

Effective Ways to Improve the Utilization Benefits of Scientific Research Infrastructures in University: A case study

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Abstract. Through reading literatures, the current status of laboratory management in domestic and foreign institutions of higher education were described. Based on the concept of life cycle analysis, the purchase, use, maintenance and abandonment of equipment and instruments in four Chinese universities were investigated. Inductive analysis of pros and cons in the management of scientific research infrastructures was also conducted. Taking Ningbo Institute of Technology, Zhejiang University (NITZJU) as an example, this paper puts forward some improvement measures for the existing management scheme of the Civil Engineering Experimental Center in NITZJU.

1. Introduction

Nowadays, the state attaches more and more attention to the construction of university laboratories. A large number of large-scale equipment have been purchased, but the management mode and system of universities cannot keep up with the rapid development of laboratories, resulting in the idleness of equipment and instruments and the waste of the excellent resources of laboratories, which is quite unfavorable to the development of students and schools. At present, there are some problems in the management system of large-scale instruments and equipment, resource sharing, comprehensive quality of managers and maintenance and repair of scientific research equipment in Chinese universities [1-3]. The management of instruments and equipment in foreign universities is relatively standardized. Among them, Canadian [4-7] laboratories have the characteristics of annual inspection of instruments and equipment, routine management, and automation of experimental operation, etc. The construction of university infrastructure is supported by the provincial government, and enterprises also invest in university research projects. Laboratories in the United States [8-10] have the following characteristics: professor management system, perfect security management system, advanced network management system, perfect laws and regulations to protect laboratory sharing, etc. The scientific research infrastructure of universities is the main asset of laboratories. Its large amount of assets, high value, many types and long service cycle lead to difficulties in management [11]. Therefore, the management system is a necessary condition to improve the use efficiency of equipment.

2. Laboratory investigation

The laboratory conditions of some universities in China were investigated. It is found that there are some problems in the laboratory management system, which hinder the construction of scientific research infrastructure and the improvement of utilization efficiency. The following four aspects of equipment purchase, use, maintenance and scrap of instrument and equipment are studied and solutions are proposed.

2.1 Insufficient depth of demonstration before equipment purchase

Nowadays, most of the instruments and equipment in universities in our country are purchased according to the needs of schools, colleges or research groups. Although there are corresponding purchase rules when purchasing, due to some reasons, the competent authorities are unable to

accurately evaluate all purchase declarations, which leads to the unreasonable purchase of instruments and equipment. For example, large-scale instruments and equipment purchased for scientific research projects will be idle after the end of the project, causing a waste of resources and reducing the utilization rate of large equipment.

2.2 Lack of maintenance funds and professionals

The maintenance process of equipment and instruments is too cumbersome, and the equipment will not be able to use normally during the application time, resulting in a reduction in the utilization rate of equipment. Different universities have great differences in equipment maintenance and repair. Universities with adequate maintenance funds arrange for regular maintenance of instruments by professionals. However, some universities are unable to maintain their instruments and equipment due to insufficient funds. A stable and high level maintenance team with sufficient funds is an important guarantee for the equipment to perform its functions.

2.3 Imperfect system of equipment sharing

Laboratories in most universities will be open to the outside world, with network reservation platform and sharing system. Although there are some rules and regulations for equipment sharing fees, there are no specific charging standards and systematic charging rules.

2.4 Underutilization of the residual value

Relevant management measures for equipment scrapping in universities have been established. For example, some schools need to pass expert technical appraisal and functional department examination when they scrap equipment; and some schools stipulate that the intact parts of large-scale equipment and instruments need to be disassembled or allocated for use when they apply for scrap, so as to make full use of their surplus value. However, many universities do not consider the possibility of reuse or partial utilization of discarded equipment when the equipment is scrapped, resulting in the inadequate use of surplus value.

