

# Management Status of Large Scientific Instruments in Colleges and Universities and Countermeasures for Improvement

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**Abstract:** Large-scale scientific instruments and facilities are the technical basis and important means to break through the scientific frontier and solve the major scientific and technological problems of economic and social development and national security. At the same time, as an indispensable scientific research equipment in the construction of colleges and universities, large instruments and equipment are the basis and guarantee for teaching and research. This paper mainly summarizes the management status quo of large scientific instruments in colleges and universities, such as inconvenient development and sharing, low utilization rate of equipment and lack of management personnel, and discusses countermeasures to the corresponding problems, providing ideas for realizing efficient and safe management of large scientific instruments in colleges and universities, releasing the efficiency of scientific instruments and equipment, and improving the utilization rate of state-owned assets.

**Keywords:** Universities; Large Scientific Instruments; Management Status; Train of Thought

## 1. Introduction

Colleges and universities are the convergence point of education, science and technology, and talents. They bear the heavy responsibility of educating people for the country, and also provide important support for high-quality development. Large-scale scientific research equipment is a necessary condition for carrying out cutting-edge scientific exploration and realizing major technological breakthroughs, an important guarantee for improving innovation ability and level, and a technical basis and an important means to solve major scientific and technological issues of economic and social

development and national security [1]. In recent years, with the promotion of the "double first-class" construction and the "double high Plan" construction, the state's investment in colleges and universities continues to increase, the amount of assets of colleges and universities continues to increase, the type, quantity and scale of large-scale instruments and equipment are also growing significantly, and the advanced nature of equipment is also keeping up with the forefront of technological development, laying the foundation for the training of first-class talents. Large instruments and equipment in colleges and universities are an important material basis for school teaching and research, personnel training, scientific and technological innovation, and social services [2]. With the increase in the stock resources of large instruments and equipment, problems such as low utilization rate, low degree of open sharing and non-standard management of large instruments and equipment appear. This paper will describe the current situation in the management project of large scientific instruments in colleges and universities, and put forward corresponding countermeasures to solve the problems, so as to provide ideas for scientific standardized management and efficient utilization of large scientific instruments in colleges and universities.

## 2. Management Status of Large Scientific Instruments in Universities

### 2.1 Platform Construction is Backward and Sharing Concept is Lacking

In order to promote the open sharing of scientific research facilities and instruments, effectively improve the efficiency of allocation and use of scientific and technological resources, and better serve scientific and technological innovation and society, Several ministries and commissions of the State have issued documents such as the "Management Measures for the

Open Sharing of National Major Scientific Research Infrastructure and Large Scientific Research Instruments", the "Guiding Opinions on Strengthening the Open Sharing of Scientific Research Infrastructure and Scientific Research Instruments in Institutions of higher Learning", and the "Opinions on the Opening of National Major scientific Research Infrastructure and large Scientific research Instruments to the Public". In order to do a good job in the closed-loop management of sharing work, the General Office of the Ministry of Science and Technology issued the "Implementation Rules for the Evaluation and Assessment of Open Sharing of National Major Scientific Research Infrastructure and Large scientific research Instruments" notice in 2022, which clarified that the incentive and guidance role of the reward and punishment mechanism should be further played through the evaluation of indicators such as organization and management, operation and use, and sharing service effectiveness. Improve the efficiency of scientific research facilities and instruments. Under the active guidance of national policies, in recent years, many universities have actively discussed and practiced the open sharing of large-scale experimental equipment, and the concept of open sharing has been widely accepted. By establishing a three-level organization and management system with university-level, college and laboratory as the main body, Nanjing University of Posts and Telecommunications has further improved the use efficiency of open sharing of large instruments and equipment, and promoted cross-disciplinary, cross-faculty, cross-school and cross-regional exchanges and cooperation with innovative open sharing system and mechanism as the driving force and overall resource allocation as the starting point. While improving the governance ability and resource allocation level of the school, it also meets the needs of enhancing the disciplinary innovation ability and training innovative and interdisciplinary talents, and has stepped out of a road of open and shared development of large-scale instruments and equipment that "emphasizes innovation, improves quality, increases characteristics and promotes integration" [3]. However, there is still a long way to go for the sharing of large scientific instruments. Due to inherent ideas and concepts in the sharing and promotion of cross-school,

