management of SR in CAU, considering the basic problems in the content of SR management in CAU, so as to achieve the important goal of improving the level of SR management. It has important theoretical value and practical significance in the research on quantitative PE of USRM [3, 4].

2. Research on Evaluation of SR Management in CAU

2.1. Concept Definition and Characteristics Analysis of SR in CAU

SR in CAU in China refers to all kinds of SR activities carried out by teachers and students in CAU in China. From the nature of university SR, it can be divided into: basic research, innovative research and applied research; In terms of research types, it can be divided into natural research and social research [5, 6]. In China, general SR institutions, such as enterprise research institutions and government research institutions, have much in common with university research institutions. At the same time, Chinese universities are also responsible for the training of higher talents, social function services and other functions. In terms of SR, they are more distinctive than SR institutions in the society, as follows:

First, Chinese universities have the characteristics of combining SR with talent training and teaching services. The higher education implemented by Chinese universities not only imparts knowledge, but also undertakes the exploration and innovation in the field of knowledge [7, 8]. Postgraduates and excellent undergraduates at all levels in China's CAU need to conduct SR under the requirements and guidance of their tutors. This process reflects the integration process of SR and education and teaching, which can promote the innovation and progress of SR to a certain extent, and also help improve their SR ability, creating a channel for mutual transformation between SR achievements and teaching work [9].

Second, the major universities in China have a complete range of disciplines, with a high degree of comprehensiveness and cross discipline. They have a good natural advantage in the topic selection and research of SR projects. With the deepening of human understanding of the objective material world, the differences and connections between different things, phenomena and essential laws will be excavated by human beings. Therefore, it is an inevitable trend for human and social development that the SR fields of disciplines permeate and cross each other. China's higher

education has a high degree of discipline integration and a complete range of disciplines, which is conducive to its research on major SR projects [10, 11].

Third, CAU play a very important role in China's national construction. For all kinds of SR work in CAU, the research direction and degree of discipline progress need to meet the national construction as the primary purpose, and their professional construction and discipline development should constantly match the international economic development. In China's SR system, SR in CAU is an important part, and the SR industry system in CAU is the whole social industry system that complements each other. SR in CAU must be guided by national and local policies. On the basis of meeting the needs of policy development, they must also accept the unified command and management of the higher education system. In addition, they must follow the needs of industrial development and other comprehensive influences [12, 13].

2.2. Main Contents and Management Methods of SR Management in CAU

2.2.1. Relevant theories of SR funds management in CAU

The comprehensive budget management of SR funds in CAU is a budget management mode in the whole process, all-round and full participation of SR management in CAU [14]. Comprehensive budget management requires all departments of SR management to manage financial and non-financial resources on the premise of information sharing, so as to effectively organize and coordinate SR management activities in CAU [15, 16]. The flow chart of comprehensive budget management is shown in Figure 1.

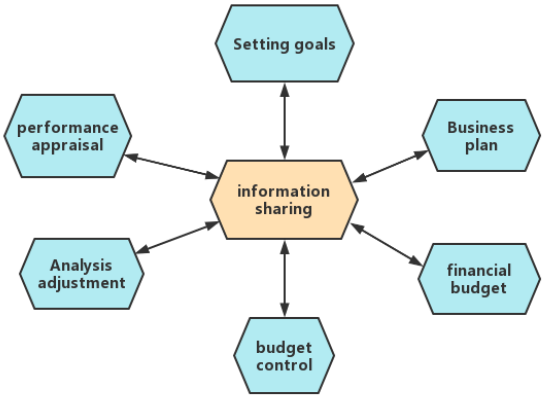

Figure 1. Flow chart of comprehensive budget management

2.2.2. Basic principles of project process evaluation

When preparing the project plan, it is difficult to foresee many problems or difficulties that may occur. Therefore, deviations often occur in the process of project organization and implementation. The project process evaluation is to realize the correct identification of deviations, eliminate deviations through plan adjustment, and ensure the realization of project objectives [17]. In fact, the project initiation evaluation has realized the foresight or predictability of project control; the final evaluation of the project is to summarize the project control management work and take remedial measures; The project process evaluation runs through the whole process of project control and is the main body to achieve project control [18].

3. DTA

3.1. ID3 Algorithm

3.1.1. Information

Let T be a set of t data samples, suppose that the class label attribute has m different values, define m different classes Ci (i=1,..., m), let ti right be the number of samples in class Ci, and the expected information required for a given sample classification is:

$$I(t_1, t_2, ..., t_m) = -\sum_{i=1}^{m} p_i \log(p_i) \tag{1}$$

Where, pi is the probability that any sample belongs to Ci and is estimated by ti/t.

