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Incentive Mechanisms and Implementation Pathways for Open Sharing of Experimental Resources in Higher Education Institutions

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Abstract: *In the context of advancing high-quality development in higher education, the open sharing of experimental resources in universities is crucial for enhancing scientific innovation and optimizing resource allocation. This research investigates the incentive mechanisms and implementation pathways for this sharing, addressing current challenges such as insufficient experimental technical staff, outdated service models, and inadequate incentive policies. Through a comparative analysis of peer institutions, the study identifies key gaps and proposes a comprehensive strategy. Core recommendations include strengthening the experimental technical team, transitioning from basic testing to intelligent, data-driven analytical services, increasing the revenue return ratio to motivate participation, recognizing external sharing services in research workload assessments, and streamlining internal payment processes. These pathways aim to transform resource utilization efficiency and bolster the university's capacity for technological innovation.*

Keywords: *Experimental Resources; Incentive Mechanisms; Implementation Paths*

1. Introduction

Under the new era of promoting high-quality development in higher education, university experimental resources serve as crucial material foundations for scientific innovation, disciplinary advancement, and talent cultivation. Their utilization efficiency directly impacts institutions' research innovation capabilities and their capacity to serve socio-economic development. In recent years, while the aggregate volume of experimental resources in Chinese universities has continued to grow, persistent issues of fragmentation, duplication, isolation, and inefficiency remain prominent. To address these challenges, the state has introduced multiple institutional policies to promote open sharing of experimental resources. However, implementation faces significant obstacles due to ineffective incentive mechanisms, outdated management systems, and insufficient personnel engagement, particularly hindering the sharing of existing resources. This study aims to explore improvements in incentive mechanisms for open sharing of university experimental resources. Through focused investigation of innovative concepts and practical experiences from peer institutions, comparative analysis identifies existing gaps. The research develops scientifically sound incentive mechanisms and proposes actionable implementation pathways, providing targeted insights to enhance resource utilization efficiency and support innovation-driven development strategies in higher education.

2. Current Management and Incentive Mechanisms for Open Sharing of Experimental Resources in Universities: A Case Study of Xidian University

2.1. Platform Development Status

2.1.1. Instrumental Analysis Center

The establishment process began with a feasibility study in April 2021, followed by formal construction initiation in November 2021. It was officially inaugurated in July 2023 as the university's first public research platform. Currently equipped with 37 instruments valued at CNY 55.3 million, the Center provides comprehensive capabilities spanning microstructural characterization, physical property testing, processing and preparation, and compositional analysis. It primarily supports research

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development in physics, chemistry, materials science, life sciences, electronic science and technology, and integrated circuits.

The Center's technical capabilities include high-precision micro/nano-structural characterization, spatial distribution analysis of elements and their chemical states, performance evaluation under multi-field coupling (mechanical-thermal-electrical), and in-situ mechanical testing at micro/nano-scale.

Actively implementing the educational philosophy of experimental pedagogy, the Center leverages its resources to enhance students' practical and innovative abilities. It serves as an advanced experimental education zone, creating replicable models for talent development. The Center supports 11 teaching activities including the undergraduate course "Introduction to Disciplines" and graduate course "Preparation and Characterization of Electronic Materials" in the School of Materials. It also facilitates practical components of the ideological and political course "Ideological and Political Education in Future Technology Fields" offered by the School of Marxism, while providing learning platforms for student leadership development and international exchange programs.

2.1.2. High Performance Computing Center

The Center was initiated in March 2021, commenced construction in late January 2023, and officially launched in July 2023. It has consistently operated under the guiding principles of "unified planning with phased implementation, institutional leadership with multi-stakeholder collaboration, open sharing with managed access, and application-oriented prioritization of practical outcomes." The Center provides scalable computing power sharing services for large-scale scientific computation and big data processing, serving both internal and external users.

To date, the Center has supported 197 institutional users, delivering 14.76 million core-hours of high-performance computing services and over 30,000 card-hours of intelligent computing resources. These capabilities have facilitated the execution of 11,463 computational tasks across diverse fields including information and communication engineering, electronic science and technology, computer science, optoelectronics, integrated circuits, life sciences, space science, materials science, and artificial intelligence. Furthermore, 132 computing devices of various specifications, contributed by 34 faculty members from five schools (including Intelligent Science, Computer Science, Microelectronics, and Materials Science), have been successfully integrated into the Center's infrastructure, effectively alleviating critical computational bottlenecks for researchers and students. The Center actively fosters computational capacity building through user needs assessment, training programs for supercomputing documentation development, and proactive engagement with internal and external partners through targeted outreach and collaborative exchanges.

