Application Research of Management Accounting in Science Institute

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Abstract: In order to improve the management level of scientific research and development (R & D) funds in scientific research institutions, this paper explores the ways and methods to optimize the management of R & D funds of scientific institutions by using management accounting. According to the scope and characteristics of the factors influencing the management of R & D funds, the evaluation index of R & D funds management is defined as four secondary indexes and 14 third-level indicators. The four secondary indexes are R & D funds management organization, management system, management information and management process. Then fuzzy comprehensive evaluation method is adopted, and an evaluation example named M is chosen to carry on the empirical analysis, the appraisal grade is calculated finally. The evaluation results are in good agreement with the actual situation of the R & D funds management of the evaluation example M. At last, this paper puts forward the measures to improve the R & D funds management of scientific research institutions, and provides the basis and reference for strengthening the overall planning and optimizing allocation of R & D funds.

Keywords: Management Accounting, R & D funds Management, Fuzzy Comprehensive Evaluation Method, Evaluation, Application

1. Introduction

Management accounting is a branch of accounting, which is conducted by organization strategy and servers internal management. Management accounting provides information plat and deciding support for the forecast, decision, planning, controlling, evaluation and assessment of the organization economy process, by calculating and analyzing accounting information. With the deepen of economic structure adjustment and industry upgrade, the need of management accounting playing important role in optimizing energy allocation and scientific decision is more urgent. Comparing the management accounting situation of developed country, as 90% accountants are engaged in management accounting and 75% time is served for the decision supporting, China mainly focus on providing authentication, accounting and analysis information to external relevant organization and persons. The role of using information to take part in internal operating decision and strengthen management is not full [1]. Therefore, it is urgent to strengthen the application of management accounting in operation management, to improving the efficiency of funds use.

The fuzzy comprehensive evaluation method transforms the qualitative evaluation into the quantitative evaluation, and makes an overall evaluation to the objects or objects controlled by many factors, which solves the problem that the evaluation object is fuzzy and difficult to quantify [2]. In recent years, domestic and foreign scholars widely used the fuzzy comprehensive evaluation method in environmental, safety, medicine, management and other fields. In this paper, a research institute is chosen as an example, and the fuzzy comprehensive evaluation method is used to evaluate the situation of R & D funds management of the institute. According to the evaluation results, the research institute uses the management accounting to optimize the R & D funds management, to provide the basis and reference for strengthening the overall planning, optimizing allocation of scientific research funds, and improving the application of management accounting.

2. Model Establishment of Fuzzy Comprehensive Evaluation Method

Fuzzy comprehensive evaluation applies the principle of fuzzy relation composition, and judges the degree of the membership grade of the evaluated things from several factors. Using the fuzzy relation matrix R as a fuzzy converter from the factor set U to the comment set V, judgment factor weight vector A, through the operator of the synthesis, calculating the evaluation results vector B (figure 1). The final form of the collection is represented as the assessment results, which can more accurately describe the assessment of the fuzzy object itself [3]. So, there are more fuzzy subjective factors in the comprehensive evaluation of scientific research fund management. Fuzzy comprehensive evaluation can give full play to the advantage of fuzzy method, and use the idea of mathematical modeling to evaluate and analyze it quantitatively.
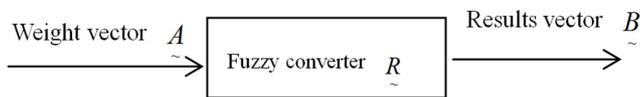

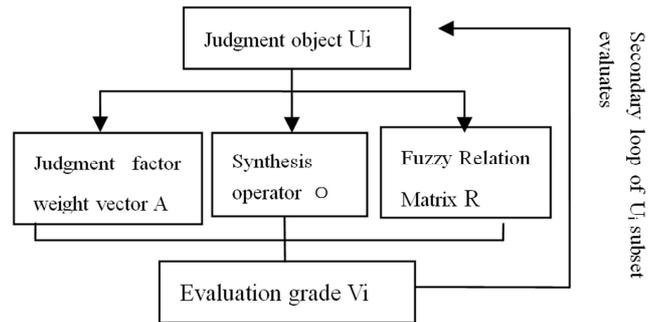*Figure 1. The basic model of fuzzy comprehensive evaluation.*

Figure 2. Fuzzy comprehensive evaluation construction process.