cross-regional and even cross-industry sharing, many universities often privatize large instruments and equipment, and even many large instruments and equipment managed by departments or configured according to the topic are only limited to their own departments or teams. The formation of school, department, team ownership, lack of enthusiasm and initiative for open sharing, resulting in a low degree of open sharing of large instruments and equipment within and between schools. In addition, the construction of large-scale instrument sharing website is relatively lagging, resulting in the inability to realize equipment sharing among universities, off-campus personnel to reserve instruments and equipment use fees payment channels are not smooth, which limits instrument sharing to a certain extent, resulting in a waste of resources.

## **2.2 Lack of Professional Equipment, High Maintenance Costs**

Colleges and universities have invested a lot of manpower, material and financial resources in the construction of large-scale scientific instrument platforms. However, due to site restrictions, many large-scale instruments and equipment cannot be centrally managed. Some large-scale instruments and equipment have insufficient number of full-time experimental technicians or lack of technical level of technical personnel, resulting in the equipment cannot be put into use in time. Or in the process of use due to careless operation, improper maintenance, etc., resulting in equipment damage and shutdown. The lack of full-time technical personnel for professional management of large instruments and equipment leads to a serious shortage of management team personnel, resulting in the chaos of "one person with multiple posts and multiple positions", which further limits the possibility of service practice teaching [4].

At the same time, colleges and universities "heavy purchase, light management", lack of consideration for equipment maintenance and maintenance when purchasing. Large scientific instruments and equipment, especially imported high-end large instruments and equipment used by the consumables generally need to be imported, there is a large gap in the use of instruments and operation funds. University laboratory personnel generally only understand the use of the instrument, not proficient in the construction principle, can not carry out

follow-up maintenance, once the equipment fails, due to monopoly constraints, the need for professional maintenance of the original factory, the cost is often more expensive. The loss of large instruments and equipment will increase due to the increasing mobility of users in practical teaching. Once unnecessary failure and damage occur, maintenance is a major problem [5].

### **2.3 Lack of Management Body, Prominent Security Problems**

The university-based management method in colleges and universities is easy to lead to difficulties in cross-college and cross-laboratory instrument inquiry.

It is impossible to judge whether the instruments can meet the purpose of use, and at the same time, multiple or multiple identical devices are purchased in the same school, resulting in a waste of resources [6]. The reason is the lack of management subjects and the inability to achieve unified planning. With the dynamic changes and continuous deepening of scientific research work and research topics, new safety hazards have emerged in large instrument rooms, such as the increase of instruments and equipment and supporting facilities (high-pressure cylinders, circulating cooling water, uninterruptible power supply, etc.), large number and variety of test samples, and large mobility of personnel entering the instrument rooms [7].

The installation and operation of large scientific instruments and equipment have certain requirements for the environment, such as temperature, humidity, dust and so on. The operation of the instrument under unfriendly conditions will have an adverse effect on the normal operation of the instrument, especially the instrument that is turned on for a long time, such as the liquid mass coupling instrument, the temperament coupling instrument, etc., the humidity is too large, the dust is too much, which is easy to cause short circuit of the instrument and then cause danger. Secondly, in the process of using the public experimental platform, the testers carry chemical reagents and drugs, and the types of these reagents and their corrosiveness and danger are often only known by the testers themselves. For example, the slight leakage of some strong carcinogens is easy to threaten the personal safety of experimental personnel [8].

### **2.4 Insufficient Development of Teaching Functions and Low Utilization Rate**

In colleges and universities, the purchase of large scientific instruments is mainly based on colleges or research centers, and the equipment purchase funds are mostly directly allocated from the school to the college or research group in the name of talents, projects, discipline construction, etc. Once the budget is approved, it must be implemented, otherwise it will affect the efficiency of the overall budget execution of the school and damage the interests of the college and research group. Therefore, in order to complete the fund budget, the phenomenon of purchasing equipment by sudden spending of money has led to the problems of repeated purchase, less purchase and inefficient allocation [9].

