Design and Implementation of University Scientific Research Information Management System

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Abstract

In view of the difficulties of comprehensive management and insufficient refinement of scientific research services in scientific research management of colleges and universities, a scientific research information management system is designed and implemented. Firstly, it introduces the functional modules of the university scientific research information management system, including the modules of project management, fund management, achievement management, scientific research assessment and basic resources. Then, it introduces the concrete construction process of university scientific research information management system, including database design, data interface and data exchange, user role division and so on. Through information technology, the innovation of university scientific research management is effectively promoted.

Keywords

Scientific research management, data analysis, intelligent decision.

1. Introduction

In recent years, the state has vigorously promoted the construction of science and technology management information platform. The Ministry of Science and Technology, the National Natural Science Foundation of China and the provincial science and technology administrative departments have successively established various science and technology resource management platforms such as science and technology plans, platforms and experts. The application of science and technology management platforms by the science and technology administrative departments has put forward the demand for information transmission, exchange and sharing for the scientific research management departments of colleges and universities. The construction of scientific research information management system in colleges and universities is not only the internal demand of scientific research management departments in colleges and universities to support scientific and technological innovation, but also the external demand of connecting with national and provincial science and technology resource platforms and promoting science and technology resource information sharing.

Scientific research management informatization is an important means to make comprehensive use of information technology, network and Internet technology, build the resource platform of scientific research management, construct the soft environment of scientific research management information, reform scientific research management and innovate the way of scientific research activities. Through the construction of scientific research information management system, colleges and universities can effectively support and promote the innovation of scientific research management, change the mode of scientific research management and service, innovate the use and management mode of scientific research funds, and promote the construction of digital technology evaluation and decision-making supporting environment, so as to better serve the scientific research management and decision-making, better serve the majority of scientific researchers to carry out creative scientific research

activities, so as to improve the scientific research output. We will promote the commercialization of scientific research.

Therefore, the concrete practice of scientific research information management system construction in North China University of Technology will be taken as an example to study the construction and implementation methods of scientific research information management system in colleges and universities. Through the construction of scientific research information management system in colleges and universities, it provides an efficient business management platform for scientific research management departments in schools, provides convenient channels for scientific research affairs processing for researchers, liberates researchers from complex and transactional work, promotes the sharing of scientific and technological resources, builds a smart scientific research environment, and promotes scientific and technological innovation.

2. System function module

The scientific research information management system of North China University of Technology was upgraded in 2022, and has realized the functions of project management, fund management, achievement management, results network promotion, research platform, research assessment, data visualization, etc. It serves more than 1,200 faculty and staff of the university, and the system is visited more than 100 times per day. The system is connected to the wechat of the school and enterprise, which can query and process the information of the scientific research system on the mobile terminal, realizing the mobile scientific research anytime and anywhere. The scientific research information management system of North China University of Technology includes five functional modules: project management, fund management, achievement management, scientific research assessment and basic resources. The functional modules of the system are shown in Figure 1.
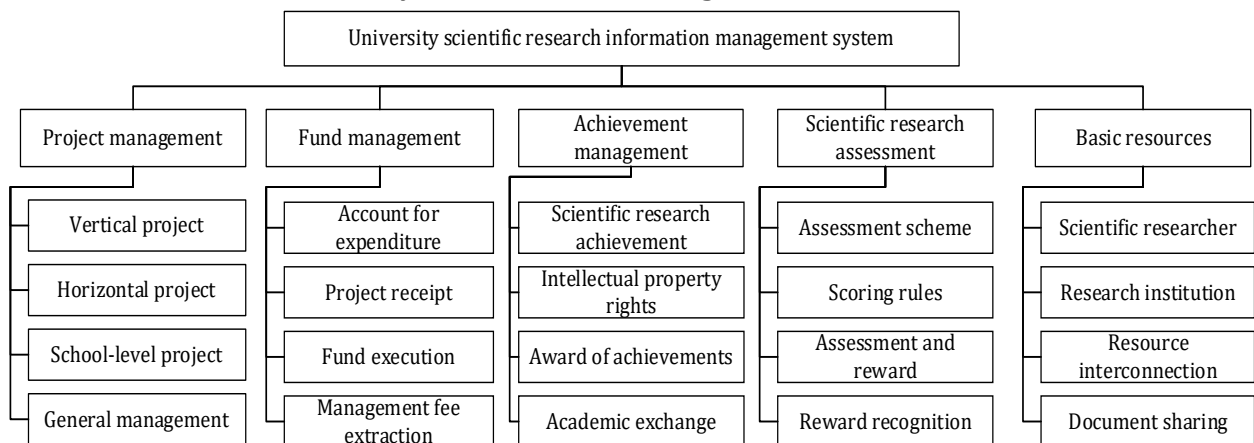

