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A Brief Discussion on Multifunctional Integration Pathways in University Scientific Research Management Systems

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Abstract: Current university research management systems often face challenges like fragmented functions and data silos, increasing faculty workloads, and hindering efficiency. This article proposes a multifunctional integration pathway centered around data-driven solutions and service enhancement. It advocates for improving systems through measures such as building a unified data platform, integrating research management portals, upgrading intelligent services, and strengthening collaboration and security. The aim is to promote academic innovation in research management services and effectively advance the "streamline administration, delegate powers, improve services" reform in science and technology governance.

Keywords: Research management system; Data silos; Multi-functional integration; Intelligent services; Data sharing

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1. Introduction

Currently, university scientific research management systems (hereinafter referred to as "systems") widely exist with issues of fragmented functions and data silos [1]. Most systems only support basic functions such as achievement entry and basic statistics, lacking the ability for in-depth analysis and mining of scientific research achievements. Some systems even remain at the stage of electronic record books, with a lack of logical connections between modules, leading to data redundancy and limited statistical dimensions. In addition, there is a severe lack of integration among various systems within universities, such as research, educational administration, finance, and personnel systems, which adopt different development standards, posing technical barriers to data interoperability. Departmental parochialism results in data barriers and a lack of data interaction and sharing mechanisms, causing some data to be repeatedly filled out, further increasing the workload of various personnel. With the advent of the era of artificial intelligence, the technological innovations it brings are expected to reshape the ecological environment of scientific research management through system integration and process optimization.

2. Optimization directions for core architecture

2.1. Data integration and sharing mechanism

University scientific research management systems should achieve multifunctional integration, effectively focusing on the perspective of faculty use, strengthening the sense of responsibility and service, and constructing an efficient and collaborative management system through technological integration and service optimization. Taking our university as an example, the current system basically integrates modules such as in-school project applications, project management, funding management, achievement registration, and patent applications. However, important modules such as various research achievements are filled out and reviewed in the human resources performance system of the Personnel Office. The scientific research management department cannot obtain various important scientific research achievement information from its own system and annually collects teachers' scientific research achievements (such as papers, academic appointments, publications, standards, academic exchanges, etc.) from various colleges multiple times, not only wasting valuable teachers' time but also easily leading to data inconsistencies. Therefore, relevant systems within the school should establish unified data standards to achieve automatic capture and verification of cross-departmental data, ensuring that teachers only need to fill in the data once for multi-system sharing. In addition, a permission hierarchy mechanism should be constructed to achieve dynamic data updates and real-time sharing under the premise of ensuring data security, allowing data to truly flow.

2.2. Unified data platform

Based on the needs of work collaboration and efficient linkage, it is recommended that all relevant systems within the school first establish a unified technical platform during the initial construction stage to achieve efficient integration and utilization of various element modules and avoid repeated construction [2]. Establish API interfaces to realize bidirectional data synchronization among personnel evaluation, scientific research management, educational administration management, finance, equipment and consumables procurement, contract signing, and other management systems [3]. At the same time, the scientific centralized management of data should be standardized; for example, all scientific research data and achievements should be managed and reviewed by the scientific research department, but other related systems can invoke them in a coordinated manner.

2.3. Integrated scientific research management portal

Similar to a unified portal for internal management systems in universities, scientific research management systems should also integrate portal functions for management services and information dissemination, implementing the "one-stop" service concept, which can significantly reduce repetitive work at various levels [4]. For example, daily work for college scientific research administrators is filled with numerous notifications related to project applications, process management, patents, transfers, etc. After these notifications are sent out through the webpage or email system of the scientific research management department, each college needs to forward them to their respective webpages, email systems, and WeChat groups, leading to numerous notification channels and types. The system can integrate notification publication and task delivery functions to achieve unified publication of related notifications. Each college only needs to set its own deadlines or personalized requirements based on this and can mark teachers according to the objects involved in the notification, thereby avoiding the confusion of repeated information transmission and the waste of labor costs. At the same time, on the user interface, one can clearly see the notifications and tasks that need to be handled. Changing traditional working methods can greatly

improve the work efficiency of various departments.

In addition, the system can set corresponding modules according to the types of data regularly collected by higher-level departments to meet the needs of various data reports. For example, for the task of collecting data at the end of the year with research institutions as the unit, the system can add a mode of matching personnel with institutions. Teachers only need to select their affiliated institution, and the system can automatically associate their scientific research achievements with institutional information. By using intelligent algorithms to generate reports that meet the reporting format, the time required for manual sorting can be effectively reduced. At the same time, the system should establish a data quality warning mechanism to mark and remind of abnormal data to ensure the accuracy and completeness of the reported data. The system should also establish multi-dimensional data statistical analysis based on data-driven approaches to provide real-time data support for scientific research decision-making and make management more precise and efficient, as shown in **Figure 1** [5].

