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Research on the Equipment Maintenance Management in Colleges and Universities

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Abstract

In colleges and universities, laboratory instruments and equipment serve as essential material foundations for daily operations, classroom teaching, experiments, and scientific research. As the scale and specialization of higher education institutions continue to expand, the variety and quantity of instruments and equipment have been steadily increasing. The operational condition of these instruments and equipment plays a critical role in ensuring the smooth progress of daily activities and the normal conduct of teaching and research. Proper maintenance and repair of instruments and equipment are vital for the stable operation of university activities. To enhance the maintenance management of laboratory instruments and equipment, ensure their functionality and utilization rates, and reduce maintenance costs, this paper examines the current state of maintenance management in colleges and universities. It analyzes the key issues in the management of instrument and equipment maintenance and proposes corresponding solutions. The goal is to strengthen and optimize the maintenance management of laboratory instruments and equipment, improve the efficiency of maintenance work, and ultimately enhance the quality of teaching and research.

Keywords

Universities; Instrumentation and Equipment; Maintenance Management.

1. Introduction

Teaching, scientific research, and daily operations in higher education institutions all rely heavily on laboratory instruments and equipment as a crucial material foundation. With the rapid development of higher education in China and the continuous advancement of technological content in instruments and equipment, the quantity and quality of these assets have significantly increased. Teaching instruments and equipment are different from low-cost consumables; some specialized equipment features complex structures, high costs, and long usage lifespans, while devices such as computers in laboratories or projectors in multimedia classrooms are subject to rapid updates. How to carry out targeted maintenance and repair of laboratory instruments and equipment, ensuring their performance and functionality, is a key aspect of instrument and equipment management in Chinese universities.

1.1. Basic Concept of Instrument and Equipment Maintenance

Instrument and equipment maintenance refers to the technical activities carried out to restore the functionality of the equipment after the deterioration or malfunction of one or more of its technical states. This includes various types of planned repairs, unplanned fault repairs, and accident repairs, all of which aim to eliminate the factors causing damage to the equipment. The main objective is to repair the damaged parts, eliminate faults, and ensure the normal operation of the equipment.

In terms of timing, instrument and equipment maintenance can be divided into two categories: corrective maintenance and preventive maintenance.

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Corrective maintenance refers to the repair activities performed after an instrument or piece of equipment has malfunctioned. This type of maintenance is more targeted and can help avoid over-repairing. However, if the components of the equipment are highly interconnected, the failure of one part may cause damage to other parts, thereby worsening the overall fault. Therefore, this maintenance mode is suitable when the direct and indirect losses are minimal, and the failure of one component does not lead to further damage to others.

Preventive maintenance refers to repair measures that are taken during routine maintenance to enhance technical inspection and confirm the equipment's condition in advance. This type of maintenance is commonly applied to components that are prone to wear and tear, with the goal of preventing unexpected failures such as sudden shutdowns or malfunctions. It helps slow down the equipment's deterioration and prevents accidents.

1.2. Importance of Instrument and Equipment Maintenance Management

University instruments and equipment are essential physical assets for teaching, research, and community service. The construction of a high-level university cannot be separated from the support of these instruments and equipment. With the implementation of national policies for the development of university disciplines, the level of instrument and equipment construction in universities has further improved and developed. Enhancing the maintenance management of equipment is an effective way to ensure the normal operation of instruments and extend the lifespan of equipment, especially large-scale instruments. It is also a powerful tool for ensuring the smooth operation of daily school activities and an important driver for improving the management level of instruments and equipment.

1.2.1. Ensuring the Smooth Progress of Teaching and Research Activities

University teaching and research activities rely heavily on various instruments and equipment. If instruments or equipment fail, it may interrupt the progress of experiments, delay research projects, or even affect teaching schedules. This not only impacts the quality of teaching and research but may also lead to inaccurate experimental data, thereby affecting the reliability and credibility of academic results. Good maintenance management ensures high equipment availability, preventing teaching and research activities from being disrupted by equipment malfunctions.

1.2.2. Extending Equipment Lifespan and Utilization

Through scientific maintenance management, potential issues in equipment usage can be identified and resolved in a timely manner, preventing the escalation of faults. Regular maintenance and servicing help to extend the equipment's lifespan and reduce the frequency of replacement due to aging. This not only saves on procurement costs but also improves equipment utilization, maximizing its effectiveness.

1.2.3. Reducing Maintenance and Operating Costs

The repair of equipment failures often requires significant expenses, particularly for expensive, high-end instruments. Without timely maintenance or preventive repairs, equipment failure may become more complicated, leading to higher repair costs or even irreparable damage, ultimately requiring equipment replacement. Effective maintenance management can prevent major faults, reduce emergency repairs, and, in turn, lower maintenance and replacement costs.

