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The strategy of implementing effective scientific research management system in colleges using DEA method under the analysis of multiple cases

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Abstract: *As the priority direction of modern university research activities, research management is an important factor that directly affects the ability to stimulate the potential of university research activities and improve its competitiveness in the field of education. Therefore, modern universities must implement advanced scientific research management concepts, innovate, optimize and improve the contents and methods of scientific research management, improve the scientific research management system, provide high-quality services for scientific researchers, and meet the needs of scientific research success. This paper will analyze and study the case analysis and data collection of the innovation and development of university scientific research management, combined with the effectiveness of the case analysis strategy. The results show that the strategy has good effect in scientific research management and has broad application prospects.*

Keywords: *university management; scientific research management; innovation; multi-case analysis; DEA method*

1. Introduction

In the current era of educational innovation, the development of scientific research innovation in colleges must keep pace with the times [1]. In addition to cultivating and transferring more high-quality and high-tech talents, modern colleges also need to vigorously innovate and develop, cultivate and learn more advanced scientific and technological achievements, and make greater contributions to social construction and development[2]. To improve the quality of scientific research management, universities must strengthen innovative and perfect scientific research management, rationally apply innovative scientific research management methods according to their own conditions and scientific research needs, and scientifically apply fine management models to ensure that problems are considered and solved from the perspective of researchers, to promote the stable and sustainable development of the management of universities and scientific research institutions.

The development of colleges is inseparable from innovation. While pursuing scientific and technological innovation and development, universities should pay close attention to scientific research management innovation[3]. By establishing a professional and well managed scientific research management talent team, colleges guide managers to form a people-oriented scientific research management concept, improve management measures in combination with scientific research innovation management of the University, and create favorable conditions for scientific research work. Promote the harmonious and stable development of scientific work [4-7].

At present, there are many problems in the management of scientific research in colleges. Due to the influence of the traditional educational management work concept, many scientific research managers in colleges are relatively backward in concept, lack the awareness of independent innovation and positive enterprising spirit, and have been using the traditional scientific research management model. The management procedures are simple and mechanical and cannot be combined with actual scientific research activities. The contents and methods of management must be rationalized so that the authority can perform its functions and promote the success of scientific research [8-10]. In addition, the top scientific management level lags behind the self-service and people-oriented thinking, often only pays attention to scientific research management achievements, ignores the quality of the whole management process.

Scientific research administrators in universities have not effectively formulated scientific and sound policies and measures to motivate researchers and teachers to engage in scientific and

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technological research, formed a complete evaluation and assessment system for scientific research activities, and set corresponding rewards according to the actual performance of scientific researchers [6-7]. In addition, incentives are also a key factor to stimulate the continuous innovation of scientific research managers. Universities have not taken this into account in the establishment of scientific research incentive mechanisms, resulting in lack of enthusiasm and initiative for scientific research managers to innovate, and various management work is a mere formality[11-14].

2. Strategies

The management of scientific research data in universities is a very important work. We first consider data management services. Throughout the life cycle of data, the Institute has benefited from scientific management services. For details, including data generation, please refer to Figure 1.

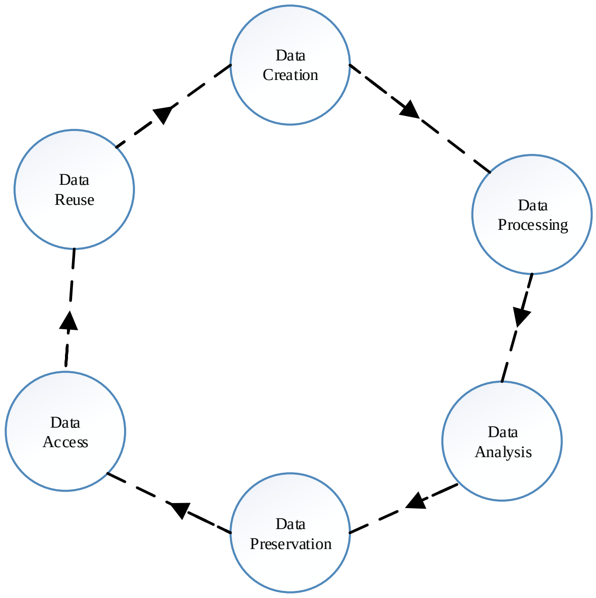

Figure 1: University data lifecycle model

According to the "Research Data Policy", universities divide the data that needs to be managed into three categories: Research Data, Final Research Data and Metadata ¨1. Scientific research data means data in any format or form collected, observed, generated, created and obtained throughout the conduct of a scientific research project, including digital, descriptive, audio, video or other physical formats recorded by scientific researchers, and also by instruments Device-generated models, simulation data. Final data refers to the final data set obtained when researchers stop any processing of the data. Metadata refers to a set of information or facts used to attribute, describe, manage, validate, and discover research data.

