

Original Paper

Optimization Design and Practice Path of Shared Management of Large-Scale Instruments and Equipment in Universities Driven by “Internet Plus”

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Abstract

The ownership of large-scale instruments and equipment in universities, as core strategic resources, has been continuously increasing. However, problems such as resource fragmentation, low efficiency, and redundant purchases caused by traditional management models have become increasingly prominent. From the perspective of “Internet Plus” technology empowerment and combined with practical cases of universities in Sichuan Province, this paper systematically analyzes the existing pain points in the shared management of university instruments and equipment in five dimensions: mechanism construction, technical support, resource allocation, operation and maintenance guarantee, and user services. Guided by problems, it constructs a five-in-one optimization system of “mechanism coordination, technical empowerment, resource optimization, operation and maintenance upgrading, and service quality improvement”, and proposes specific practice paths. The purpose is to provide a reference path for the digital transformation of the shared management of university instruments and equipment, and help improve the efficiency of scientific research and innovation in universities.

Keywords

Internet Plus, large-scale instruments and equipment in universities, shared management, digital transformation, resource optimization

1. Introduction

Driven by both the connotative development of higher education and the improvement of scientific research and innovation capabilities, the ownership of large-scale instruments and equipment—core strategic resources for universities to carry out cutting-edge research and cultivate high-quality talents—has been continuously increasing. However, most universities still adopt traditional instrument

management models, with prominent problems such as fragmented resources, isolated information, low utilization efficiency, redundant purchases, and fragmented operations. A large number of high-end instruments remain idle for a long time, forming a sharp contradiction with the practical demand for the optimal allocation of scientific research resources.

With the in-depth penetration of the “Internet Plus” strategy in the fields of education and scientific research, technologies such as the Internet of Things, big data, and cloud computing have provided a new path to solve the problem of instrument sharing in universities. As a major province in higher education, Sichuan Province has actively responded to national policy guidelines in recent years. In June 2025, four departments—the Sichuan Provincial Department of Science and Technology, the Sichuan Provincial Development and Reform Commission, the Sichuan Provincial Department of Finance, and the Sichuan Provincial Department of Education—jointly issued the “Measures for the Administration of Open Sharing of Major Scientific Research Infrastructures and Large-Scale Scientific Research Instruments in Sichuan Province”. This document promotes universities in the province to connect to the Sichuan Provincial Large-Scale Scientific Research Instruments and Equipment Sharing Platform, laying a policy foundation for inter-university and cross-regional resource coordination. Pain points under the traditional management model, such as barriers to inter-departmental collaboration, time and space constraints, and information asymmetry, urgently need to be addressed through digital transformation. Realizing the “Internet Plus shared management” of large-scale instruments and equipment can not only break the time and space boundaries of resource circulation, improve instrument utilization rates, and reduce scientific research costs, but also promote interdisciplinary, cross-campus, and even cross-regional scientific research collaborative innovation. This is in line with the development requirements of the state and Sichuan Province regarding the open sharing of scientific research infrastructures.

Against this background, constructing an “Internet Plus” shared management system adapted to the needs of universities has become a key measure to promote the intensive use of university resources and strengthen scientific research service capabilities. Focusing on the practical pain points and urgent needs of the shared management of large-scale instruments and equipment in universities in the “Internet Plus” era, this paper conducts research on the optimization design and practice paths of the shared management system combined with practical cases of universities in Sichuan, aiming to provide theoretical references and practical plans for the digital upgrading of instrument sharing management in universities.

2. Analysis of Existing Problems in the Shared Management of Large-Scale Instruments and Equipment in Universities

2.1 Lack of Shared Management Systems and Insufficient Collaborative Linkage Efficiency

The shared management of large-scale instruments and equipment in universities generally lacks systematic institutional support, with core cruxes focusing on ambiguous division of powers and responsibilities and barriers to cross-subject collaboration. Most universities adopt a “college/department independent management” model. Taking the author’s university as an example, five laboratories or

projects with investment exceeding 10 million yuan each have been built in recent years, but the ownership and management rights of large-scale equipment are highly concentrated in each secondary college. Cross-college and interdisciplinary sharing still remains fragmented, and few departments are willing to share their equipment. Meanwhile, from the actual sharing situation of various universities, common phenomena include extensive shared use management, inconsistent charging standards, lack of reward and punishment mechanisms, vague intellectual property protection systems, and unclear definition of the ownership of scientific research achievements generated by cross-team use of instruments. For some provincial universities in Sichuan Province, even though they have accessed the provincial sharing platform in accordance with the requirements of the “Measures for the Administration of Open Sharing of Major Scientific Research Infrastructures and Large-Scale Scientific Research Instruments in Sichuan Province”, problems such as slow response to cross-campus scheduling, insufficient resource coordination, and unbalanced resource allocation still exist.