1.2.4. Protecting Asset Security and Reducing Asset Loss

Instruments and equipment are important fixed assets for universities, typically with high value and long-term investment. Without effective maintenance management, equipment may become damaged, idle, or lost, resulting in financial losses for the school. Proper maintenance management helps extend the life of equipment, ensuring that it is fully utilized throughout its lifecycle, thereby protecting the university's assets from loss.

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1.2.5. Improving Work Efficiency and Response Speed

Universities often have numerous laboratories and research institutes with a variety of equipment, some of which are critical to work progress. If a piece of equipment fails and there is no efficient maintenance management system, the repair process may be delayed, affecting the overall progress of research or teaching. Establishing a comprehensive maintenance management system enables quick responses to equipment failures, improving repair efficiency and ensuring that equipment is restored to working condition as soon as possible.

1.2.6. Enhancing the University's Management Level

The level of instrument and equipment management reflects the overall management capabilities of the university. A well-established maintenance management system not only ensures the stable operation of equipment but also showcases the university's meticulous approach to resource management. The higher the level of standardization, institutionalization, and informatization of maintenance management, the more advanced the university's hardware management philosophy and capabilities.

1.2.7. Supporting the University's Discipline Construction and Research Development

As discipline construction and research projects evolve, universities increasingly require high-precision and complex instruments. The normal functioning of these instruments directly impacts the quality of research results. An efficient maintenance management system ensures that such equipment remains in optimal working condition, providing stable support for researchers and promoting the development of discipline construction and research..

2. Current Situation of Instrument and Equipment Maintenance Management in Universities

With the rapid development of higher education in China, universities have increased their investment in instruments and equipment, continuously exploring and practicing in the management and utilization of these resources. As a result, the management level and utilization efficiency of instruments and equipment have improved. However, there is still a significant gap between the current level of management and the growing demand for the intelligentization and scale of instrument and equipment management in Chinese universities. New challenges and issues continue to arise in the management of instruments and equipment, particularly in the areas of maintenance and repair.

2.1. Lack of Awareness in Maintenance Management

In China's universities, while a standardized and effective organizational system and operational procedures have been established for equipment procurement, bidding, and contract auditing, there is a noticeable lack of awareness when it comes to maintenance and upkeep. Once instruments and equipment are placed in laboratories or research institutes, they are often used continuously with little to no routine maintenance. Some equipment is overused due to heavy experimental or research tasks, leaving no time for regular checks. In other cases, managers either don't know how to maintain the equipment or are too indifferent to do so. Many universities lack dedicated maintenance and management departments, and equipment is often used without any regular servicing. It is only when the equipment can no longer function that major repairs are carried out. A complete maintenance management system has not been established, making it difficult to effectively control equipment failure rates or improve utilization and operational status.

2.2. Incomplete Management System

When the Ministry of Education evaluates universities, the focus is primarily on the total value of instruments and equipment, and the per-student value of equipment. Over time, universities

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have developed the misconception that meeting these numerical criteria is sufficient to meet evaluation requirements, without regard for whether the equipment is functional or well-managed. Most universities have departments dedicated to equipment management, such as equipment offices. However, due to limited staff, these departments are often overwhelmed with daily tasks such as equipment procurement, inventory, transfers, and decommissioning, leaving little time to physically inspect and monitor the usage and maintenance of the equipment.

2.3. Lack of Professional Maintenance Personnel and Systematic Training

With the rapid advancement of science and technology, the level of automation in instruments and equipment has steadily increased, which has lowered the technical requirements for operation. However, the complexity of these instruments has also grown, and maintenance now requires higher levels of expertise and technical skill. Many instruments need to be diagnosed and repaired by engineers with significant practical experience. As universities expand their scale and teaching content continues to evolve, the workload of teachers and laboratory personnel increases, leaving them little time or energy to carry out maintenance. In some cases, even specialized laboratory technicians are not equipped to perform the necessary professional repairs and maintenance for large, specialized instruments.

2.4. Insufficient Budget and Limited Maintenance Funds

As the quantity and quality of instruments and equipment in universities increase, the cost of maintenance is also rising. Sometimes the cost of repairing a single piece of equipment can amount to tens or even hundreds of thousands of yuan. However, many universities have not set aside dedicated funds for equipment maintenance, or the maintenance funds are severely insufficient. The corresponding financial management systems are also often inadequate, resulting in situations where damaged equipment cannot be repaired due to lack of funds or cannot be repaired in a timely manner. This ultimately leads to equipment being left idle, awaiting decommissioning, or being discarded, causing significant losses to the university's fixed assets. In many cases, the proportion of the budget allocated to equipment maintenance is relatively low, and universities fail to invest enough in maintenance, which affects the quality and efficiency of repairs. For various reasons, maintenance tends to focus on emergency repairs when equipment has suffered significant failures, making it difficult to control repair costs effectively.