2.1 Data creation and processing

Data creation is the basic step of scientific research management. The data space needs name, identifier, contact email, affiliation, content introduction, category, metadata type, other information, etc. when it is created. A dataset is a collection of data files, documents, and code, and there is no limit to the size or number of files that each dataset can hold. The relationship between data space, dataset and file can be seen in Figure 2. The files of the dataset can be added directly by dragging and dropping. A single file does not exceed 10GB at most, and a compressed folder does not exceed 1000 files at most. The uploaded compressed package will be automatically decompressed to generate a corresponding directory tree. Documents are best described and marked so others can identify them.

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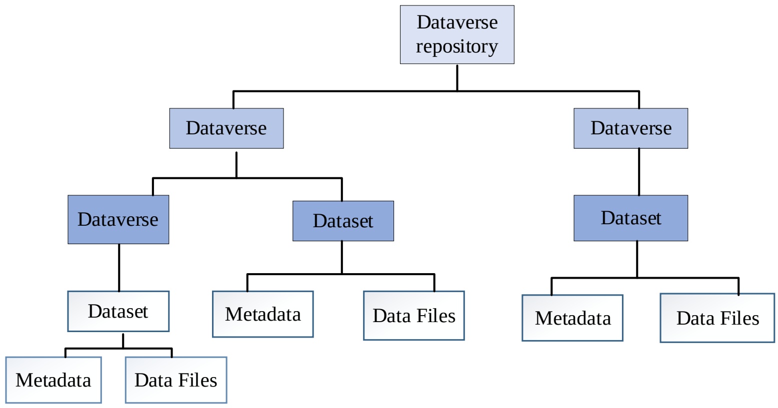

Figure 2: Data space (data verse), data set (dataset) and file relationship

2.2 Data Storage

The system is developed based on Data verse, Data verse uses the social science metadata standard (Data Documentation Initiative, DDI), and adopts the Space platform of Dublin Core Element Set (DC), DDI can be viewed from macro and micro perspectives.

The comprehensive evaluation system of university scientific research management further designed in this study is an evaluation model based on executive ability and priority, which aims to evaluate the ability and priority of each proposed criterion in the process. The theoretical basis of the evaluation model is Kaplan and Norton's Balanced Scorecard and Sati's Analytic Hierarchy Process. There are 7 categories of application, scientific research basic conditions and scientific research management. These standards are obtained from previous literature and case studies.

Step 1: Determine the target and point category. The goal is to assess the research management capabilities and priorities of colleges. This objective was an executive evaluation finalized during an extensive literature review and multiple case study interviews.

Step 2: Formulate evaluation criteria for scientific research management in colleges. These criteria were drawn from a literature review and multiple case studies.

Step 3: Divide the evaluation criteria into three levels and use the AHP to establish three levels of evaluation forms.

At the highest level, the objective of the project was demonstrated, that is, to assess the capacity and priorities of institutions to conduct environmental impact assessments. The second layer lists the contributions of scientific researchers, scientific research costs, topics and academic exchanges, etc. Basic conditions of scientific research and evaluation types. The third level is the detailed evaluation criteria, which are classified according to the actual situation. These levels are interrelated. According to the hierarchy analysis, the value from the lowest level will affect the highest level until the highest level. The specific category and weight relationship are shown in Figure 3.

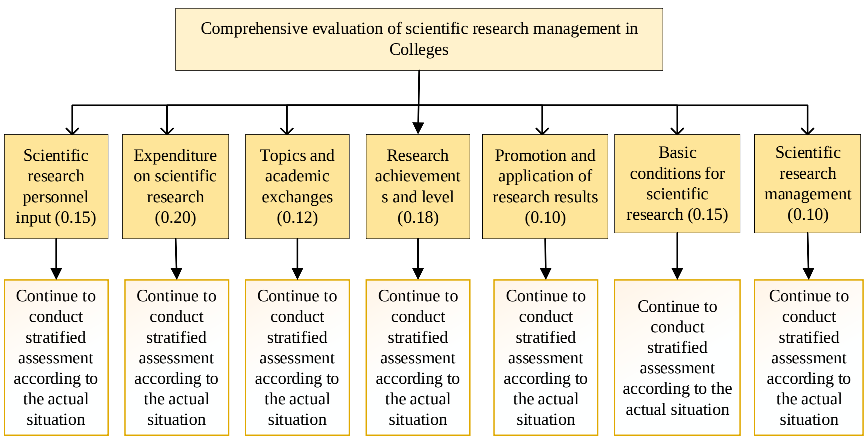

Figure 3: Diagram of basic mode of comprehensive evaluation of scientific research management in universities