In this paper, a two-level fuzzy comprehensive evaluation model is used to analyze the scientific research fund management, and the modeling program is shown in figure 2 [4].

To determine the weight of evaluation factors, this paper uses the analytic hierarchy process (AHP), according to the objective reality judgment. The relative importance of each level is given the quantitative results [6], then determining the relative importance of all the elements [7]. The steps are shown in Figure 3.
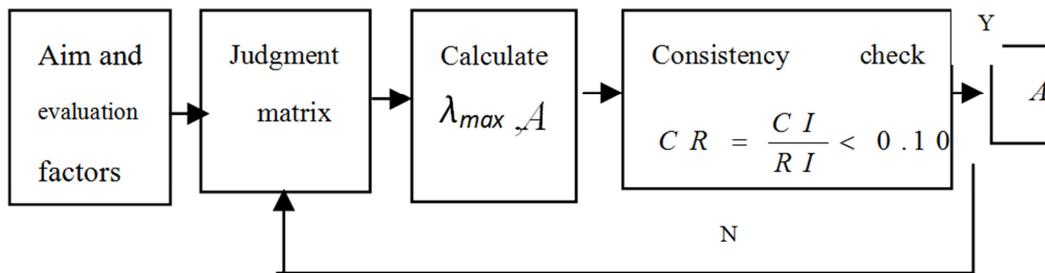

Figure 3. Weight determination step under AHP.

3. Example Academic Institute Introduction

The example academic institute named M, has been established in 1986, which mainly engages in energy, power and environment etc, research. With the implement of innovation-driven development strategy, the institute M aims at the country demand and international frontier research field, taking the cleaning energy, power system, and renewable energy as its important developing direction, to accelerate the transformation of scientific and technological achievement, promote the construction of technological demonstration project, build normative and efficient operating and management pattern, and try to develop to a energy research institute occupying the absolutely superiority in China energy field.

In recent year, the academic institute M developed fast, and achieved many research task and funds. But the funds management of M can't keep up with the demand of development, and the problem that management functions is weak, operating management dispersing, more after management and less prior management have been exposed. It urgent needs effective measure to regulate funds using and optimize resources allocation, in order to make the research funds play leading role on M's science arrangement and encouraging role on researchers.

4. Evaluation of the Management of R & D Funds of M

4.1. Building Factor Set

The factor set is a set that influence the evaluation object. In view of the scope of influencing factors of R & D funds management, the indicators reflecting the evaluation factors of R & D funds management can be put forward from different aspects. The selection of indicators plays an important role in the accuracy of evaluation results. It is complex system engineering, and these factors interact, influence each other and penetrate each other [8]. The complex evaluation system involves many factors, such as management organization, management system, and information system and management process. The evaluation factors are listed in Table 1.

Table 1. Evaluation factors indicators.

First level indicator	Second level indicator	Third level indicator
R & D funds management situation	R & D funds management organization 0.18	Project team 0.12
		Laboratory 0.25
		Research surpporting department 0.18
		Collaboration between lab and support department 0.45
	R & D funds management system 0.2	R & D funds management internal control system 0.5
		R & D funds budget management system 0.3
		Indirect R & D funds management system 0.2
	R & D funds management information 0.32	information building 0.3
		database linkage 0.5
		database stability 0.2
	R & D funds management process 0.16	Research project budget preparation 0.4
		R & D funds using 0.3
		Research project financial settlement 0.2
		Financial acceptance ofresearch projects 0.1

4.2. Set the Weighting for the Evaluation Factors

The AHP is used to determine the index weight. By comparing the importance of the two indexes, we use the 1-9 scale method to get the judgment matrix A. Taking the main factor as an example, according to the opinion of an expert, R & D funds management organization (O), R & D funds management system (R), R & D funds management information (I) and R & D funds management process (P) four factors are establish as the index system [4]. The judgment matrix A is:

$$A=\begin{bmatrix} 1.00 & 0.25 & 0.14 & 1.00 \\ & 1.00 & 0.25 & 2.00 \\ & & 1.00 & 8.00 \\ & & & 1.00 \end{bmatrix}$$

By using DPS software [9], the Max-characteristic root of the judgment matrix A is obtained.

$$\lambda_{max}=4.072.$$

The corresponding feature vector: $\overline{W}_i = (0.3410,\ 0.1807,\ 0.0400,\ 0.2357)$
The calculation results are shown in Table 2.
The weighting calculation result in table 2 only represents the weight set given by an expert for each factor analysis condition.