2.1.3. Comprehensive Experimental Center for Chemistry and Bioscience

Established through a feasibility study initiated in July 2021, the Center commenced construction in January 2023 and was formally inaugurated in July 2023. Its infrastructure comprises 43 fully-equipped laboratory workstations—including fume hoods, glove boxes, biosafety cabinets, and supporting infrastructure—complemented by 12 specialized biochemical instruments such as flow cytometers and LC-MS systems. The Center possesses cross-scale analytical capabilities spanning cellular operations (including sorting) to molecular-level characterization (nucleic acids, proteins, and small molecules), providing critical support for interdisciplinary research in biomedical engineering, materials science, integrated circuits, and chemistry. Four part-time technical teams deliver comprehensive operational and analytical support, positioning the Center as a benchmark for both open resource sharing and safety protocols.

The Center leverages its advanced instrumentation to serve dual functions of talent development and pedagogical innovation. Through immersive experimental learning, it enriches students' disciplinary perspectives and guides undergraduate engagement in fundamental research, thereby enhancing elite training in core scientific disciplines. Its support extends to foundational activities in the School of Life Science and Technology, including freshman seminars and summer programs. By incorporating advanced techniques such as patch-clamp electrophysiology, the Center integrates research narratives with educational values, demonstrated through sessions tracing the evolution from the Human Genome Project to autonomous sequencing technologies. Additional initiatives include mentoring programs for undergraduate communities, interdisciplinary academic salons for graduate students, and institutional support for talent recruitment forums such as the Huashan Scholars Youth Program.

ISSN 2522-6398 Vol. 8, Issue 11: 135-141, DOI: 10.25236/FER.2025.081120

2.1.4. Electromagnetic Signal Sensing and Testing Center

The center commenced trial operations in January 2025, featuring a shielded anechoic chamber measuring 30.6m*18.1m*18m. Its electromagnetic scattering measurement system operates in the frequency range of 0.8 GHz to 40 GHz, establishing it as the only platform in Northwestern China capable of evaluating the stealth performance of aircraft, radar systems, and naval vessels. The electromagnetic radiation measurement system is capable of precisely measuring key parameters including gain, beam width, and sidelobe levels for antennas with apertures up to 3 meters, thereby providing an optimal testing environment for various phased array antennas and radar imaging applications.

2.1.5. Instrument and Equipment Library

Based on the highly interconnected and closely related nature of academic disciplines within the university, as well as the strong versatility of instruments and equipment, the Instrument and Equipment Library was established to address the practical challenges faced by early-career faculty who lack funding to purchase or face difficulties in accessing necessary equipment. This initiative aims to counteract the tendency of instrument resources being monopolized by individuals or specific research groups. Following extensive needs assessment, the Library was developed under the guiding principles of "unified allocation and specialized management, fee-based borrowing and mandatory return."

A customized management information system was also developed in collaboration with relevant research teams at the university. The Instrument and Equipment Library represents an innovative exploration of sharing models in higher education. By redefining the conceptual framework, it transforms isolated and static "fixed assets" into dynamic, interconnected "innovation service capabilities," better aligning with research needs and adapting to academic workflows.

A tiered fee structure is implemented to ensure affordability for early- and mid-career faculty while preventing prolonged, inefficient, or unnecessary occupancy of equipment by individual users or teams.

2.2. Current Status of Platform Management and Incentive Mechanisms

2.2.1. A shortage of experimental technical talent reserves

The efficient operation and high-quality services of public platforms rely on a professional, stable, and adequately sized support team as the core guarantee. The scale of personnel allocation and their professional competence directly determine the efficiency of resource utilization and the quality of services. Currently, the Analytical Testing Center, the High-Performance Computing (Dedicated Supercomputing) Center, and the Spatial Electromagnetic Signal Perception Testing Center face significant shortcomings in their professional support staffing: the number of full-time personnel is insufficient, and the personnel structure is unstable. This staffing situation shows a notable gap compared to similar platforms in multiple peer universities surveyed during the same period. In most surveyed universities, the scale of full-time and part-time personnel in similar centers is generally larger than that of our institution, with a higher proportion of formally employed professional technical staff. Team members in these institutions possess deeper professional expertise in areas such as instrument operation, equipment maintenance, computing power scheduling, and testing technology development, enabling the formation of a stable technical support team.

With the rapid development of our university's public platforms, the current staffing configuration is increasingly struggling to meet the growing testing demands from both internal and external users. On one hand, the large-scale precision instruments, high-performance computing resources, and various complex testing systems within the platforms require specialized personnel to perform regular maintenance, calibration, debugging, and troubleshooting, while also providing users with technical guidance and operational training services. On the other hand, the shortage of personnel hinders the improvement of service efficiency and quality, constraining the platforms' ability to respond promptly to user testing needs and to engage in in-depth technological innovation and service expansion. This has limited the platforms' role in supporting scientific research innovation and industrial services, thereby restricting the full realization of the public platforms' overall value.