3.1.2. Information Gain

Let attribute A have different values {a1, a2,..., av}. The attribute A can be used to divide T into V subsets {t1, t2,..., tv}, where ti contains such samples as T, which have values aj, on A. If A is selected as the test attribute, these subsets correspond to the branches grown from the nodes of the containing set. Let tij be the number of ci like samples in subset tj, and the entropy or expected information divided into subsets by A is given by the following formula:

$$E(A) = \sum_{j=1}^{Y} \frac{t_{1j} + ... + t_{mj}}{t} I(t_{1j}, ..., t_{mj}) \tag{2}$$

Where $\frac{t_{ij} + ... + t_{mj}}{t}$ is the weight of the Jth family, and is equal to the number of samples in the subset (i.e. A value is aj) divided by the total number of samples in T. The smaller the entropy, the higher the purity of the partition.

3.2. Principle of Project Dynamic Control

The project process evaluation conforms to the basic principle of project dynamics. The project dynamic control runs through the whole process of the project implementation stage, which is a limited cycle process. Its principle is shown in Figure 2.

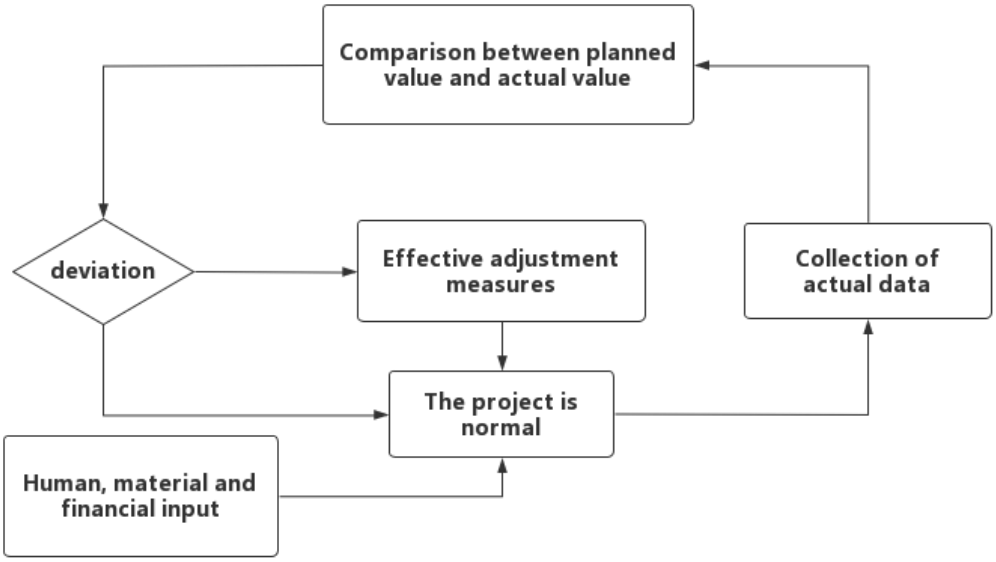

Figure 2. Schematic diagram of project dynamic control

3.3. Process Evaluation of SR Projects

In order to effectively grasp the implementation of the SR project plan, it is necessary to keep track of the operation of the project in a timely manner. On the basis of timely establishment of feedback information, make a systematic and comprehensive comprehensive evaluation of the implementation of the project plan. Through reasonable and effective evaluation, corresponding adjustment measures are formulated to ensure the smooth implementation of the project.

The process evaluation of SR projects is based on the index system. The selection and establishment of the indicator system shall be based on whether the operation status of the project is reasonably reflected. The indicator system can be represented by vector X. The attributes of vector X change with time reflect the dynamic development of the project process. The vector X can be called the indicator system vector or the state vector of the operation status of SR projects.

With the definition of the state vector of SR projects, the mathematical analysis method of vector space can be used to comprehensively analyze and evaluate the operation of SR projects. Suppose that the index system of the SR project to be evaluated includes m indicators, that is, the X state vector has m components. Suppose that n operation conditions of X state vector are recorded, that is, X state vector values corresponding to n times. It can be recorded as:

$$X(i) = [x_{i1}, x_{i2}, ..., x_{im}]^T \qquad i = 1,2,...,n \tag{3}$$

Based on this, the project operation status at moment i can be constructed, according to the comprehensive evaluation function in a certain sense:

$$Y(i) = f(w, X(i)) \tag{4}$$

Where $w = [w_1, w_2, ..., w_m]^T$ is the non negative normalized index weight vector. Nonnegativity is determined by the physical meaning of the indicator weight. From this, the comprehensive evaluation value Y (i) of the project operation state at time i. According to the value of Y (i), it can

be judged whether the operation state of the project at time i belongs to the normal implementation state.

The general steps of process evaluation of SR projects include: establishing the index system of process evaluation of SR projects, which is usually a qualitative method; For the evaluation of evaluation index values, experts provide evaluation values as initial values for quantitative analysis; The selection of evaluation model requires the combination of qualitative and quantitative methods; Determination of weight coefficient and application of mathematical quantitative method; Judgment of project operation status.