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3. Case study

We selected five types of universities for analysis. The specific proportion of each type of university is shown in the Figure 4. According to the empirical rule of applying DEA model, it is generally required that the number of DMUs should not be less than 2 times of the evaluation index system. In this paper, 2 undergraduate colleges and 2 higher vocational colleges are randomly selected as DMUs in each type of colleges, using DEAP2.1 software as data analysis tools, using C2R model and BC2 model to calculate the technical efficiency and pure technology of 20 DMUs The decomposition factor values of efficiency, scale efficiency value and scale return are analyzed to analyze the relative efficiency of DMU, which provides data reference in my country (see Table 1 and Figure 5 for details).

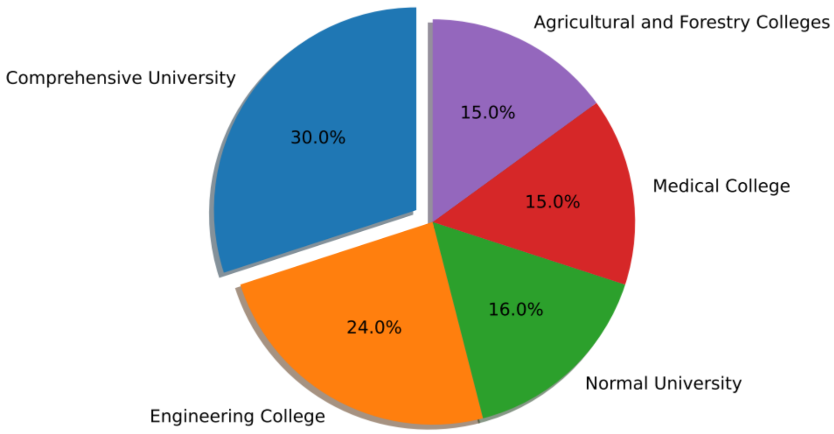

Figure 4: Proportion of different colleges

Table 1: Relative efficiency of scientific research input and output of various universities

School Name:	Average technical efficiency	Homogenization technical efficiency	Average scale efficiency	Return on Scale (piece)
Comprehensive University	0.677	0.618	0.977	Drs (3)> IRS (1)
Engineering College	0.679	0.628	0.936	Drs (4)> IRS (0)
Normal University	0.815	0.927	0.812	Drs (1)< IRS (4)
Medical College	0.744	0.712	0.869	-
Agricultural and Forestry Colleges	0.505	0.514	0.885	Drs (3)> IRS (1)
mean value	0.685	0.679	0.705	/

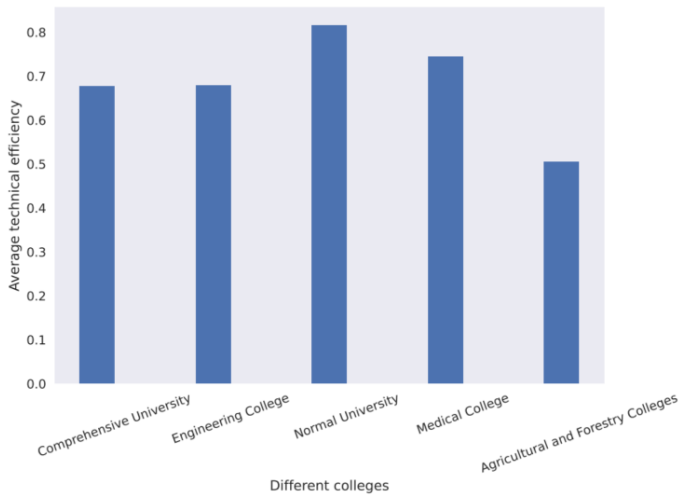

Figure 5: Average technical efficiency of colleges

From Table 1 and Figure 5 that the relative efficiency of scientific research in China's higher

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education institutions is relatively low. Only medical universities belong to DEA, and the income scale has not changed. The average technical efficiency and pure technical efficiency are above 0.7. Therefore, while increasing scientific research investment, most medical universities also pay special attention to rationalization. The existing trend remains unchanged. However, most of the other four types of colleges are ineffective. Among them, only normal universities are in the stage of population growth, and the average technical and pure technical performance indicators exceed 0.8, which is the lowest in the sample. Research shows that universities have obvious advantages in management mode and technical conditions, and relatively weak dependence on the scale of scientific research investment.

