

# *Design and Research of Data-driven Scientific Research Management Platform*

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**Abstract:** Based on the spiritual guidance of the national implementation of the data outline, the functions of various scientific research management platforms at the current national to provincial levels are investigated, the technical and functional characteristics of data-driven scientific research management platforms are analyzed, and the design scheme of existing technical compatibility and multi-platform cooperation is proposed. The platform uses the unified identity authentication technology to realize the data docking and integration of personnel system and financial system. Based on the data element model, the user classification and role management functions are realized, so as to realize the integration of scientific research fund budget and financial execution. The platform can track and manage the whole life cycle of project content and funds, and at the same time, it can use the network to assist the management of scientific research results, collect the authenticity of paper results in real time, and integrate visual data analysis function, which provides scientific decision-making basis for managers in the process of funding support, project establishment, review and other processes, and provide information support for the research trends of researchers.

## **1. Introduction**

As early as 2015, the state put forward the development principle of "innovation-driven and collaborative innovation" in the "Action Program for Promoting the development of Big Data". The outline supports scientific macro-control, improves big data for education and culture, develops scientific big data, and actively promotes the construction of open and sharing of data for scientific research activities and production. The problems existing in the current scientific research management process. The outline provides policy support in the field of data decision-making function of scientific research management. In the "Guidance on Promoting New Education Infrastructure to Build a High-quality Education Support System" issued in July 2021, the connotation of "new education infrastructure" is clearly defined, it is a new type of infrastructure system led by the new development concept, led by information, oriented to the high-quality development of education, focusing on information network, platform system, innovative application and other aspects. This presents new challenges and opportunities for the design, research and application management of scientific research platform.

### **1.1. Information management decisions between systems rely on offline operations**

On the one hand, there are many departments in charge of scientific research application and many scientific research management systems, and the project information of superior supervisors stays in the offline operation on paper, and the information is not exchanged [1]. There is no global tracking and supervision of the progress cycle of scientific research project execution. On the other hand, the information of researchers' project achievements is fragmented in time and space, and the information of "whether the project is concluded" of multiple researchers is not global for managers, and no available data information has been formed. When the applicant's qualification is to be formally audited, the project status information cannot be immediately judged, nor can the member's project participation be grasped. When the decision is not accurate and the project is blindly approved, it will lead to too many projects in charge, resulting in slow project execution.

### **1.2. There is no global tracking and supervision of the implementation schedule of scientific research projects**

Because there are many departments in charge of scientific research projects, the use of platforms is not the same, and various projects form a large number of paper archives. These paper documents cannot be managed by the same department, which will lead to the separation of the scientific research management process of various projects at all levels, and the information judgment such as project establishment decision will rely on offline operation. Managers will not be able to fully grasp the research progress and implementation of individuals in the scientific research team, and they will not be able to track the timeliness and long-term effectiveness of individual scientific research behaviors. Therefore, data-driven research management model [2] should be promoted and explored.

### **1.3. The collaborative efficiency of personnel information review is low**

The audit of basic qualification information such as the title, age and title of talent of the applicant basically relies on manual audit operation. The personnel information under review is not related to the information of the school personnel information system, the existing data information exists in information islands among various platforms, and the existing decision information cannot play a collaborative decision-making role due to data barriers. Data decision-making function [3] should be strengthened through multivariate data integration analysis .

### **1.4. The legitimacy of the actual expenditure of scientific research funds is uncontrollable**

When the project is declared, the budget account information of the project is not digitized in the scientific research management platform, which leads to the fact that the budget account of the fund cannot match the actual budget account of the financial system. Due to objective or subjective reasons during the development and implementation of the project, the budgeted account of expenditure is inconsistent with or deviates from the actual account of expenditure, the reimbursement items in the financial system are inconsistent with the budget items reported in the scientific research system, which leads to unscientific evaluation of funding efficiency or scientific research performance [4].

### **1.5. It was not possible to review the repeatability or innovation of the submissions**

The declaration content of scientific researchers exists in the declaration of the applicant himself, and the declaration content is independent of each other. Content independence includes two aspects of independence, on the one hand, it is independent from the content of the project carried out by

individuals in the past, and on the other hand, it is independent from the content declared by others at that time. When different experts review the content of the declaration, the experts can not determine whether the content of the declaration is repeated with the previous declaration, nor can they judge whether the content of the declaration is repeated or similar to the content of the declaration of others. This will lead to unfair or duplicate project approval. Due to the lack of collaborative sharing of scientific research management information based on public application resources, it is necessary to build an information sharing platform for scientific research projects [5] to realize platform information sharing, so as to provide a large amount of data information for scientific decision-making by scientific research managers.