Large instruments and equipment are not only important assets and high-quality resources for colleges and universities, but also important guarantees for training innovative talents and carrying out scientific research, and have become one of the important conditions to measure the teaching and research strength of science and technology majors in colleges and universities. However, the opening and utilization of large instruments and equipment for undergraduate experimental teaching is far from enough. In the undergraduate teaching of most colleges and universities, theoretical knowledge of relevant majors is mainly taught, while the training of practical ability and innovation ability to solve practical problems is less, so it is difficult for teachers and students in need to make appointments and use it with low efficiency [10]. For example, Hunan Institute of Technology "automotive pump parts design and manufacturing technology" national engineering laboratory of large instruments and equipment utilization rate is only 22%. Among the junior and senior students in the School of Intelligent Manufacturing and Mechanical Engineering, only 6% said that they had been exposed to large-scale instrument and equipment experiments, and these students mainly participated in large-scale instrument and equipment experiments through the scientific research projects of teachers, and most of them participated in routine experiments in daily teaching [4], resulting in insufficient development of the functions of large-scale scientific instruments in teaching

### 3. Management Strategies of Large Scientific Instruments in Universities

With the deepening of education informatization, in the context of digital campus construction, colleges and universities should actively try new practices and explore the establishment of a business platform of "unified supervision, classified management, information sharing, and collaborative interaction" to solve the problem of disconnection between large-scale instrument and equipment management and the development of various undertakings in schools.

#### 3.1 Improve the System and Clarify the Main Body of Responsibility

From the perspective of the university as a whole, the management of large scientific instruments, as part of the fixed assets of universities, is a systematic full-cycle work, involving various links such as fund management, purchase demonstration, procurement management, technical team construction, experimental teaching, performance assessment, daily use and maintenance, and requires the cooperation of multiple functional departments. The application of large scientific instruments and equipment in practical teaching is not only an extension of management work, but also an expansion of teaching activities. Therefore, schools should straighten out the management system and form a long-term executable management process [5]. Colleges and universities should clearly focus on the management department according to the actual situation of the school and the division of responsibilities, and at the same time, it is clear that the ownership is all owned by the school, and the user department has direct management responsibility. The centralized management department is responsible for coordinating the relevant functional departments, planning and formulating the system, improving the condition guarantee system and other aspects of the construction, and supervising the implementation of various work. The head of each department is fully responsible for the management of the department, and determines an asset manager to implement the management responsibility to the department and individual, and strictly implement the university's fixed asset management policies. At the same time, specific management methods and implementation rules should be formulated

according to the characteristics of the management assets of the department, and reported to the centralized management department of the school for the record. If the information of large scientific instruments and facilities changes, the responsible department shall report the changes to the centralized management department in a timely manner to ensure that the information is timely, effective, accurate and complete. Thus, a top-down, clear subject and clear responsibility management system is formed, so that large-scale scientific instruments play an important role in the development of schools.

#### 3.2 Optimize Personnel Allocation and Improve Supervision and Evaluation Mechanism

Large scientific instruments are usually expensive, with high value and professional characteristics, requiring professional technicians to operate and maintain, and requiring high professional level of management personnel. It is an important means to improve the management level of large instruments and equipment to build an experimental technical team with reasonable structure, strong business ability and strong service consciousness. The members of the experimental technical team are not only the original instrument and equipment custodians, but also the operators and managers of large-scale instruments and equipment, which need to have a solid theoretical foundation, a strong professional application background and a constantly updated knowledge system [11]. However, for many universities, the annual promotion of experimental technicians is limited, and a large number of experimental technicians are facing promotion difficulties. In addition, because the evaluation standards of professional titles are too unified, personnel of different disciplines and work requirements are put together in the evaluation, and only unified standards are used. This aggravates the outflow of high-level laboratory technology talents and hinders the construction of talents needed for the long-term development of platform laboratory [12].