Figure 1: Function module diagram of North China University of Technology research information management system

2.1. Project management module

The project management module realizes the fine and differentiated management of all kinds of vertical projects at all levels, including the management of basic information of vertical projects, horizontal projects and school-level projects, as well as the whole process management of project approval, inspection, change and settlement of all kinds of projects. The project classification structure tree is established, and various project levels, budget standards, fund construction card mode, budget split rules, cost extraction scheme and numbering rules are configured. It has realized the university-level project online declaration management. Based on the project declaration scheme, it has realized the functions such as preparation of

declaration plan, setting of declaration conditions, registration of declaration information, submission and review of declaration materials, etc.

2.2. Fund management module

The fund management module includes fund arrival, fund execution and fund early warning management, realizing the functions of bank arrival information registration, inquiry, statistics and so on. The system sets the extraction proportion and calculation method of the management fee according to the project category. When the project is recorded in the account, the management fee is automatically calculated and extracted, and can be adjusted manually. At the same time, the system can realize the data docking with the financial system, and realize the project budget information sharing and fund implementation tracking.

2.3. Achievement management module

The achievement management module realizes the registration, review, inquiry, import and export and statistical analysis of the relevant information of scientific research achievements, intellectual property rights, achievements awards, academic exchanges and so on, including the management of academic papers, research reports, patents, software Copyrights, standards, awards, academic influence, academic exchanges and other information. The system realizes the paper network push function, the system automatically matches the paper data in the network database with the school teachers, realizes the intelligent matching, pushing and teacher claim of the school teachers' paper data, reduces the paper data registration and audit workload.

2.4. Scientific research assessment module

In the scientific research assessment module, scoring rules for various assessment items are formulated according to the assessment management measures of the school, including benchmark score value, weight score value and allocation method. According to the assessment time range, the assessment batch is established, including the whole process management of importing assessment personnel, starting the assessment batch, monitoring the assessment results, ending the assessment, recording the assessment data, etc. The system realizes the statistical analysis of the assessment results and report export..

2.5. Basic resource module

The basic resource module is used to maintain the basic information of scientific researchers, research institutions, research platforms and other resources, and realize the management, maintenance, inquiry, statistics and export of basic information of scientific researchers. The system can generate personal research details, collect personal research projects, funds, achievements and other data, and realize the export or printing of personal research details.

3. System function realization

The university scientific research information management system is constructed with EADP technology platform and developed with SUN's open source framework. It has the ability to deploy and run in different operating systems and supports Oracle, SQL Server, Mysql and other mainstream relational databases. The system adopts SOA architecture, supports online business configuration development, and combines component technology, visualization technology, graphics technology with SCA, SDO and other SOA standard technologies to provide the full life cycle management from design, development, debugging and deployment to operation, maintenance, control and governance. The technical framework of the system is shown in Figure 2.
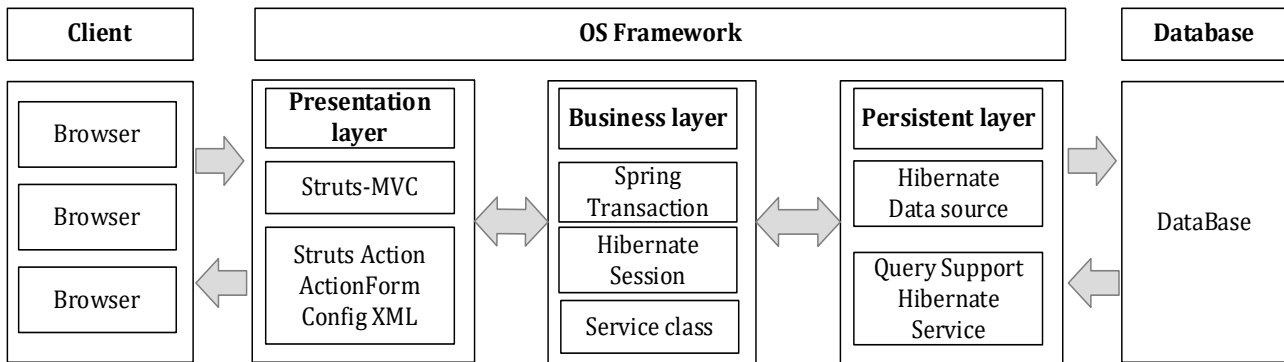
Figure 2: Technical framework of university scientific research information management system