Table 2. Weighting calculation of the first level evaluation factor.

Judgment matrix A	u_1	u_2	u_3	u_4	$\overline{W}_i$	CI	RI	CR	λ_{max}
u_1	1	0.25	0.14	1	0.0774				
u_2		1	0.25	2	0.2060	0.0241	0.88 62	0.0272	4.072
u_3			1	8	0.6619				
u_4				1	0.0831				

4.3. Evaluation Factors Membership Determination

Because the evaluation factors of R & D funds management are mostly qualitative, this paper adopts the improved grading method to determine the membership degree of single factor. That is a number of experts directly evaluate the membership of an evaluation factor, and then take the average as the factor of membership. Because the factors of the evaluation system of R & D funds management focus on the two aspects of management level and management measures, the use of good or bad to assess the degree of membership [10]. Determine the level of discourse rating V = {poor, less poor, medium, less good, good}. (Note: in the inspection of the statistical tables, the meaning of the number is 1 (20 points), 2 (40 points), 3 (60 points), 4 (80 points), 5 (100 points)).

4.4. Establish Factors Grade Matrix

According to the five experts scoring, the membership degree of each evaluation index is analyzed synthetically and normalized to get the evaluation matrix:

$$R1=\begin{bmatrix} 0 & 0 & 0.67 & 0.2 & 0.13 \\ 0 & 0.1 & 0.6 & 0.3 & 0 \\ 0 & 0.1 & 0.5 & 0.2 & 0.2 \\ 0 & 0.1 & 0.8 & 0.1 & 0 \end{bmatrix} R2=\begin{bmatrix} 0 & 0 & 0.2 & 0.7 & 0.1 \\ 0 & 0 & 0.1 & 0.6 & 0.3 \\ 0 & 0 & 0.1 & 0.8 & 0.1 \end{bmatrix}$$

$$R3=\begin{bmatrix} 0 & 0.13 & 0.67 & 0.2 & 0 \\ 0 & 0.3 & 0.5 & 0.2 & 0 \\ 0 & 0 & 0.4 & 0.6 & 0.1 \end{bmatrix} R4=\begin{bmatrix} 0 & 0 & 0.7 & 0.2 & 0.1 \\ 0 & 0 & 0.5 & 0.3 & 0.2 \\ 0 & 0 & 0.3 & 0.4 & 0.3 \\ 0 & 0 & 0.4 & 0.5 & 0.1 \end{bmatrix}$$

4.5. First Level Comprehensive Evaluation

First level of fuzzy comprehensive assessment is to integrate a factor of each level, assess their impact on the assessment of the object. According to expert assessment, using $M(\wedge, \vee)$ operator, first level comprehensive evaluation result Bi [5] is calculated.

$$b_j=\bigvee_{i=1}^{n}(a_i \wedge r_{ij})(j=1, 2, …, m)(1)$$

$\wedge$ and $\vee$ are taken small (min) and take a large (max) operation, that is

$b_j=\max[\min(a_1, r_{1j}), \min(a_2, r_{2j}), …, \min(a_n, r_{nj})]$,

The evaluation factors weighting is:

$A=\{0.18, 0.2, 0.32, 0.16\}$

$A_1=\{0.12, 0.25, 0.18, 0.45\}$

$A_2=\{0.50, 0.30, 0.20\}$

$A_3=\{0.30, 0.50, 0.20\}$

$A_4=\{0.40, 0.30, 0.20, 0.10\}$

$B_1=A_1 \circ R_1=$

$$\begin{Bmatrix} 0.12 \wedge 0 & \vee & 0.25 \wedge 0 & \vee & 0.18 \wedge 0 & \vee & 0.45 \wedge 0 \\ 0.12 \wedge 0 & \vee & 0.25 \wedge 0.1 & \vee & 0.18 \wedge 0.1 & \vee & 0.45 \wedge 0.1 \\ 0.12 \wedge 0.67 & \vee & 0.25 \wedge 0.6 & \vee & 0.18 \wedge 0.5 & \vee & 0.45 \wedge 0.8 \\ 0.12 \wedge 0.2 & \vee & 0.25 \wedge 0.3 & \vee & 0.18 \wedge 0.2 & \vee & 0.45 \wedge 0.1 \\ 0.12 \wedge 0.13 & \vee & 0.25 \wedge 0 & \vee & 0.18 \wedge 0.2 & \vee & 0.45 \wedge 0 \end{Bmatrix}^T$$

$=\{0, 0.1, 0.45, 0.25, 0.18\}$

The same,

$B_2=\{0, 0, 0.2, 0.5, 0.3\}$

$B_3=\{0, 0.3, 0.5, 0.2, 0.1\}$

$B_4=\{0, 0, 0.4, 0.3, 0.2\}$

The normalized processing is used to establish the total evaluation matrix B.

$$B=\begin{bmatrix} 0.0000 & 0.1020 & 0.4592 & 0.2551 & 0.1837 \\ 0.0000 & 0.0000 & 0.2000 & 0.5000 & 0.3000 \\ 0.0000 & 0.2727 & 0.4545 & 0.1818 & 0.0909 \\ 0.0000 & 0.0000 & 0.4444 & 0.3333 & 0.2222 \end{bmatrix}$$

4.6. Second Level Comprehensive Evaluation

First level fuzzy comprehensive evaluation reflects the influence of single factor and different grade on evaluation factors. Due to the large number of factors involved, in order to seek the overall impact of many factors on the evaluation results, second level fuzzy comprehensive evaluation is necessary.

Therefore, the second level fuzzy evaluation:

$C=A \circ B$

$$C = \{0.18, 0.2, 0.32, 0.16\} \circ \begin{bmatrix} 0.0000 & 0.1020 & 0.4592 & 0.2551 & 0.1837 \\ 0.0000 & 0.0000 & 0.2000 & 0.5000 & 0.3000 \\ 0.0000 & 0.2727 & 0.4545 & 0.1818 & 0.0909 \\ 0.0000 & 0.0000 & 0.4444 & 0.3333 & 0.2222 \end{bmatrix}$$

$C = \{0, 0.2727, 0.32, 0.2, 0.2\}$

The normalized processing is used and the result of calculation is:

$C = \{0, 0.2747, 0.3224, 0.2015, 0.2015\}$

4.7. Treatment of Fuzzy Comprehensive Evaluation

When the situation of R & D funds management is evaluated according to five grades, the results are given in percentage points (as table below shows), and the total score of the system can be obtained.

Table 3. Evaluation grade scores.

Points	20	40	60	80	100
Evaluation grade	poor	less poor	medium	less good	good

Based on the score of the evaluation level and the result C after being normalized, the total score of the calculation system is as follows:

$f=20\times0+40\times0.2747+60\times0.3224+80\times0.2015+100\times0.2015=66.59$

According to the score of R & D funds management of the case M, R & D funds management status level of the case M is medium, the case M need improve its R & D funds management level.

5. Optimization Measure of R & D Funds Management

5.1. Reconstructing the Funds Management Organizational System

Mneed change the past issue of project leader managing funds, and restructure the funds management organizational system. M need build the mutual cohesion, co-supporting funding management system, which includes two levels as macro level and micro level. The macro level takes financing department as the core, the research development department, scientific supporting center, personnel and educational department as the main coordinating management body [5], to overall manage the institute research funding. The micro level takes the laboratories as the main body to manage the laboratory funding. The funding managers in the laboratories, as the bridge to connect the macro and micro level

management, reflect the research funding using and demand, according to which financing department cooperates with the other management departments to comprehensively distribute institute research funding [11].