Therefore, the relevant departments of colleges and universities should carry out the evaluation and assessment of experimental technicians according to the actual management situation, and support the individuals with excellent management of large scientific instruments

through the post-grant mechanism according to the evaluation and assessment results. Establish and stabilize a high-level professional experimental technical team, and implement incentive policies and measures in the aspects of post setting, professional training, salary treatment, promotion of professional titles, evaluation and assessment.

### 3.3 Technology Enables the Safety Management of Large Instrument Rooms

Technology is developing rapidly and is being used more and more in all aspects of life. Colleges and universities can rely on the self-resource platform to build a comprehensive and complete large-scale scientific instrument management business chain under the "Internet +" model, strengthen the application of information technology means, and improve the efficiency of information timely. For example, our school has built a large instrument monitoring platform, and monitors the current changes of large instruments and equipment through Internet technology to complete the monitoring of equipment. By recording the change of equipment current to judge the use of equipment; By continuously recording the current changes of large instruments and equipment, complete the statistics of the use time of large instruments and equipment, and achieve the record and analysis of the use efficiency of large instruments; At the same time, through the real-time monitoring of abnormal current, the daily use of large scientific instruments can be further guaranteed.

### 4. Closing Remarks

Large scientific instruments in colleges and universities are necessary to ensure the normal development of teaching, scientific research, social services and other work, and are an important part of state-owned assets. Through optimal management of large scientific instruments in universities and reasonable allocation of equipment resources, resource waste can be avoided, income from assets and equipment can be increased, and the output rate of scientific research achievements can be improved. At the same time, school management, school-enterprise cooperation, resource sharing can be promoted, management and teaching levels can be improved, and regional influence can be increased.

### References

- [1] Liu Jingyan, Zhou Yuqi, Liu Qingsheng, et al. Exploration and practice of Whole Life Cycle Management Mode of Large Instrument Sharing Platform in universities. *China Equipment Engineering*, 2024, (16): 269-271.
- [2] Cui Xuefeng. Problems and Countermeasures of open sharing of large instruments and equipment in universities. *Public Standardization*, 2024, (19): 91-93.
- [3] Cui Guoyin, Shen Qingming, Zou Mengling. Research on Open sharing Path of Large instruments and equipment in Industry-characteristic universities -- A case study of Nanjing University of Posts and Telecommunications. *Logistics Technology*, 2019, 46(23): 168-171.
- [4] Deng Bin, Li Qingfen, Wu Yi. Application and Management of Large instruments and Equipment in Local College Undergraduate Teaching. *Equipment Manufacturing Technology*, 2024, (05): 78-80.
- [5] Liu Zhao. Thinking and practical Exploration of large-scale instrument and equipment management for new engineering. *China Modern Educational Equipment*, 2024, (17): 5-7.
- [6] Gu Meimei, Zhou Haoran. Current situation and Countermeasures of laboratory equipment management in universities. *Laboratory Testing*, 2024, 2(05): 61-64. (in Chinese)
- [7] Chen Rui. Safety Management of Large instrument Room empowered by Modern Technology. *Experimental Science and Technology*, 2024, 22(04): 132-136.
- [8] Tai Hongxiang, Zhou Wen, Wang Xue. Problems and countermeasures in the construction management and maintenance of large-scale precision instrument platform. *Laboratory Science*, 2018, 27(03): 159-162.
- [9] Guan Aomei, Huo Huizhi, Fu Li, et al. Research on fine Management of the whole life cycle of large scientific research equipment in universities. *Laboratory Testing*, 2019, 2(10): 56-58. (in Chinese)
- [10] Dong X Z, An F Q, Li Q, et al. Application of large instruments and equipment in undergraduate experimental teaching. *China Modern Educational Equipment*, 2024, (11): 33-35.
- [11] Zhang Aimin, Gao Xueping, Zhang Luyuan. Mechanism for improving open Sharing

- efficiency of large instruments and equipment in universities. *Laboratory Research and Exploration*, 2022, 41(8): 310-313,317. (in Chinese)
- [12]Huang Dake, GUI Li, Jia Xuemei. Discussion on the training and improvement of comprehensive quality of experimental technicians on instrument sharing platform in colleges and universities. *Modern Medicine and Hygiene*, 2015, 31(20): 3197-3198.