2.2 Weak Technical Support and Lagging Informatization Construction

There is a common misunderstanding of “valuing construction over functions” in the informatization construction of instrument sharing in universities, which makes it difficult to meet the needs of full-process management. Existing sharing platforms have single functions, mostly only providing basic equipment information display and reservation functions, and lacking core modules such as real-time monitoring of equipment status, intelligent scheduling, and data analysis. Researchers cannot accurately grasp instrument dynamics, and often face unavailable equipment due to malfunctions after reservation, delaying scientific research progress. Investigations show that equipment operation data and usage records rely on manual entry, which is inefficient and prone to data errors, failing to provide accurate support for optimal resource allocation. Although some universities in Sichuan Province have accessed the provincial large-scale scientific research instruments and equipment sharing platform, data standards of their original school-level management systems are inconsistent, leading to data barriers in docking with the provincial platform and forming “information silos”. This makes it difficult for the university to achieve centralized management and coordinated analysis, and also prevents full utilization of the inter-university collaboration functions of the provincial platform.

2.3 Unbalanced Resource Allocation, Coexistence of Idleness and Redundant Purchases

There are significant structural contradictions in the allocation of instrument and equipment resources in universities, presenting a “two-tiered” situation: on the one hand, science and engineering colleges concentrate a large number of high-end equipment, while liberal arts and art colleges are short of resources; on the other hand, different colleges within the same university repeatedly purchase equipment with similar functions due to disciplinary barriers. Some instruments have an annual usage time of less than 500 hours, with an idleness rate as high as over 40%. When purchasing equipment, some universities do not strictly conduct duplicate checking and demonstration through the provincial sharing platform in accordance with the requirements of the provincial management measures, but blindly apply for purchases at the college/department level, resulting in redundant configuration of large-scale instruments

with similar functions on the same campus. For example, some universities have purchased imported soil analysis instruments with low annual utilization rates, while other colleges within the university still need to reserve similar equipment through off-campus channels, causing a contradiction between resource idleness and demand gaps.

2.4 Extensive Operation and Maintenance Support, Urgent Need to Improve Service Capabilities

The imperfect operation and maintenance support system has become a key bottleneck restricting the quality of shared services. In terms of staffing, the construction of professional operation and maintenance teams lags behind. Most universities do not have full-time operators and maintenance personnel, who are mostly part-time teachers or graduate students. Their insufficient professional skills make it difficult to meet the needs of complex fault handling and daily maintenance, leading to delayed equipment repairs. Meanwhile, maintenance management adopts a passive “repair-after-failure” model, without establishing full-life-cycle maintenance files for equipment, ignoring daily maintenance and regular inspections. This results in increased equipment failure rates and shortened service lives. The charging and settlement mechanisms are irregular, and the method of sharing operation and maintenance costs is vague. Due to the lack of special funds, some universities pass on costs to users, and excessively high charges inhibit usage demand. For example, individual universities, without setting up special operation and maintenance funds, include all maintenance costs of large-scale instruments in shared charges, leading to higher unit prices for off-campus users than the market average. This not only violates the “cost compensation and non-profit principles” of the provincial management measures, but also significantly reduces the user activity of the platform.

2.5 Homogeneous User Experience and Low Willingness to Participate in Sharing

Pain points in user experience directly affect researchers’ enthusiasm for sharing. In terms of reservation processes, some platforms have complex operation interfaces and cumbersome steps. Cross-college and cross-campus reservations require approval from multiple departments, with a cycle of up to several days, failing to meet urgent scientific research needs. There is a lack of coordination mechanisms for reservation conflicts, and the absence of fair scheduling rules when multiple users reserve the same equipment is prone to disputes. Although the sharing platforms of some universities have accessed the provincial system, they have not updated detailed equipment information synchronously, only marking the equipment name and affiliated college. This makes it impossible for inter-university users to judge whether the equipment is suitable for their research needs, resulting in low actual utilization rates even though the provincial platform provides inter-university reservation channels. After-sales service response is lagging; technical support cannot be obtained in a timely manner when problems arise during use, complaint and feedback channels are not smooth, and reasonable demands are difficult to be addressed.