2.2.2. Traditional Service Models Need to Be Upgraded

Currently, public platforms exhibit a notable homogeneity in their service model development and have yet to establish a multifaceted, in-depth service system. The core service model remains confined

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to the linear process of "sample in, report out." Under this model, the services provided by the platform are limited to basic testing and data output: users submit samples for testing, and the staff merely complete the testing procedures according to standardized protocols, ultimately delivering a report containing basic test data to the user. The entire service process lacks in-depth analysis and extended services based on the test data.

2.2.3. The current incentive policies remain insufficient

In the income redistribution mechanism for the open sharing of large-scale instruments and equipment in domestic universities, there is a widespread issue of insufficient redistribution ratios, particularly with the relatively low proportion of funds that can be directly used to incentivize frontline personnel. This, to some extent, dampens the enthusiasm of management faculty. For instance, Chongqing University stipulates that, after deducting the portion retained by the university from external service income, the proportion of personnel labor compensation in the funds redistributed to secondary units is not high. Similarly, under the distribution plan of Henan University of Urban Construction, although the income redistributed to the college can be used for personnel labor and business training, these funds are managed at the college level and are not entirely allocated directly to frontline operators. While Guangdong University of Technology mentions that a certain proportion of the redistributed income can be used as overtime pay for laboratory staff, this calculation is based on the amount after redistribution, meaning the actual proportion of incentives relative to the total service income remains limited. These cases collectively reflect that, even though universities have established income redistribution mechanisms, the proportion of funds that can effectively compensate for the intellectual and time costs incurred by equipment management personnel, especially part-time staff, remains relatively low, resulting in limited incentivizing effects.[1]

2.3. Current Status of Platform Management and Incentive Mechanisms

2.3.1. Management Experience and Incentive Mechanisms of Peer Institutions

University A has established a three-tiered system of university-level, college-level, and specialized platforms based on its disciplinary layout, the characteristics of large-scale instruments, and their sharing potential. It has built an integrated institutional framework that covers sharing, management, service, and evaluation, and implemented a fully digital management system for the entire process from "sample submission, testing, to data tracing." Furthermore, the university has formed a technical team with a "fundamental, core, and leading" structure, comprising 30 full-time experimental technicians, which robustly supports the substantive development of its public platforms. The implementation of a "temporary, probationary, and long-term" appointment system promotes participation from diverse stakeholders and a multi-faceted evaluation and assessment approach.

University B employs a "public platform-faculty team" sharing model. It has established a one-stop professional analysis and testing service system to ensure the efficient integration of "advanced equipment, scientific research, and analytical testing," advancing the development of its public platforms through multiple dimensions and initiatives. The university's analysis and testing center, staffed by 30 experimental technicians, operates with a "academic leadership, technical chief, specialized expertise, and execution team" personnel model. This structure facilitates the continuous refinement of an "education-research-cultivation" talent development system and promotes diversified growth.

University C promotes the development of large-scale instrument testing platforms through its university and college-level platforms, which employ centralized management and deliver testing services and research collaboration across multiple dimensions. The university has instituted a routine supervision and inspection mechanism to ensure standardized laboratory operations. It has also built a "1+N+X" team model—where "1" is the laboratory director, "N" represents fixed positions scaled to operational size, and "X" denotes project-based personnel hired according to actual needs. The public platform currently has 147 personnel. By recruiting professionals from diverse disciplinary backgrounds to act as "translators" between fields, the university reduces communication costs and enhances service quality.

University D and University E have adopted a "crowdsourced" resource integration model in the field of high-performance computing. Departments or research teams can contribute funds to purchase new equipment, thereby breaking down resource silos. Through "co-investment in shared resources" or "cluster access" models, decentralized computing resources across the university are integrated, achieving campus-wide computing power pooling and dynamic scheduling. This enables the

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comprehensive integration of computing power, data, and instruments, breaking down data silos and resource barriers.

2.3.2. Incentive Mechanisms

Regarding revenue distribution models, specifically the proportion of income returned to personnel as incentives, an analysis of five universities reveals varied approaches. University F does not differentiate between internal and external shared revenue; it returns 90% of the total income to secondary units and imposes no cap on the proportion allocated for performance-based personnel incentives. Similarly, University G returns 80% of the total undifferentiated revenue to secondary units, also without an upper limit on the share for personnel performance. University H returns 80% of the total revenue to secondary units, with personnel incentives capped at 40% of this total income. University I operates under a similar 80% total revenue return model, setting the personnel performance allowance at a maximum of 50% of the returned portion, which equates to 40% of the total gross revenue. University A returns 80% of its total shared revenue to secondary units, with personnel incentives specifically set at 50% of the revenue generated from external sources. In a distinct model, University B returns 100% of internal and 95% of external shared revenue to its secondary units, with no stipulated upper limit on the proportion that can be used for personnel performance payments.[2]