3. Solution

3.1 Solution to the problem of insufficient depth of pre-purchase

The process system of purchase demonstration in Colleges and universities should be established to make the process of purchase demonstration more scientific and reliable. The supplier management system should be established [12-13], to ensure that the supplier can timely feedback information when conducting market research. In addition, the university should invite experts to demonstrate the rationality, importance and economy of equipment purchase [14]. Universities should correctly handle the relationship between advanced technology and use, and not blindly pursue when selecting instrument models [15]. In order to avoid repetitive purchasing, it is necessary to investigate the use of laboratory equipment and instruments in surrounding universities.

3.2 Solution of equipment maintenance and repair problem

Universities should establish a one-person-one-machine system for the maintenance of large-scale equipment. Professionals should take responsibility for the daily management and maintenance of equipment. Using Internet means to simplify the maintenance procedures of experimental equipment so that the damaged instruments can be repaired in time. When solving the problem of maintenance funds, the university can consider cooperating with the enterprise to establish maintenance funds. Moreover, the fees charged by universities when sharing laboratories can also be used for the maintenance of equipment.

3.3 Solution to the problem of using instrument and equipment

The laboratory sharing platform of university network management should be established and the charging rules system should be improved. Users of instruments and equipment can obtain detailed information of the required equipment, charging system and contact information of managers on the

shared platform. College housing sites should be charged on the basis of their area when sharing. In order to avoid the long-term occupation of the site by an individual or group when sharing the site, the price per unit time should increase with the increase of time when charging.

3.4 The solution to the problem that the residual value of instrument and equipment is not fully utilized

A complete set of equipment scrapping process should be established in universities. After the equipment and equipment are applied for scrapping, they should be evaluated and audited by maintenance personnel, factory engineers and laboratory management department in turn, and then the equipment should be scrapped after confirmation. Parts that can be used for secondary use should be recycled by schools, and worthless parts can be acquired by companies with relevant professional qualifications. The administrator of the experiment should disassemble and assemble the scrap equipment and display it to make the students more intuitive to observe the equipment and instruments, understand its internal structure, better understand the working principle of the equipment and instruments, and further deepen the experimental principle.

4. Case study

Based on the above problems and solutions, this paper takes the Civil Engineering Experimental Center in NITZU as a case to analyze how to improve the construction of scientific research infrastructure and use efficiency.

4.1 Management status and deficiencies

(1) Purchase stage: Ningbo Institute of Technology's laboratories purchase instruments and equipment according to the principle of "optimal allocation". However, the school does not specify the argumentation process before purchasing the equipment in detail.

(2) Using stage: Schools will make unified allocation of long-term non-used instruments and equipment to improve their utilization. Only a small part of the experimental projects are charged by the laboratory, and the sharing content of the laboratory only considers the sharing of equipment, instruments and experiments, ignoring the sharing of the experimental site.

(3) Maintenance phase: There is no explicit regulation on maintenance and repair of equipment in the management scheme of laboratory. There are only some conceptual management modes, and there is also the problem of insufficient maintenance funds.

(4) abandonment stage: The instrument and equipment that need to be scrapped shall be identified by the technical appraisal team and then submitted to the superior for unified disposal. However, the front-line personnel in the laboratory are more aware of the residual value of instruments and equipment than the higher department, and there are defects in only dealing with by the higher departments.

4.2 The solutions

(1) Purchase stage: In the acquisition stage of instruments and equipment, the process and rules should be refined. The process of argumentation must be rigorous to avoid the problem of insufficient argumentation depth at the early stage.

(2) Using stage: The fees should be charged separately for the instruments and equipment of university laboratories and for the housing sites. The charges for equipment and instruments shall be mainly for medium-sized and large-sized instruments and equipment, while the charges for small-sized instruments and equipment shall be based on the charges for housing sites. School staff can have some preferential services, such as half price.

(3) Maintenance phase: The maintenance personnel should check the instrument and equipment regularly, and regularly use the equipment and instruments that have not been used for a long time, so as to ensure the equipment and instruments can still operate normally after a long period of idleness. Users should contact maintenance personnel to inspect the instruments when they find problems in using them. In terms of maintenance and repair costs, in addition to the fees charged during the sharing

of laboratories, it can also cooperate with off-campus enterprises to establish maintenance and repair.