### **1.6. There are routine changes in the scientific research management system**

Due to the development and changes of schools, the management mode and assessment mode of administrators in different periods are different. For example, the requirements for conditional audit and review of applicants are not the same, in different periods, the number of projects that can be declared by colleges and universities is different, the number of projects that can be declared by individuals is different, the age and professional title requirements of applicants for different projects are also different, and the number of projects that can be participated in as project members will also change. These frequent changes in management requirements directly affect the technical lines of platform planning and design.

## **2. Technical characteristics and framework of research management platform design**

To solve the above problems, it is necessary to comprehensively consider the collaboration of the scientific research management platform business process, the sharing of data transactions, and the confidentiality of the transaction process, so as to provide managers with a platform, that is clear in data application, complete in statistical information, complete in resource library, convenient in team management, secure in permissions, and can be independently planned. Overall, it must have the following characteristics:

### **2.1. Service networking**

The entire process of scientific research management involves researchers, research managers, review experts, and technical support and maintenance personnel. In order to realize multi-role and multi-function operation, the network of platform design is an inevitable requirement. To improve collaboration and convenience, the system is developed using both B/S mode based on WEB. A large amount of data processing is handed over to the server, and users at all levels only need to read and trade data through a browser. Users do not need to install any client software to improve basic business operation efficiency.

### **2.2. Data centralization**

A lot of scientific research data and management data in the system are concentrated in the server side. Scientific research management platform involves multi-role and multi-operation transactions, and will generate a large number of dynamic and static data, which needs to use large and medium-sized databases for data storage and transaction. Large and medium-sized databases have high availability features such as complete data recovery and backup. Large and medium-sized databases are used to centrally manage the data of the scientific research management platform, which is convenient for data backup and recovery and other maintenance work. Information centrally stored

and updated in the process of scientific research management includes: scientific research team, review experts, project information, process status, fund revenue and expenditure information.

### 2.3. Modularization based on metadata pattern

The system consists of several subsystems. Sub-systems are connected by configuring service data and metadata. The subsystems are independent and connected with each other, and can be divided into independent functional modules through permissions. The modular design can flexibly meet the changing needs of users. During system function maintenance, you can also implement relatively independent function changes based on permissions. Based on the metadata design, the system adopts the design pattern based on metadata to realize parameterization and function modularization, and provide users with personalized services.

The technical framework adopted by the platform is shown in Figure 1.

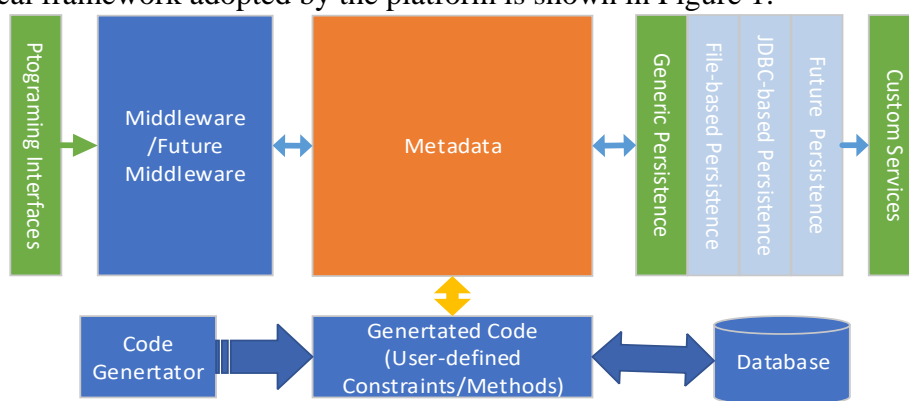


Figure 1: Modularization based on metadata pattern

### 2.4. Multi-platform compatibility and multi concurrency

The software system adopts JAVA development technology and N-layer application architecture. The database server system, web server system, and application server system can run on various operating system platforms, which include Windows NT/2000/2003/2008, Unix, and Linux (Red Hat Linux). To improve the running speed of the system and enhance the system's responsiveness when multiple users access the system simultaneously, advanced caching technology is used to effectively improve the concurrency performance of the system.

