Risk Assessment of Funding for Projects in Power Research Institute

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Abstract. China's electricity industry is a huge market and its market size is constantly increasing. Demand for technological development of power network companies is steadily increasing. In recent years, the average scientific research funds of the electric power enterprise has already reached hundred billions. With the increase in investment in scientific research and development, demand for science and technology administration funds and efficient administration is becoming more and more sharp. The purpose of this study is to analyze the characteristics of technology project administration of electric power companies. Then, the index system was constructed. The risk rating was given for each execution risk phase. Meanwhile, the risk rating of the manage points were counted. This article applies the PDCA method to solve the funding administration problem of power projects. The project describes funding adjustments and project execution through information. The purpose of this research is to enhance the risk controlling of R&D project, and provide reference for the typical application examples of funding administration in scientific project administration.

Keywords: Research and development project · funding administration · PDCA · risk administration

1 Introduction

With the rapid development of science and technology in the world, the scope of science and technology investment is expanding. The rapid increase of scientists, institutes, and ongoing critical variation of the funding administration model of the scientific research projects, which increased the complication of science and technology administration. Lots of specific administration issues were revealed. Various deficiencies of scientific research projects in professional administration and internal control have also become apparent. From the viewpoint of domestic and overseas research, the funding administration research centered on scientific research administration and characteristics evaluation [1, 2]. There is a lack of theoretical and methodological research on the use of PDCA methods and technical risk analysis tools. The plans of the project can be check from the angle of administration, the administration of scientific research projects, the auxiliary decision making, the performance evaluation and the leadership budgeting. This paper investigates and analyzes the scientific research project using the PDCA circulation theory [3–5]. In the course of the implementation of the scientific research project, the

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author starts from analyzing the present state and actual problems of funding administration applications, analyzes the actual problems that exist objectively, and submits the plan and path of funding administration optimization by use of the PDCA methods. In order to optimize the progress and performance evaluation of the project, the research and analysis of the real time changes of data were started. The project and the research institute tightly combined the construction of the funding administration system. Building a funding administration system "fusion" is an important measure for the funding administration of the Institute and the funding administration of scientific research projects [6–8].

Another notable feature of the administration is the uncertain characteristics, as follows.

First, indeterminacy of the target. The design features of the science and technology project of the energy company decided the significance of the subject matter of the research and progress. When the project and the relevant work was carried out, the boundedness of technologies restricted the realization of research and development goals for science and technology projects. The controlling of planning, funding and quality of the R&D project administration are difficult to grasp. Due to the existence of unknown factors in implementation, there are usually certain differences between the final results and expected goals.

Second, indeterminacy of technique. The redundant and complex manual processing increases the difficulty of management. Which increases the possibility of failure. At the same time, some of the features of advanced technology must be validated, so it does not result in the expected scientific research project.

Thirdly, the evaluation criterion is uncertain. It is relatively easy to create an evaluation criteria for traditional projects. The difference between cost and actual expenditure must be calculated first. The indicator can be quantitatively assessment based on the execution data. In energy and electricity technology projects, evaluation indicators are an unquantifiable indicator, and the evaluation indicator system is difficult to standardize and indexing. So it is necessary to establish appropriate evaluation systems for different types of projects. Conduct project evaluation by adding scientific and reasonable flexibility indicators.

2 PDCA Funding Administration

During the execution of technology projects, funding is required to ensure the smooth progress of the project. At this point, project financial management becomes particularly important. Effective financial management can ensure that research projects can achieve their expected goals. Financial management refers to the process and activities of conducting financial management on a project within the budget amount. By establishing the concepts of "full lifecycle cost management" and "comprehensive cost management", project management can be made more objective, scientific, and standardized. PDCA refers to Plan Do Check Action. The PDCA management method refers to managing in this order and continuing through cycles. Figure 1 shows the project administration quality control method of by using the PDCA model.

To improve the overall quality of scientific research projects, it is necessary to explore the integration law of project basic elements, judge the evolution trend of achieving the

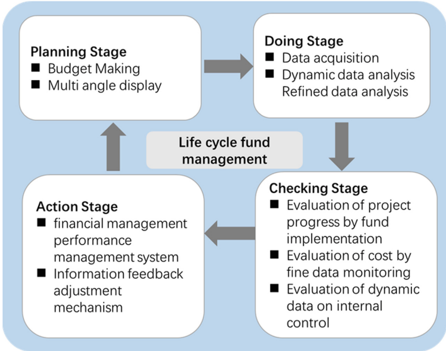

Fig. 1. Cost element of the energy science technology project plan.

overall goals, adjust strategies based on actual situations, achieve more scientific and refined management, and achieve the best overall performance of the project. PDCA cycle management can be implemented in various stages of project management, as well as in the entire project management system. It is in line with the laws and characteristics of scientific research projects and can meet the requirements of scientific management of scientific research projects.