4. Research on Evaluation of USRM based on DTA

In order to verify the effectiveness of the DTA for the evaluation of SR management in CAU, this paper comprehensively considers the three elements of quality, time and cost, and adheres to the project process evaluation based on quality management under the premise of fully considering the actual situation of project progress and cost.

4.1. Data Acquisition Process

Basic information of the project. Data description: save the basic information of all the vertical projects that have been approved. Data source: the data related to the project is mainly provided by the SRers of the project, and then reviewed and approved by the departments and SR offices. The vertical project management personnel of the SR Department can enter, modify, delete and other operations on the relevant data of the project.

Vertical project member information. Data description: save the members of the vertical project, including school staff, students, and off campus staff; Data Source: entered at the same time as item information.

Vertical project cost budget. Data Description: saves the expense budget information of all vertical projects; Data Source: entered at the same time as item information.

Problem management process. Once a project is established, it is not allowed to arbitrarily change the project leader, project team members, project team member ranking, budget, project and other relevant important information, nor to arbitrarily postpone or terminate the project. If there is any change in the important information related to the project or an application for extension or termination of the project, the project leader needs to fill in the project change application form to apply for change, and only after the approval of the relevant competent department can the project related information be changed.

Communication management mechanism: communication management mechanism includes weekly project status report, weekly project regular meeting and special quality analysis meeting.

Special quality analysis meeting: for the quality problems found in the evaluation of quality management activities in recent years, the quality manager shall request the project director to hold special quality analysis meetings from time to time. All members of the project team shall attend the meeting, and if necessary, experts in relevant fields shall be invited to attend the meeting.

Plan change management process: random plan change may lead to project quality fluctuation and affect the normal progress of the project. A strict management process must be implemented for plan changes.

Figure 3 is the process chart of the evaluation guarantee of a university's SR project.

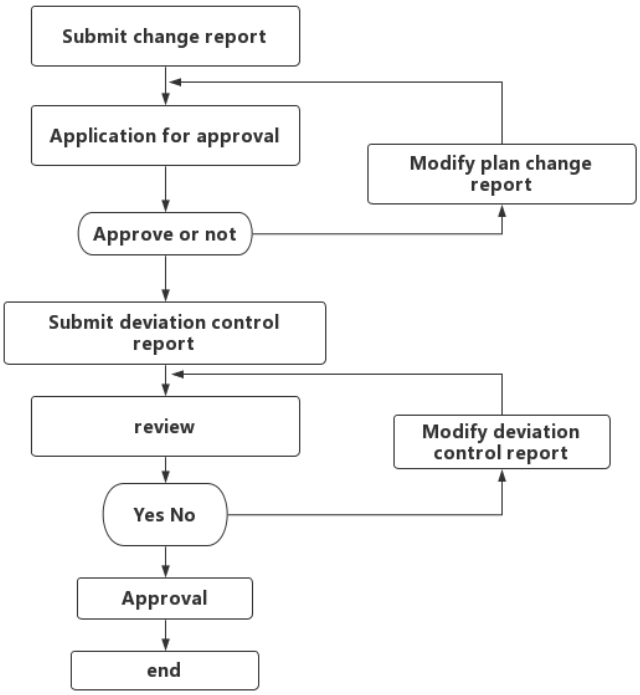

Figure 3. Process assessment guarantee of university scientific research projects

4.1.1. Process Audit

In the implementation of process evaluation of SR projects, process audit is used to achieve quality audit. The quality controller is specifically responsible for the process audit related matters, including communication, coordination and cooperation with the project R&D team required to complete the process audit task, writing the audit report after the audit, and verifying the problems found in the audit within the specified time. If the verification problem is effectively solved, the acceptance shall be approved; if the acceptance is unqualified, continue to follow up the handling of this problem. All quality audit reports and problem handling processes shall be recorded in detail by the quality controller and submitted for filing.

4.1.2. Management Review

In the construction and implementation stage of the process evaluation of SR projects, management review is used to solve the problems in the progress of the projects. The management review consists of regular review meetings and irregular periodic project summary meetings. The data used are from the weekly project status report and the minutes of the weekly project meeting. The convening of the review meeting mainly reflects the participation of the management in decision-making, comprehensively understanding the actual situation of the project progress, comprehensively analyzing the existing problems and risks, and determining the corresponding solutions. The project summary meeting mainly reflects the results of each stage or important activities of the project life cycle, and forms a summary report. The summary report shall include the description of the results, the analysis of the main deliverables and the importance of the project, and shall also reflect the progress, defects, demand changes, etc. of the project. The project summary report is required to be transmitted to the management and other personnel related to the

project.