3.1. Database design

The database design of the university scientific research information management system follows the principles of standardization, efficiency, compact, ease of use and security. The system business metadata, business code table, business comparison table, spare fields and business operation record attributes are designed, and database planning is carried out according to the actual business of the university to integrate all kinds of scientific research data. Taking project approval management as an example, the realization of this function mainly involves project table, project member table, discipline category code table, project nature code table, project classification code table, social and economic objectives code table, discipline code table, research category code table, organization form table, cooperation form table, industry table, project status code table, etc.

3.2. Data interface and data exchange

The university scientific research information management system uses WebService interface and MQ message-oriented middleware to exchange data. WebService is mainly used to enable isolated sites to communicate with each other and to communicate with other applications using standard network protocols. WebService is a synchronous interface that responds in real time. When a request is made to the interface, data exchange will be triggered immediately. MQ is an asynchronous interface that is triggered periodically to ease the load on the server and network. Data exchange is not triggered immediately after a request is made to the interface. MQ is suitable for large data transmission. It supports a maximum length of 100M messages and can process large messages in segments.

WebService can be divided into data exchange center interface and other business system interface. According to data change monitoring, data exchange center interface triggers WebService to synchronize data and push scientific research management shared data. You can batch update, delete, add or delete all new data. Other business system interfaces directly interact with the scientific research data exchange platform for real-time business data, which takes effect after the business system review of both parties or other conditions are triggered. The common interface for WebService is shown in Table 1.

Table 1 WebService interface method table

Method	Description
getRecord()	The data exchange platform obtains data from the scientific research system
insertRecord()	When data is added to the scientific research system, the data is synchronized to the data exchange platform
updateRecord()	When the data is updated in the scientific research system, the data is synchronized to the data exchange platform

deleteRecord()	After deleting data from the scientific research system, synchronize the data to the data exchange platform
insertAllRecord ()	Insert all the data in the scientific research system into the data exchange platform
insertManyRecord ()	Incrementally insert the latest data in the scientific research system according to the log records of the data exchange
updateManyRecord ()	Update the latest data in the scientific research system to the data exchange platform according to the log records of the data exchange platform
processBatchRecord ()	Data that needs to be deleted, updated and inserted in the scientific research system should be synchronized to the data exchange platform at one time

3.3. System user roles

According to different user permissions, different user roles are set in the scientific research management system, including: researcher, school leader, school leader, school secretary of scientific research, research institute leader, research institute administrator, etc. Among them, researchers can input and query their own research projects, achievements, assessment, etc.; School leaders can view the scientific research data, data statistical analysis, data cockpit; College leaders can view the faculty project, funding, achievements and research evaluation data; The scientific research secretary of the College can manage the teachers' projects in the college, inquire and make statistics of the teachers' projects, funds, achievements and assessment data; The leaders of the research Institute can view the scientific research data, statistical analysis and data cockpit of the whole school; The vertical project manager can conduct the whole school vertical project project approval, process management and payment management; Technical contract project manager can conduct the whole school technical contract project approval, process management and payment management; The application results manager can manage the whole school's intellectual property, awards, base and campus projects; Academic results managers can manage papers, books, research reports and academic impact.