2.1 Planning Stage

Targeting actual needs and optimizing the guidance system. A research guide is a long-term and systematic plan for a certain field based on national and practical needs. Developing scientific, reasonable, and forward-looking research guidelines is the key to guiding scientific and technological personnel to propose excellent topics. One is to take the bottleneck technology that restricts the generation of new combat effectiveness as the fundamental basis, and determine the overall structure of the research guide based on thorough research and discussion. The second is to develop research guidelines based on actual classification, which should not only focus on breakthroughs in basic theories, but also apply mature technologies to practice in a timely manner to solve practical problems. The third is to follow objective laws and pay attention to sustainable development. The progress of a technology is generally a spiral upward process over time. When demonstrating research guidelines, it is necessary to objectively propose the next research goals based on the research results of previous relevant technologies. The funding element constitutes the basis of the integrated budget organization of the scientific research project.

2.2 Doing Stage

Strict review, survival of the fittest, and improvement of implementation performance. The implementation of scientific research projects mainly includes project initiation, implementation, and assessment. During the implementation process, strict project review mechanisms should be implemented, standardized management should be implemented, and project implementation performance should be improved. During the project

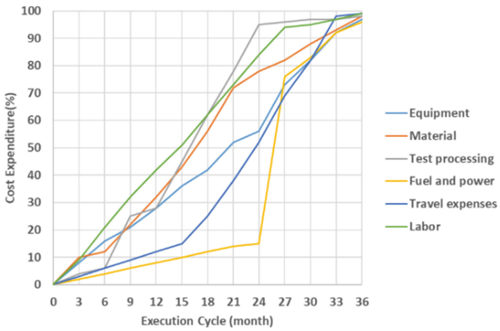

Fig. 2. Typical situation of funding execution for scientific research projects in power enterprises

initiation stage, a fair, open, and competitive application and evaluation mechanism should be established. For scientific research projects that apply for project approval, comprehensive argumentation and review should be conducted based on research guidelines and actual needs; For projects that have passed the initial review, guidance should be strengthened in the later stages, and modifications and improvements should be made based on expert opinions before they can be officially approved. During the project implementation phase, it is necessary to follow the laws of scientific research work and scientifically divide the stages. An important feature of the scientific research implementation process is its "suddenness". Completing a new technology inevitably requires a large amount of experimentation and practice. Therefore, the stage division should be based on the principle of not violating the task book and contract, and should not be too intensive. The key is to check the progress of the project, timely identify problems, and correct deviations.

2.3 Checking Stage

Respect laws, standardize processes, and promote construction through evaluation. A sound process supervision mechanism and quality evaluation method are key to ensuring the quality of scientific research projects. The biggest difference between scientific research projects and engineering projects is the "invisibility" of the research process of scientific research projects, which means that except for the results in the final delivery stage that are visually visible and unchangeable, the results in previous stages may change, and the entire project can be regarded as the thinking process of scientific researchers. Although the thinking results can be solidified through experimental data and other means, the thinking process and methods are difficult to solidify. Therefore, it is necessary to improve the stage inspection method, reveal the intangible thinking process, and form a fixed stage inspection result. Figure 2 shows how funds run a general energy science and technology project, and the duration of these projects is three years.

2.4 Action Stage

Targeting cutting-edge needs, motivating and guiding, and optimizing reforms. The improvement process is actually a prerequisite for connecting the past and the next, and for the next cycle to rise. Statistical comparison and analysis of important project process results and process objectives, as well as past process results and the same process results as other organizations, determine the ability of the process, identify improvement needs, and develop next step optimization measures. In terms of research guide planning, on the one hand, we look forward to the future and focus on developing interdisciplinary, integrated, and forward-looking disruptive technology requirements. On the other hand, aiming at practical needs and improving the conversion and application rate of mature technologies. On the basis of summarizing the implementation results of the previous methods, fully utilizing mature and advantageous technologies, combining with the characteristics and laws of scientific research projects, classifying and optimizing improvements, laying the foundation for more scientific and reasonable supervision of project implementation.