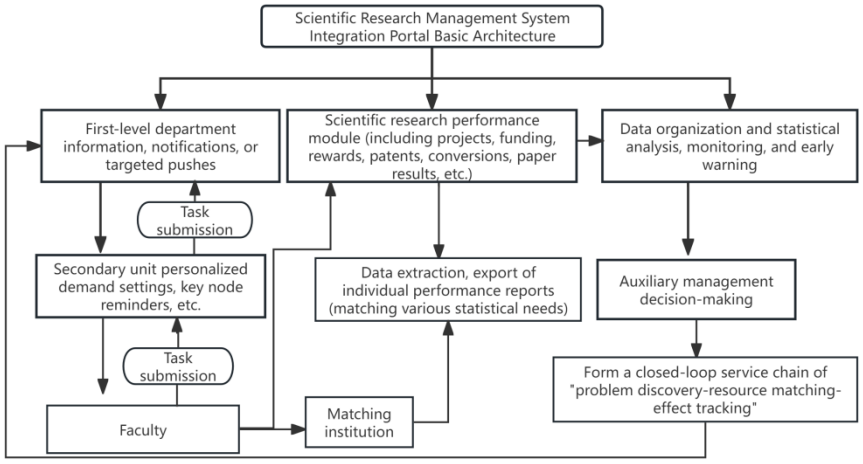

Figure 1. Vision of the integrated portal architecture for scientific research management systems

3. Upgrade of service functions

3.1. Full-cycle intelligent services

From the moment a teacher logs into the system, the system can provide various convenient assistance methods. For example, the system introduces intelligent form technology to automatically fill in more than 80% of the fields in various registration forms. At the same time, it is connected to rule bases such as financial accounting to verify the compliance and scientific nature of budgets or executions in real-time, significantly reducing manual review processes [6]. The system can also intelligently recommend options based on teachers' historical filling habits and automatically match associated project information, achieving "one-time filling, lifelong benefits." These intelligent functions free teachers from cumbersome affairs and allow them to focus more on research or teaching.

The system can also combine algorithms to automatically match teachers' research fields, accurately push relevant notifications, and set intelligent reminder functions to ensure that teachers do not miss important application deadlines. At the same time, for in-school project applications or pre-review projects, online pre-review services are provided to automatically check the completeness of application materials, reducing invalid applications due to format or condition issues. The built-in collaborative review function enables experts to

conduct online evaluations more conveniently, while the real-time data dashboard helps managers accurately grasp the concentration of application fields and provide appropriate application guidance. The system provides functions such as funding execution rate alerts, achievement milestone reminders, and automatic generation of financial final settlement reports, effectively avoiding management omissions. In addition, the system can automatically recommend potential collaborators based on teachers' research directions, promoting the formation of interdisciplinary teams. This full-process digital management not only reduces administrative burdens but also stimulates scientific research innovation vitality.

3.2. Extended function development

Scientific research management systems can also build intelligent docking channels for corporate needs and scientific research, promoting the formation of an efficient innovation chain with enterprises as the main body and connected from front to back. Through intelligent algorithms, the allocation of scientific research resources is dynamically optimized to achieve seamless integration of the entire industry-academia-research-application chain, enabling university innovation achievements to be rapidly converted into real productivity [7]. An information sharing mechanism for major scientific and technological research projects can also be established to promote interdisciplinary and cross-institutional collaborative research, forming an open and inclusive innovation ecosystem. At the same time, the depth of industry-academia-research integration is strengthened, a joint research mechanism is constructed, and the application and transformation of scientific and technological achievements are promoted, forming a virtuous circle of efficient flow of innovation elements.

4. Collaborative management and security assurance

Collaborative management and security assurance are critical supports for system implementation. Data access permissions are dynamically allocated through a hierarchical authorization mechanism, with cross-departmental data needs authorized at different levels based on actual conditions. At the data security level, core scientific research data is protected through multiple measures such as data desensitization, encrypted transmission, and the establishment of an off-site disaster recovery system to ensure that the fault recovery time meets business continuity requirements in extreme situations [8]. This architectural design, which balances efficiency and security, not only meets the needs of cross-departmental collaboration but also strengthens the security line for scientific research innovation.

5. Establishment of a dynamic feedback mechanism

The continuous optimization of the system requires the establishment of a dynamic feedback mechanism. A built-in user satisfaction evaluation module can collect teachers' feedback in real-time on dimensions such as the complexity of data filling and service response speed [9–10]. Management departments monitor indicators such as service response rate and repeated collection rate in real-time through the data cockpit to quantitatively assess service effectiveness and promote the transformation of the management model from "control-oriented" to "service-oriented" [11–12]. For example, when the system detects that the horizontal project application rate of a certain college is below the average

6. Conclusion

Through the integration of the aforementioned functions, university scientific research management systems will reshape the scientific research management ecosystem, effectively advancing the reform of "delegating power, streamlining administration, and improving services" in the field of science and technology, and alleviating the burden on scientific researchers [13]. Additionally, the precision of resource allocation by management departments will be significantly enhanced. This data-driven, service-empowerment model not only breaks the dilemma of "information silos" and repetitive labor but also stimulates scientific research innovation vitality through intelligent technology and proactive services [14–15]. University scientific research management systems will become the core engine driving academic innovation, providing a solid digital foundation for the construction of "world-class universities and first-class disciplines."

Disclosure statement

The author declares no conflict of interest.

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