## 3. The Logic of Functional Module Design for Scientific Research Management Platform

### 3.1. The functional characteristics of data-driven scientific research management platform

There are many supervisory departments for scientific research projects in natural and social sciences in China. There are also many supervisory project platforms in industry fields, including the National Social Science Application Platform, the National Education Science Planning and Management Platform, the National Arts Fund Application System, the Ministry of Education Humanities and Social Sciences Research Management Platform, the Yunnan Philosophy and Social Sciences Planning and Research Management System, and the Yunnan Provincial Science and Technology Information Management System. There are more than ten systems. Each system has different manifestations and applications in big data decision-making, they are generally divided into three major functions: management, application, and review. From the functional perspective, the scientific research management platform is generally divided into three functions: management,

declaration and review. Management functions mainly include declaration plan push, project approval, review, fund management, basic resources and natural information audit. The declaration function mainly includes the maintenance of natural information of scientific researchers, the uploading of declaration documents, the management of members, the budget and implementation of funds, and the document management in the process of project implementation. The review function mainly includes the evaluation and review of the basic information of the project, the contents of the declaration, the budget subjects, the expected results, and the basis of the team.

To solve the above problems, the scientific research management platform needs to be able to apply a large number of data-driven decision-making and management, and its functional characteristics are summarized as follows:

### **3.1.1. Management Collaboration**

Based on the big data decision-making function, various management departments can achieve collaborative management of projects. On the one hand, the scientific research platform and the personnel information platform can jointly review the information such as title and age; On the other hand, the tracking management of fund budget and fund execution can be realized between the scientific research platform and the financial platform. In addition, the scientific research platform can authenticate and verify the published scientific research results through the data of other platforms on the network, and identify the authenticity of scientific research results through the information push of other platforms.

### **3.1.2. Scientific decision-making**

Through the data concentration and analysis of the platform, scientific research managers can make judgments on project application qualifications and assist managers in decision-making, at the same time, according to the relevance of the project application discipline, match the review experts, and send the relevant audit content to the experts. The platform can automatically review the basic information such as age and title of the project members, match the basic content of the project with keywords, and issue reminders or warnings to the applicants and reviewers for repeated or similar content, so as to avoid repeated project approval. After the establishment of the project, the progress of the implementation of funds can be tracked and managed and early warning.

### **3.1.3. Full lifecycle tracking management**

The platform needs to conduct centralized data classification management for researchers, research results, project processes, etc. Track the whole process of scientific research management, such as the situation of scientific research personnel, scientific research results, fund implementation progress and expenditure subjects, scientific research results, etc. The platform can register or import scientific research projects from different authorities, and carry out full life cycle management of project initiation time, completion time, project members, project results, funding sources and destinations, and results categories. Realize the whole process trace management of declaration, review, project approval, implementation, conclusion, change process and document, so as to trace the dynamic trace.

### **3.1.4. One identity authentication, multiple system access**

In the process of scientific research system management, in addition to organizational management, scientific research managers also need to carry out a lot of service work, such as policy interpretation, paper archiving, business consulting, etc. For centralized and unified management and improved collaboration efficiency, the system needs to implement the unified identity authentication function.

After a login audit, multiple systems can be identified, and there is no need to switch between multiple systems with multiple accounts. Password user self-management and reset are also required.

### 3.2. The functional structure of data-driven scientific research management platform construction

The main modules of the system basic functional structure design are as follows in Figure 2.