3. Implementation Pathways

3.1. Strengthening the Experimental Technician Team Structure

Building upon the mature talent allocation models observed in peer institutions and aligning with the university's specific disciplinary strengths and platform service orientation, a clearly-defined, collaborative, and efficient personnel structure will be established, comprising "Platform Chief Engineers, Domain Experts, and Technical Service Specialists."[3][4]

To continuously enhance the team's overall professional competence and technical capabilities, a systematic skills development mechanism will be implemented. This includes regularly organizing targeted training programs focused on core technical areas—such as the operation and maintenance of large-scale equipment, advanced testing technologies, and computational resource scheduling optimization—as well as service protocol standards. These sessions will be delivered by industry experts, academics, and senior technical staff to ensure the training content is both practical and forward-looking. In addition, team members will be actively encouraged to participate in high-level academic conferences, technical workshops, and professional training programs. Necessary financial support and time allowances will be provided to facilitate their attendance, helping them broaden their academic perspectives, stay updated with industry trends, and keep pace with technological advancements both domestically and internationally.

Furthermore, to break down internal information barriers and promote the transfer and innovation of technical expertise, a regular internal exchange platform will be established. Through activities such as internal technical sharing sessions, case study discussions, and problem-solving workshops, team members will be encouraged to share accumulated technical experiences, typical challenges encountered, and effective solutions. This will foster technical dialogue and knowledge exchange among personnel at different levels and across various specializations, creating a supportive atmosphere of collaborative learning and mutual improvement, thereby enhancing overall team coordination efficiency and innovation capacity.

Additionally, a dedicated research and testing fund will be set up for part-time platform staff and early-career faculty. This fund will primarily support part-time personnel in conducting technical research and optimizing testing methods related to platform services. It will also assist early-career faculty in utilizing platform resources for experimental testing within their research projects, providing them with reliable technical and resource support, while encouraging them to explore extended functionalities and novel applications of existing platform equipment.

3.2. Enhancing Interdisciplinary and Intelligent Testing Capabilities through Multi-Platform Integration

The testing capabilities of platforms can be significantly enhanced through the integration of AI and high-performance computing resources. Simulation-based pre-testing optimizes procedures and

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improves efficiency, thereby facilitating a transition from passive testing to active empowerment. This transformation upgrades the conventional single testing service into a closed-loop process encompassing "solution design, simulation verification, precise testing, and solution optimization." Focusing on the enhancement of test plan formulation capabilities serves as the pivotal point for this transition, accelerating the strategic evolution of public platforms from "instrument operators" to "research decision-making partners."

3.3. To increase the revenue return ratio and stimulate engagement in open sharing

Drawing on advanced practices from leading domestic universities and aligning with our institution's specific developmental context, we propose to further increase the overall return ratio of revenue generated from open sharing services. This adjustment will ensure the return ratio remains within a reasonable range for the sector while maintaining strong competitiveness. By implementing a higher return ratio, secondary units will tangibly benefit from these policy incentives, effectively stimulating their enthusiasm for engaging in open sharing initiatives. This approach will foster a positive working environment characterized by "active participation and proactive contribution," thereby maximizing the translation of policy benefits into tangible developmental outcomes.

3.4. Recognition of Research Workload

Integrating off-campus shared testing fees into the research workload assessment framework yields dual benefits. On one hand, it fully acknowledges faculty members' intellectual contributions and technical expertise in providing professional research testing services to external parties and promoting cross-institutional sharing of research facilities. This approach addresses the limitations of conventional evaluation models that primarily rely on publications and grants as singular metrics, thereby enabling a more comprehensive recognition of faculty's diverse research values. On the other hand, this inclusive assessment method establishes an effective incentive mechanism, allowing faculty to tangibly perceive institutional commitment and support at the policy level. This recognition effectively stimulates faculty initiatives in pursuing research collaboration and delivering off-campus shared testing services, ultimately fostering a positive research ecosystem characterized by a willingness to share, proactive collaboration, and initiative in service.

4. Conclusions

Against the backdrop of the nation's vigorous promotion of technological innovation and high-quality development in higher education, the open sharing of university experimental resources has emerged as a crucial measure to activate innovation potential and optimize resource allocation. The refinement and enhancement of incentive mechanisms and implementation pathways have become critical links in advancing university research capabilities and serving strategic national needs. Looking ahead, as the 15th Five-Year Plan advances comprehensively, the open sharing of university experimental resources will enter a new developmental phase. The synergistic optimization of incentive mechanisms and implementation pathways will inject stronger momentum into this initiative, effectively promoting the full realization of the value of university experimental resources, thereby supporting institutions in playing a greater role in serving high-level technological self-reliance and strengthening.

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