4.1.3. Technical Review

Technical review constitutes the quality assurance of project products. The technical review meeting mainly completes the review of the deliverables and forms the technical review report. Deliverables are documents to be submitted at the end of each phase of the project, mainly including project implementation plan, demand analysis, outline design, detailed design and test design. The personnel participating in the technical review shall include the project team members, the quality manager, the head of the SR Department and the invited experts in the project field.

4.2. Application of Project Process Evaluation Model

Calculation of the lowest level indicator value: the lowest level indicator value, here, refers to the value of the second level indicator. The value of the sub indicator of "SR staffing", the structure of professional titles and the structure of education background are shown in Table 1 and Table 2.

Table 1. Professional title structure analysis table

Title	Senior	Intermediate	Primary	Other
Score f_i	4	3	2	1
Number of people m_i	4	2	1	1

Table 2. Education structure analysis table

Education	Doctor	Master	Bachelor	Other
Score f_i	4	3	2	1
Number of people m_i	5	1	2	0

The value of "project progress report" sub indicator: frequency of progress report: the highest satisfactory frequency of project progress report fmax=2 times/month, and the lowest satisfactory frequency of project progress report fmin=0.25 times/month. On average, the actual frequency of submitting project progress reports by the research group every month is f=0.5 times, and the index value of "frequency of progress reports" is A31:

$$A_{31} = \frac{f - f_{\min}}{f_{\max} - f_{\min}} = \frac{0.5 - 0.25}{2 - 0.25} = 0.1428 \tag{5}$$

The value of the sub indicator of "environmental support conditions": the expert evaluation committee has five members. For the sub indicators of "environmental support conditions", such as "information resource guarantee degree (IRGD)", "hardware resource guarantee degree (GDOHR)", "degree of adaptation to current policies (DOATCB)", and "support degree of the undertaking unit (SDOUN)", the expert evaluation committee will score according to five levels: "very good v5", "good v4", "medium v3", "poor v2", and "very bad v1". The scoring results are shown in Figure 4.

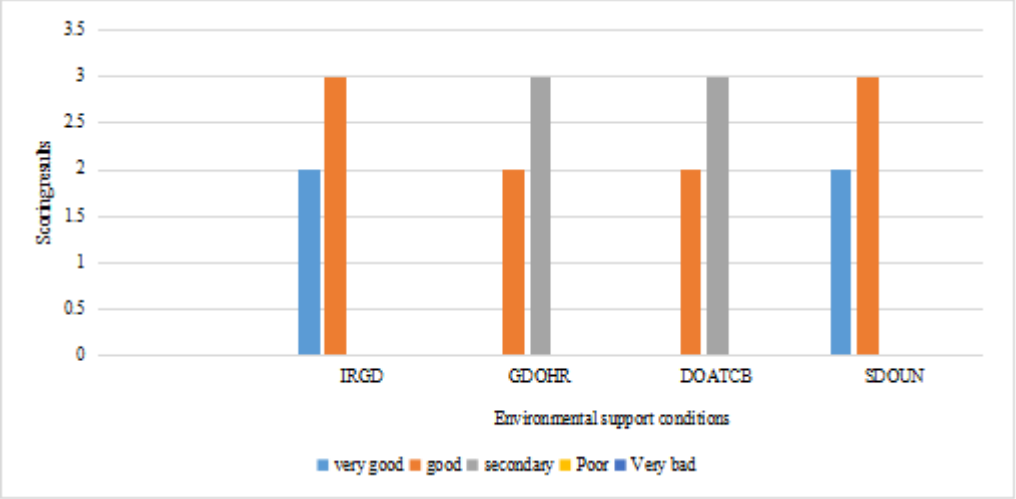

Figure 4. Scoring results data chart

From the above scoring results, it can be seen that the evaluation accuracy of USRM based on the DTA proposed in this paper is high, and the selection of evaluation criteria and methods is scientific, reasonable, and appropriate.

5. Conclusion

Based on the summary of previous research results on the PE of SR management in CAU, combined with the DTA, and based on the interview and research of experts in SR work in CAU, this paper analyzes the evaluation of SR management in CAU according to the characteristics of SR management in CAU. The inadequacy of this paper is that the method of investigating and studying the relative importance of indicators is relatively simple, and it fails to use more methods to verify the importance of indicators; In terms of how to set more reasonable target interval and corresponding score of SR indicators in the use of the PE scale of USRM, due to the insufficient depth of time and space research, there is no detailed discussion on the combination of qualitative and quantitative PE indicators. The process evaluation of SR projects is a difficult problem in the management discipline. This paper only conducts empirical discussion from a local perspective. This paper also needs to make improvements in the more general application conditions, and quote SR data from other universities to carry out evidentiary research. The evaluation of SR management in universities based on DTA needs further research and analysis.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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