(4) abandonment stage: Let the laboratory management department and maintenance personnel evaluate the residual value of discarded instruments. Whether part of the scrap equipment can be disassembled and used, or the instrument can be degraded to carry out low-precision experiments. Especially for small equipment and instruments, because of their low value and large quantity, it is possible for parts to be exchanged and used. After the evaluation is completed, parts with no residual value will be recycled by professional recycling companies.

5. Conclusions

The construction of scientific research infrastructure and the improvement of its utilization efficiency are the current situation that all colleges and universities must face. It is very important to give full play to the benefit of scientific research infrastructure and strengthen laboratory management to promote the development of teaching and scientific research. This paper studies the four stages of purchase, use, maintenance and abandonment of instruments and equipment, and puts forward corresponding solutions:

(1) A perfect demonstration management system should be established when colleges and universities purchase instruments and equipment. The necessity, rationality and economy of the purchase of instruments and equipment should be analyzed in an all-round way.

(2) Universities should share the use of laboratories, and put forward specific calculation principles for the charge in the use process.

(3) Set up professional maintenance and repair personnel and establish maintenance and repair funds.

(4) After confirming that the equipment is scrapped, universities should make full use of their surplus value to improve the use efficiency according to the corresponding management methods.

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Reference

- [1] L. Chen, Current situation and analysis of large-scale instrument and equipment management in colleges and universities, *Management Observer*, pp. 106-107, 2018.
- [2] G. Y. Cui, The status quo and mode innovation of university laboratory management, *Value Engineering*, vol.37, pp. 96-97, 2018.
- [3] S. P. Xu, Laboratory management characteristics of universities in Canada and its inspiration, *Experimental Technology and Management*, vol.27, pp. 170-173, 2010.
- [4] D. W. Wang, S. Zhao, and D. Liu, Innovation mechanism of scientific research management in Canadian universities -- a case study of university of alberta, *Chinese University Science and Technology*, pp. 58-61, 2019.
- [5] Z. X. Zhao, Canadian drug laboratory management specification and enlightenment, *Forensic Science and Technology*, pp. 44-46, 2008.
- [6] C. H. Zhang, Y. Ge, Enlightenment on the construction and management of scientific research laboratory in university of Ottawa, Canada, *Research on Laboratory Work in Universities*, pp. 60-62, 2015.
- [7] H. C. Wang, The experience on management of biological laboratory in american university, *Education Teaching Forum*, pp. 7-8, 2018.

- [8] D. M. Tian, W. Xia, Learning on management of chemical laboratory in university of Utah (USA), *Experimental Technology and Management*, vol. 34, pp. 262-265, 2017.
- [9] X. L. Ding, L. Guo, and T. Liu, Large instruments and equipment sharing in colleges and universities: the United States mode, *Research and Exploration in Laboratory*, vol. 36, pp. 234-237, 2017.
- [10] X. P. Xu, Q. Q. Xu, and H. Q. Wu, Analysis on how to improve the utilization rate of experimental equipment in colleges and universities, *Science and Technology Information*, pp. 513, 2010.
- [11] Z. Q. Zhong, Management situation and countermeasures of large instrument and equipment in colleges and universities, *Technology Wind*, pp. 70, 2018.
- [12] G. J. Campbell, General capital equipment selection process, *Electric Railways in a United Europe*, pp. 659-660, 1995.
- [13] G. H. Yang, Management and thinking of the prophase demonstration work of equipment purchasing in colleges and universities, *China Modern Educational Equipment*, pp. 10-11, 2007.
- [14] C. Li, P. H. Su, Thoughts on strengthening the procurement of equipment and instruments in scientific research units, *Technology Innovation and Application*, pp. 278, 2015.
- [15] G. H. Ling, Y. Wan, The exploration of construction of large equipments' sharing management platform for army medical university, *China Modern Educational Equipment*, pp. 3-5, 2018.