3. Optimization Paths of University Instrument and Equipment Sharing Management Driven by “Internet Plus”

3.1 Construct a Coordinated Management Mechanism System

Break the collaboration barriers through institutional construction by establishing a unified coordination body at the university level. Clarify its core responsibilities in resource scheduling, rule-making, and interest coordination to break the fragmented pattern of independent college/department management. The practice of Sichuan University is worthy of reference. The university has formulated a series of systems such as the “Measures for the Use and Management of Shared Funds for Experimental Instruments and Equipment” and the “Implementation Measures for the Management of Open Sharing Charges”, and signed the “Annual Responsibility Letter for Equipment Management and Open Sharing”. These measures clarify charging standards, reward and punishment rules, and intellectual property ownership, forming a systematic institutional guarantee system.

Formulate standardized sharing rules, including unified cross-departmental charging standards and reward/punishment mechanisms based on usage efficiency. Provide financial inclination to colleges/departments that actively share equipment, and force idle equipment to be included in the sharing platform. Strictly follow the requirements of the “Measures for the Administration of Open Sharing of Major Scientific Research Infrastructures and Large-Scale Scientific Research Instruments in Sichuan Province”, improve the intellectual property protection system, and clarify the ownership and distribution plan of scientific research achievements generated by cross-team and inter-university use of instruments. Establish a cross-campus collaboration mechanism to realize the interconnection of equipment information and coordinated scheduling across different campuses. Build a unified university-wide sharing management hub through the “Internet Plus” platform, promote the standardization and transparency of management processes, and ensure data synchronization and functional collaboration with the provincial sharing platform.

3.2 Build an Intelligent Informatization Platform with Technology Integration

Upgrade the functions of the sharing platform relying on “Internet Plus” technology, integrate the Internet of Things, big data, cloud computing and other technologies, and construct a full-process intelligent management system. In terms of core functional modules, add a real-time equipment status monitoring module to collect operating data through sensors and realize automatic fault early warning; develop an intelligent reservation and scheduling system to support multi-dimensional retrieval, time-sharing reservation and automatic conflict coordination; build a data analysis and decision-making module to conduct visual analysis of data such as usage efficiency and idleness rate, providing accurate support for resource allocation. University of Electronic Science and Technology of China has promoted the data standardization transformation of the university-wide equipment management system by holding promotional meetings on the open sharing of large-scale instruments and equipment, laying a technical foundation for classified configuration and public platform construction. Its experience can provide reference for universities in the province. Strengthen platform security construction, adopt multiple

identity authentication, data encryption and other technologies to ensure the security of user information and transaction data.

3.3 Construct a Precise and Efficient Resource Allocation Model

Realize optimal resource allocation with the help of big data analysis. Collect demand data of scientific research equipment across the university through the sharing platform, establish a demand forecasting model, provide scientific basis for equipment purchase decisions, and avoid redundant purchases. Strictly implement the provisions of the “Measures for the Administration of Open Sharing of Major Scientific Research Infrastructures and Large-Scale Scientific Research Instruments in Sichuan Province”. When purchasing large-scale instruments of 2 million yuan or more, conduct duplicate checking and demonstration through the provincial sharing platform, and take the duplicate checking results as an important basis for purchase approval. In response to the differences in equipment needs of different disciplines, coordinate interdisciplinary equipment sharing packages through the platform to improve the balance of resource utilization. Establish a post-purchase evaluation mechanism for equipment, link usage efficiency data with subsequent purchase budgets, and force the precision of resource allocation.

3.4 Improve a Professional and Standardized Operation and Maintenance Support System

Build a professional operation and maintenance team management mechanism relying on the platform, clarify the post responsibilities of full-time operators and maintenance personnel, and realize the full-process management of personnel qualification review, skill training and work assessment through the platform. Establish full-life-cycle maintenance files for equipment, set up maintenance plan reminders on the platform, and realize full-process tracking from daily maintenance to fault repair. Standardize the operation and maintenance cost sharing mechanism, strictly follow the “cost compensation and non-profit principles”, set up special operation and maintenance funds, and realize transparent cost settlement through the platform to avoid excessive cost transfer to users. Build an operation and maintenance technical exchange platform to promote experience sharing among operators, improve overall service capabilities, and ensure stable operation of equipment. Referring to the practice of Sichuan University, take the income from shared services as a source of performance-based salary funds, and give distribution inclination to experimental technical personnel to stimulate the work enthusiasm of the operation and maintenance team.