3 Risk Administration of R&D Projects

Under the current scientific research funding management system, the responsibilities and rights between the organization and coordination of enterprise scientific research project management and the supervision of the use of scientific research funds are not clear. The management of scientific research projects and research funds should have been coordinated as a whole, but due to the different powers and responsibilities of functional departments, the management department of scientific research projects cannot fully understand the use of research funds, and it is also difficult for the management department of scientific research funds to timely understand the progress of scientific research projects. Inevitably, the coordination relationship between research project management and research funding management has been severed. On the other hand, the project leader lacks sufficient understanding of the rules and management regulations for the use of scientific research funds, and the finance and research departments also lack training and guidance for the project leader. This information asymmetry between the project leader and functional departments can easily lead to the wrong idea of project funds being managed by themselves, which may lead to unscientific budgeting and non-standard use processes. There is information asymmetry in scientific research management, which can easily lead to weak cooperation awareness between research project managers and research fund managers, disconnection between fund management and project management, illegal and inefficient use of research funds, and other issues.

The uncertainty of scientific research itself has brought significant difficulties to the planning and management of funds. The funding management system provides relevant materials such as funding budgets during the project application phase. The review phase takes a long time, and the approval phase is allocated in a certain proportion, which leads to a large span of project cycles. The management regulations for the use of scientific research funds are too rigid, the budget adjustment process is complex, and the management requirements that are too rigid do not comply with the inherent laws of uncertainty in scientific research activities. The internal management system of scientific research funds in enterprises often focuses on issues such as allocation of funds, while specific business guidance on the use of funds and expenditure standards is insufficient. Enterprises have formulated management measures for scientific research funds, but there are no rules to follow for the management process, internal control, division of responsibilities, and handling standards of scientific research funds, which makes it difficult to truly implement the management of scientific research funds. There are various sources of scientific research funds, and different types of funds also have their own usage and management methods. However, the internal management methods of universities often only differentiate between horizontal and vertical topics, without formulating different usage methods for different sources of funds. The classification management of different projects and funds is also not in place. This internal management system and methods are not scientific, leading to low efficiency in scientific research fund management.

The management of scientific research funds involves multiple aspects of the input and output of scientific research funds, as well as the management process. The input, output, and management of scientific research funds also involve multiple management departments. To evaluate the performance of scientific research fund management, it is necessary to have a comprehensive understanding of the input, output, and management of scientific research funds, as well as to coordinate writing among various departments, which is difficult to operate. Secondly, the performance evaluation of research funding management involves multiple qualitative and quantitative indicators. For example, research funding investment includes the total amount and structure of investment, talent cultivation involves the quantity and quality of talent cultivation, and the output of research funding includes quantitative indicators such as papers and works, as well as qualitative indicators such as the impact of research results on the economy and society. The evaluation process of research funding is complex. The evaluation criteria are difficult to quantify. Once again, the performance evaluation of scientific research fund management requires high quality of personnel's own abilities. Scientific research evaluators need to understand both the theoretical knowledge of scientific research fund management and the practical problems in scientific research fund management. However, there is a lack of comprehensive talents who understand both theory and practice, and have a comprehensive understanding of the use rules and financial management process of scientific research funds in current scientific research fund management.

Table 1 shows the research project funding performance evaluation index system. Figure 3 shows the common quantitative indicator system for a typical science and technology project.

3.1 Risk Identification and Assessment Implementation

Table 2 shows an example of the risk target level, the administration process is the standard level, and the key control point is the index level. Hierarchical model was constructed. The first level risk controlling factors are {M1, M2, M3, M4, M5, M6}, and the second level risk factors are {N11, N12, N13}, {N21, N22, N23, N24}, {N31, N32, N33, N34}, {N41, N42, N43}, {N51, N52, N53}, {N61, N62, N63}. After the hierarchical index system was constructed, the criterion of the quantitative index was established based on the upper and lower relationships.

Calculate *Ci* of each factor in each row of the computation decision matrix

$$C_i = \prod_{j=1}^{n} u_{i,j} (j = 1, 2, \ldots, n) \tag{1}$$

Table 1. Research project funding performance evaluation index system

Indicator system	Primary indicators	Secondary indicators
Budgeting indicators	Rationality of budget preparation	Research business expenses
		Experimental material cost
		Testing, calculation and analysis fees
		Instrument and equipment costs
		International cooperation fee
		Labor costs
		Indirect costs
Budget execution indicators	Budget performance	Authenticity of expenditure
		Rationality of expenditure
		Budget adjustment situation
Acceptance evaluation indicators	Budget and final settlement situation	Total expenditure situation
		Details of expenditure
		Fund utilization efficiency
		Fund utilization efficiency
		Asset acceptance status
Tracking indicators	Budget Balance	Usage of budget surplus funds