The scale of scientific research output, so that the non-DEA effective DMU becomes the DEA effective DMU, is the problem to be solved by using the projection analysis technology to analyze the non-DEA effective sample data. In this paper, the DEAP2.1 software is used to project the 16 non-DEA valid DMUs on the production possible set in 2016, and the input redundancy and output deficiency of each university are obtained. The improvement direction of scientific research management in colleges.

Table 2: Analysis of redundancy and deficiency of DEA effective DMU in 2016

Type	Sample	Input redundancy			Insufficient output				
		X_1	X_2	X_3	Y_1	Y_1	Y_1	Y_1	Y_1
Comprehensive University	1	18	0	24522.3	23	35	27	0	71962.88
	2	0	41215.68	0	0	0	61	0	35292.09
	3	0	12699.89	0	31	60	89	0	22706.37
	4	68	0	550.17	0	3	0	0	905.57
Engineering College	1	0	12692.3	0	0	33	0	0	1045.32
	2	0	0	0	9	0	4	84	79574.73
	3	0	80188.99	6165.36	0	14	0	0	14549.12
	4	259	58.082.67	0	16	0	29	0	21502.63
Normal University	1	0	9018.15	0	0	9	10	0	2440.83
	2	16	0	0	3	0	2	0	904.57
	3	0	0	0	0	33	54	0	0
	4	0	0	0	6	0	0	0	279.94
Agricultural and Forestry Colleges	1	8	38487.32	4003.2	0	30	26	50	96353.47
	2	0	0	0	4	0	0	0	2758.11
	3	19	74362	0	0	24	32	0	22745.32
	4	0	2889.21	5142.7	0	21	61	0	7963.21

As shown in Table 2 and Figure 6, the problem of excessive research investment in domestic universities is particularly serious. More than half of universities are facing the problem that laboratories are blindly expanded or idle without being fully utilized, resulting in the loss of scientific resources. As a high-level thinking, the performance level of scientific innovation is closely related to the number and quality of scientific research personnel. The above analysis shows that most universities do not have the redundancy of investment indicators of "full-time scientific research personnel". The phenomenon, that is, the shortage of scientific research teams in universities across the country, coupled with the general scientific atmosphere in which scientific researchers carry out scientific research for the purpose of conferring titles, makes the scientific research achievements of Chinese universities more or less quantitative and qualitative. Big discount. In addition, only five institutions of higher education have surplus research funds, and the amount of surplus is very small. It can be seen that most institutions of higher education have insufficient research funds and lack an effective financial management system. In addition to the "number of master's, doctor's and postgraduate students" with a relatively high level of productivity and talent training effect, China's universities have not achieved large-scale scientific research results in the case of a large amount of scientific research investment. The efficiency of clean technology is low. Generally speaking, the scientific research work of normal universities is consistent, scientific research resources are widely used, and scientific research tasks are well completed. Poor management needs to be discussed and improved.

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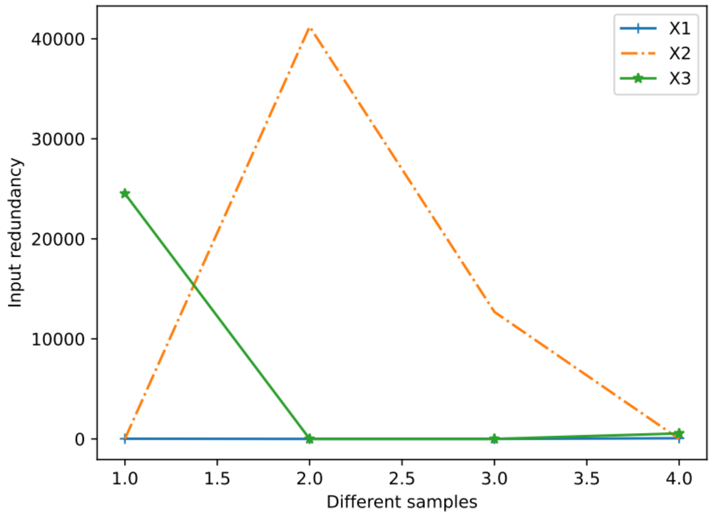

Figure 6: The input redundancy of Comprehensive University

4. Conclusion

As pointed out in the paper, a sound scientific research management system is a powerful guarantee for scientific research management to achieve tangible results. In view of this, universities should pay attention to improving and perfecting the scientific research management system, invest funds to establish a more scientific, standardized and efficient scientific research management system, and improve the efficiency of scientific research achievements management. Scientific research leaders and guidance should comprehensively and deeply study, study, analyze and demonstrate scientific research related resources, so that all parties can participate in scientific research management. And we should strengthen the guidance of scientific researchers so that they can make greater progress in self-regulation and self-development.

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