3.5 Optimize Convenient and High-Quality User Service Experience

Optimize the platform service process oriented to user needs, simplify the reservation and approval links, realize “one-click application and online approval” for cross-college and cross-campus reservations, and shorten the handling cycle. Enrich the platform information display content, detail equipment performance parameters, scope of application, operation guidelines and past cases to help users quickly match their needs. Ensure the synchronous update of information with the provincial sharing platform to improve the convenience of use for inter-university users. At the same time, establish a multi-channel service response mechanism, set up entrances for online consultation, fault reporting and complaint feedback on the platform, and assign special personnel to handle user demands in a timely manner.

Regularly conduct user satisfaction surveys through the platform, collect feedback and continuously optimize platform functions and service processes. Constructing a “demand-oriented + active communication” model can effectively improve users’ participation enthusiasm.

4. Conclusion

“Internet Plus” provides key technical support for solving the problems of shared management of large-scale instruments and equipment in universities, and is a core starting point for promoting the optimal allocation of scientific research resources and improving the efficiency of scientific research and innovation in universities. By issuing provincial management measures and building a unified sharing platform, Sichuan Province has laid a good foundation for the reform of shared management in universities in the province. Combining with the practical cases of universities in Sichuan, this paper addresses the prominent problems in the current university instrument sharing in terms of management mechanism, technical support, resource allocation, operation and maintenance support and user experience, and constructs a five-in-one optimization path of “mechanism coordination, technical empowerment, resource optimization, operation and maintenance upgrading, and service quality improvement”, forming a full-process and multi-dimensional closed-loop of shared management.

The implementation of this path can effectively break the barriers to resource circulation, improve instrument usage efficiency, reduce scientific research costs, and promote interdisciplinary collaborative innovation. In the future, it is necessary to continuously optimize the plan in combination with the school-running characteristics and disciplinary needs of different universities, deepen the integrated application of new technologies such as artificial intelligence and blockchain, give full play to the coordinating role of the large-scale scientific research instruments and equipment sharing platform, promote the upgrading of shared management from “available” to “easy to use”, and provide solid support for the connotative development of higher education and the improvement of scientific research and innovation capabilities.

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References

- Chen, M., & Wang, M. (2025). Architectural Design and Practice of a Digital Multi-Dimensional Management System for Sharing Large-Scale Instruments. *Digital Communication World*, 2025(7).
- He, Y. Q., Liu, H. Y., Xie, W. N., Wang, S., Duan, C. L., & Wang, H. F. (2019). Exploring New Approaches to Improve the Innovation Ability of Science and Engineering College Students Through the Open Sharing of Large-Scale Instruments. *Research and Exploration in Laboratory*, 38(8), 261-265.
- Liu, H., & Li, B. X. (2022). Construction of Shared Platform for Large-Scale Instruments and Equipment in Universities Under the Background of “Internet Plus”—Taking Shenyang Agricultural University as an Example. *China Modern Educational Equipment*, 2022(15), 43-46.
- Shi, M., Tang, J., Shi, M. S., Jin, Y. M., & Cui, Y. C. (2024). Suggestions for Optimizing the Open Management System of Large-Scale Instruments in Universities—Taking the Analysis and Testing Center of Xinjiang University as an Example. *Instruments and Equipment*, 12(2), 198-203. <https://doi.org/10.12677/iae.2024.122028>
- Sun, Y. X. (2023). Practices and Reflections on the Operation Mechanism of Sharing Large-Scale Instruments in Key Laboratories. *Management of Agricultural Science and Technology*, 42(4), 61-64.
- Zhao, M., Chu, X. X., Zhu, Y. W., Song, X. Q., Wang, A. D., & Yang, J. F. (2019). Exploration and Practice of Constructing Shared Platforms for Large-Scale Instruments in Local Universities. *Research and Exploration in Laboratory*, 38(1), 256-259.