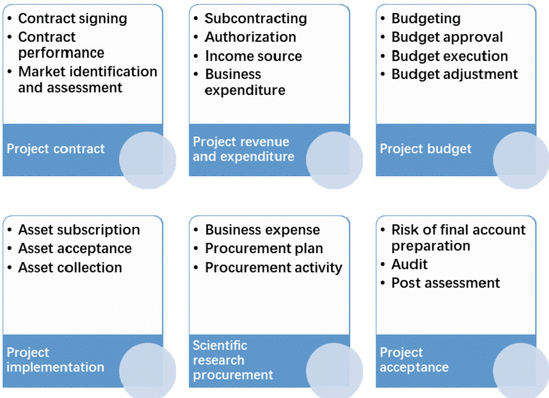

Fig. 3. Common quantitative indicator system for a typical science and technology project

$$w_i = \sqrt[n]{C_i} \tag{2}$$

Normalization,

$$\overline{W} = w_i / \sum\nolimits_{i=1}^{n} w_i \tag{3}$$

Calculate the random exponents

$$\partial_m = \sum\nolimits_{i=1}^{m} \frac{(AW)_i}{mW_i} \tag{4}$$

$$I = \frac{\partial_m{}^{-n}}{n-1} \tag{5}$$

$$\mathrm{c} = I/R \tag{6}$$

Based on the built in step level, we invited experts to compare and evaluate the level of risk points M1, M2, M3, M4, M5, M6 and secondary risk points N11, N12, N13…N63 and the evaluation matrix of each index. Each evaluation matrix passed the coincidence test. Finally, we calculated the risk sharing rate of sub goals and indices at the company level.

Analysis can reveal that, the risk level of different risk levels in each index was maintained, and the risk level of the risk control point of the University was maintained. In Table 2, High risk, medium risk, and low risk are represented by the letters H, M, and D. For example, the high risk weighted probability of contract N11 is 0.0061, the high risk weighted probability of contract N12 is 0.0053, and the low risk weighting probability of market identification and evaluation risk N11 is analogous to 0.0068. From this, we can calculate the risk levels of all key control points in the project management process. Based on the calculated results, control points are high risk.

4 Conclusion

Due to the continuous demand for technological research and development in the energy and power industry, this study proposes the PDCA cycle theory and the concept of life cycle cost management for scientific research projects. Submitted a research project funding administration framework. Through quantitative analysis of funding data during the project period, we monitored the implementation process of scientific projects and proposed a funding management method for project support decision-making and performance evaluation. The method of PDCA information feedback has guided budget coordination and project implementation, reducing the workload of researchers. This study can fully mobilize the enthusiasm of researchers and provide practical reference for the application of funding management in scientific research project management in research institutes. This study proposes a method of feedback adjustment budget and feedback project execution. By reasonably controlling risk points, scientific, university, and reasonable financial management can be achieved. By adopting more optimized information technology methods in the future, the precision and precision of financial management models can be gradually achieved.

Table 2. An example for the risk evaluation hierarchy index of scientific research projects in power enterprises

	Level 1 /M	Level 2 /N	Indicators	Type
Risk of project/ P	Contract of project/ M1	Risk of contract signing /N11	0.0061	H
		Risk of contract performance /N12	0.0053	H
		Risk of market identification and assessment / N13	0.0068	L
	Revenue and expenditure of project /M2	Risk of subcontracting / N21	0.0132	D
		Risk of authorization / N22	0.0087	D
		Risk of income source /N23	0.0092	D
		Risk of business expenditure /N24	0.0051	H
	Budget of project/ M3	Risk of budgeting / N31	0.0061	L
		Risk of budget approval /N32	0.0058	D
		Risk of budget execution /N33	0.0063	H
		Risk of budget adjustment /N34	0.0077	L
	Implementation of project/ M4	Risk of asset subscription /N41	0.0052	H
		Risk of asset acceptance /N42	0.0052	D
		Risk of asset collection / N43	0.0081	L
	Procurement of scientific research /M5	Risk of business expense / N51	0.0069	H
		Risk of procurement plan/ N52	0.0067	D

(*continued*)

Table 2. (*continued*)

	Level 1 /M	Level 2 /N	Indicators	Type
		Risk of procurement activity/ N53	0.0054	H
	Acceptance of project/ M6	Risk of final account preparation/ N61	0.0082	L
		Risk of audit / N62	0.0072	H
		Risk of post assessment / N63	0.0091	D

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