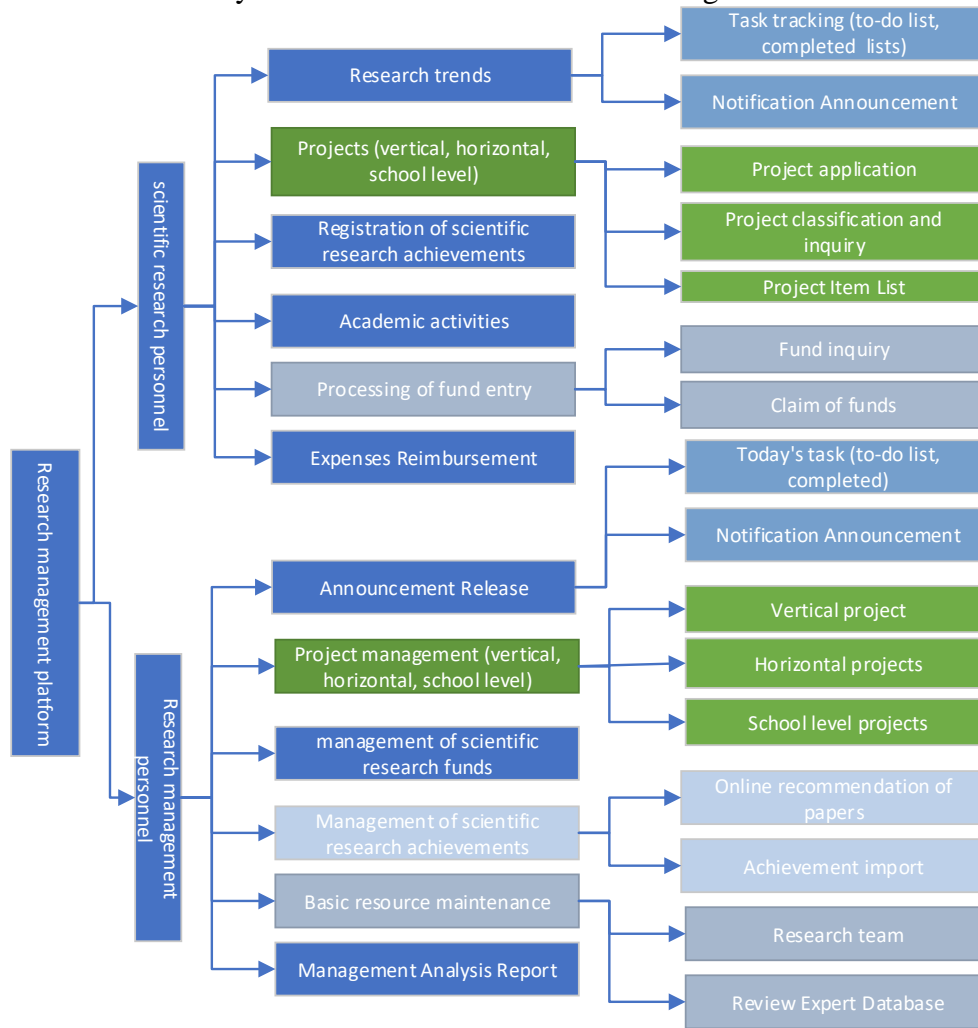


Figure 2: Data-driven scientific research management platform construction

The system complies with the following principles: User roles are easy to switch, multiple systems can be managed collaboratively, and functions are relatively independent and low coupling. The platform realizes the hierarchical management of scientific research business process according to three hierarchical management rights, which is divided into scientific research personnel, scientific research secretary and scientific research administrator. The research secretary belongs to the college department. They are responsible for communication between research managers and researchers. In terms of management function, research secretaries are a subset of research managers. Therefore, it is only necessary to give the main functional structure diagram of researchers and research managers. The research platform is certified by single sign-on and integrated with the personnel system and financial system.

The data of the scientific research team in the scientific research system is obtained from the personnel system and periodically pushed, it can avoid subjective operations by scientific researchers

in terms of age and professional title to fill in transactions. At the same time, it avoids projects that impersonate professional title identity to apply for and set professional title conditions;The platform reads the financial management data through the intermediate library and pushes it to the scientific research platform, which realizes the budget docking with the financial system, so as to realize the progress tracking of the financial budget execution by the scientific research platform.If the project funds have not been used or spent for a long time, a certain ratio of unused funds (threshold) can be set, and through the threshold comparison, the fund early warning and reminder can be made, the long-term unimplemented funds meeting a certain threshold can be warned to the researchers, and the third-party information can be used to send notifications (QQ, wechat, SMS, etc.).

In addition, the platform classifies and manages all types of projects at all levels based on the basic resource base of different roles. It has a clear list of members, and the administrator can customize the rules for project leaders and members to participate in the project. Through the data joint query audit, the automatic review of membership is realized.

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## References

- [1] Ye Jiajia. *Optimization Practice of Scientific Research Management System in Higher Vocational Colleges under the Background of "Streamlining Administration and Servicing" - Taking GM School as an Example [J]. Journal of Zhejiang Industry and Trade Vocational and Technical College, 2023, 23 (03): 29-33*
- [2] Zou Yu, Wang Yixuan. *The Application of Big Data Technology in Scientific Research Management Systems [J]. Electronic Technology, 2023, 52 (10): 292-293*
- [3] Xu Chaojun. *Research on the Construction of Information Management Systems Based on Big Data Technology [J]. Information Systems Engineering, 2023, (11): 23-26*
- [4] Qin Jie, Xu Chang, Xie Jun, et al. *Construction and Application of Smart Hospital Research Management System [J]. China Health Quality Management, 2023, 30 (10): 24-27. DOI: 10.13912/j.cnki. chqm. 2023.30.10.06*
- [5] Li Naiwen. *A Brief Discussion on the Construction of New Information Management Systems in Scientific Research Institutes - Review of "Research on Information Management Models for Science and Technology Projects" [J]. Science and Technology Management Research, 2023, 43 (19): 259*