5.2. Building Archive Database

M need build and improve the archive database information to support management plat for research funding using. M need construct several integrated linkage relational database, which includes funding database, personnel information database, fixed asset database, etc. The funding database reflects the information of scientific and research group, funding structure, income and expenditure, funding budget balance, and expenditure structure situation, etc. Personnel information database reflects the information of scientific and research group, personnel title, labor cost, staff assessment and promotion, etc. And the fixed asset database reflects the information of scientific and research group, asset classification, asset changing, asset input, asset sharing, using, maintenance, etc. The above relational database organic convergence to form the information supporting net for the institute research funding management decision.

On the base of relational database construction, M need further improve and refine funding budget database, by building the budget template of scientific and technology plan, to set up the mapping relationship between the subjects of scientific research budget and accounting subjects. The mapping relationship comply accounting with budget management, by embedding timely monitor projects budget execution in daily accounting, to obtain funding balance and budget expenditure, realize the project budget total controlling and detail controlling, and guarantee budget expenditure orderly and controllable.

5.3. Applying Chain Controlling

R & D funds management process involves some important sub-process, such as funding raising, funding allocation, funding expenditure and funding settlement. According to the character, demanding and emphasis of the funding management sub-process, M need adopt targeted measures complemented by appropriate incentive and punishment measures to effectively improve the rationality of scientific and technology funding using, guarantee the accuracy of scientific and technology funding settlement, and promote the scientific and technology funding have the maximize benefit.

In the scientific project application and funding budget preparation stage, considering the scientific action has the characters of uncertainty, M, basing on the standard of target relevance, economy reasonable, feasible operability, need follow the research action principle to prepare the funding budget. The R & D funds managers and financial management personnel work together to estimate the direct consumption of scientific research materials, equipment, outsourcing and fuel consumption [12], personnel costs, management fees and

other consumption, and reduce tasteless exactly accurate, and strive to be reasonable and flexible.

In the funding using and management stage, M need strengthen the regulation construction; optimize the fund management and resource allocation. According to national relevant scientific funding management laws and regulation, combining with its own actual situation, M need develop and implement some system, such as 'scientific research project equipment purchase acceptance management methods', 'scientific research project management fees abstraction and using methods', 'water, electricity, and housing using charges management methods', 'scientific research project budget adjustment management methods'. M need strictly control the compliance and integrity of equipment and outsourcing task purchase and execution, and focused on the rationality, fix ability and traceability of the apportion of personnel expenditure, water and electricity charges and housing using charges [13]. During the controlling process, the collaborative development of the scientific and technology projects should be fully considered.

In the financing acceptance and assessment stage, the rewards and punishments should be simultaneously taken, and the scientific research projects budget execution, annual inspection and acceptance result should be linked with the rank promotion of the projects host. If the scientific research projects of a laboratory finish well, gain praise, and are in line with the annual assessment requirements, with the funds overall arrangement reasonable, the institute would give the laboratory priority of funding arrangement, under the institute scientific development frame, and would give priority to the laboratory research team in the annual assessment and rank promotion. While the annual budget execution and financing acceptance meet the problem, the institute need analyze and determine whether the problem is caused from the policy issues or implementation issues, and should take measures in order to improve the scientific research funding management.