3.4. System Running Instances

Taking the scientific research information management system of North China University of Technology as an example, the system includes the work home page, project management, fund management, achievement management, scientific research platform, paper network promotion, scientific research performance, statistical analysis, basic resources and other functions. Take project management as an example, the vertical project establishment management can input, modify and decompose the basic information of the vertical project of the scientific research personnel; the scientific research secretary can manage the basic information of the vertical project of the college; the school-level administrator can manage the vertical project information of the scientific research personnel of the whole school; the individual cannot modify the information after the review of the scientific research secretary. After the approval of the school administrator, the scientific research secretary and individual can not be modified. The system has realized the whole-process, whole-factor and whole-cycle dynamic information management of all kinds of vertical, horizontal and university-level scientific research project application and review, project approval, in-process inspection and change, acceptance and settlement, and realized the standardized, informationized, refined and visual management of the whole process of all kinds of scientific research projects. Based on the dynamic data of scientific research management of the whole school, the system provides various statistical analysis and graphical report services to support the decision-making of

scientific research management of the school with detailed data analysis. The operation effect of the system is shown in Figure 3.
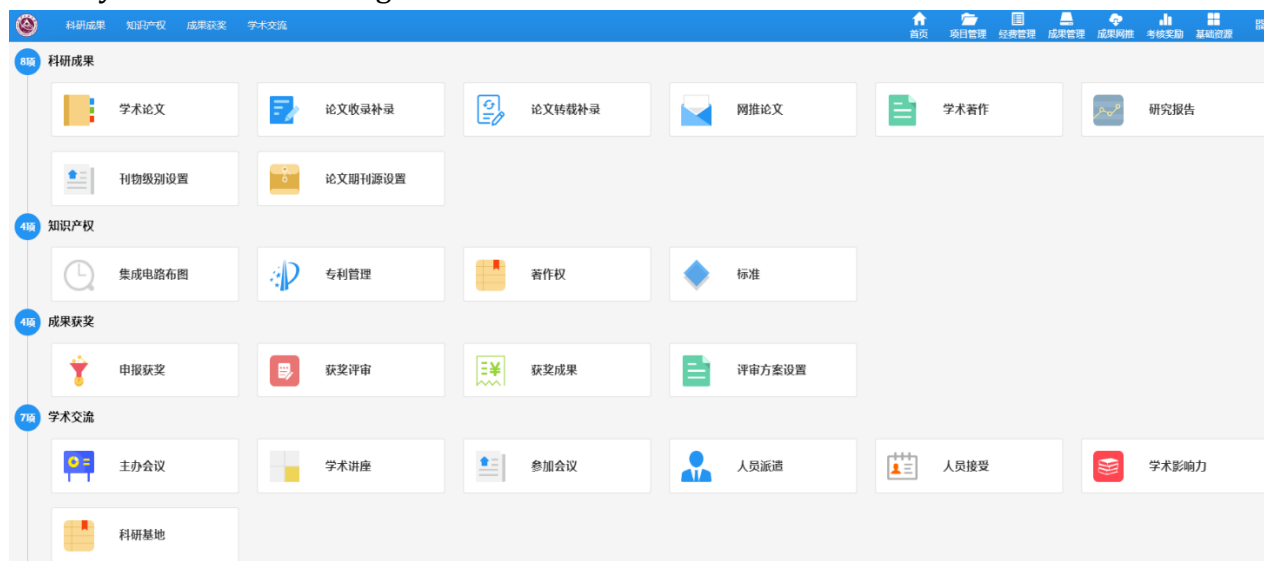

Figure 3: Operation effect of scientific research information management system in North China University of Technology

4. Conclusion

With the rapid development of higher education, the scientific research management of colleges and universities has become more onerous. In view of the difficulties of comprehensive management and insufficient precision of scientific research services in scientific research management of colleges and universities, many colleges and universities are promoting the integration of detailed management of scientific research projects, funds, achievements and other businesses with information. This paper studies the main functions and implementation methods of the scientific research information management system in colleges and universities, and makes beneficial attempts to support and promote the innovation of scientific research management, change the mode of scientific research management and service, etc. Oriented by serving the scientific research personnel, it constructs online solutions and information push solutions for scientific research projects, funds and other aspects. Optimized design, connection and intelligent service reminder of online and offline business processes have been realized, comprehensively improving the efficiency and satisfaction of scientific researchers. Taking the scientific research information management system of North China University of Technology as an example, it has realized the functions of project management, fund management, achievement management, scientific research platform, paper network promotion, scientific research performance, statistical analysis, basic resources and statistics of the Ministry of Education, which has strongly supported the university's scientific research management, scientific research data statistics and organized scientific research.

Acknowledgements

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