5.4. Strengthening Daily Analysis

Relying on the information plat of relational database, the institute need carry out regular and special analysis, think about the problem which constraints the research development, and explores the solution. In view of the unbalanced structure of funds, the uncertainty of scientific research process, and the low degree of collaborative support among research projects, M need takes into account the correlation between the expenditure of funds and the management of R & D funds, following the objective principle of scientific research projects and national R & D funds management laws, explores the establishment of pooling system of resource integration and funding comprehensive using, to provide comprehensive funding arrangement channel between the different scientific projects. The pooling system of funding overall arrangement is shown in figure 4.
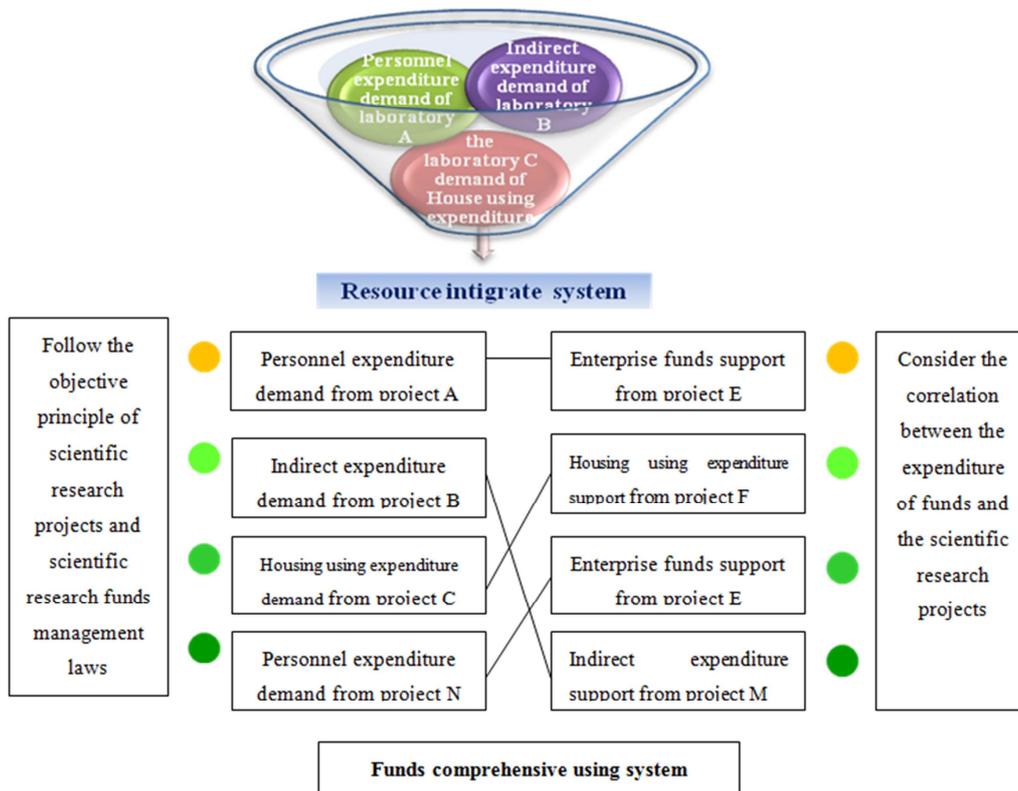
Figure 4. Funds comprehensive using integrate system.

In figure 4, the laboratory, the research group is in accordance with their respective funds supply and demand and structure; the funds are pooled into the integration of resources, adjusting each other, co-coordinating the use of funds to achieve the subject of different funding supply and demand match. And the resource integrating system will better serve the development of research projects.

6. Conclusion

(1) After a research on the R & D funds management of M by a comprehensive fuzzy assessment and analysis, the final assessment of the result is f = 66.59. The R & D funds management level of M is medium. In the course of the operation of M, there is a lack of R & D funds management synergies between the departments, and the using efficiency and the overall arrangement of R & D funds is low. The assessment results of M R & D funds management are basically consistent with the actual verification of M. Therefore, it is feasible to use fuzzy comprehensive evaluation method to evaluate the situation of R & D funds management.

(2) The fuzzy set can quantitatively describe many qualitative, nonphysical, dynamic or man-made complex factors in risk assessment. And the R & D funds management often has fuzzy phenomena, therefore, it is necessary to introduce fuzzy mathematics in assessing R & D funds management situation.

(3) Fuzzy mathematics, used in assessment of the situation of R & D funds management, can consider the various factors impact on R & D funds management, make qualitative and quantitative analysis with organic combination, reduce the individual subjective assumptions.

(4) According to the evaluation result, It is proposed that reconstructing fund management organization system, building archive database, applying chain controlling, strengthening daily analysis. In the process of strategic development of the institute M, the application of management accounting to improve the R & D funds management will provide research management professional support for the optimization allocation of resources, co-ordination of funds, and the effectiveness of R & D funds management.

Acknowledgment

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