2.5. Lagging Information Management

The delay in the informatization of maintenance management refers to the fact that many universities and institutions still rely on traditional manual management methods or have poorly developed information systems. This results in low efficiency in the management of maintenance, upkeep, and general operations, and hinders the effective use of information technology to improve management efficiency. Specifically, some universities have not yet established modern equipment maintenance information management systems, leading to a lack of real-time monitoring of maintenance progress and equipment usage status. Although some universities use equipment maintenance management platforms, many teachers still habitually report faults via phone calls, resulting in low utilization rates of these platforms.

3. Optimization Strategies for the Maintenance Management of Instrument and Equipment in Universities

The maintenance management of instruments and equipment in universities is a vital part of university management. It is an essential way to improve the equipment's functionality and utilization, and it plays a crucial role in ensuring the normal and orderly operation of teaching,

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research, and office equipment. In light of the current situation regarding the maintenance of instruments and equipment in universities and based on the issues observed in our institution, we aim to adopt a scientific approach to equipment maintenance, enhance work efficiency, shorten repair cycles, increase equipment availability, reduce failure rates, and control maintenance costs. Our proposals and explorations are based on investigations and research.

3.1. Changing Mindset and Enhancing Awareness of Equipment Maintenance Management

The management of instruments and equipment directly impacts their functionality and lifespan, influencing investment returns and the normal operation of teaching and research activities. University leaders and department heads should shift their mindset and fully recognize the importance of equipment maintenance management. They need to understand that equipment maintenance is an indispensable part of university work. It is essential to set up dedicated maintenance management departments responsible for equipment repair, coordinating external repairs, evaluating and supervising external repair processes, assisting with the decommissioning process, and ensuring proper management. This will establish a clear division of responsibilities, laying a solid foundation for the management service function of equipment maintenance.

At the same time, universities should shift from a passive to an active approach. Strengthening regular maintenance and proper usage of instruments can significantly reduce the incidence of equipment failures. Every piece of equipment, especially highly automated ones, requires proper usage and maintenance. Failure to do so will directly impact equipment utilization and lifespan, causing significant waste of university resources. The equipment management department should treat proper use and regular maintenance as a key component of their responsibilities, integrating it into the daily tasks of laboratory managers and technical personnel.

3.2. Establishing and Improving the Maintenance Management System

The processes of procurement, auditing, acceptance, use, and maintenance of equipment are interconnected. Many universities focus more on purchasing instruments and less on their maintenance, which leads to the underutilization of equipment, reduced service life, and the need for costly repairs or replacement, resulting in the invisible loss of public assets.

Therefore, universities should clarify the management responsibilities for equipment maintenance and establish maintenance systems to ensure effective daily maintenance. A dedicated maintenance management department should be set up to handle routine maintenance, troubleshooting, and the archiving of repair records.

Before equipment is put into use, training should be provided to users to ensure they can correctly operate the equipment and make initial judgments in case of anomalies. This will reduce damage caused by improper operation. Proactive maintenance should be fully implemented and encouraged. Regular proactive maintenance during the equipment's lifecycle can significantly extend its service life and increase its value. This approach should shift from emergency repairs to proactive, preventative maintenance. When equipment enters the university, a dedicated person should be assigned to manage it, ensuring that regular maintenance and upkeep are carried out through a series of institutional policies and incentive measures.

When equipment fails, the approval process and repair procedures should be streamlined. The equipment manager should directly report the failure to the maintenance department, fill out a repair request form detailing the malfunction, and allow the maintenance department to coordinate the repairs. This will help minimize the time between reporting the issue and completing the repair.

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3.3. Strengthening the Maintenance Workforce and Improving Team Quality

With the rapid development of science and technology, instruments and equipment are continuously updated, and their technical level is rising. This requires maintenance personnel to constantly learn and practice, improving their skills and expertise. To meet this need, a responsible maintenance team should be formed, focusing on accumulating repair experience and stabilizing team structure. This can be achieved through continuing education, on-the-job training, and specialized technical training from professional repair companies to enhance the technical competency of maintenance personnel. Regular training should be organized to improve their professional skills and fault diagnosis abilities. Maintenance personnel should also undergo regular evaluations to motivate them to continuously improve their repair techniques. Training programs should be diversified, utilizing multiple formats and methods, to continuously enhance the technical abilities of the workforce. Clear job responsibilities should be assigned to maintenance personnel, and incentive policies should be introduced to maximize their enthusiasm and creativity.

3.4. Implementing Information Technology for Equipment Maintenance Management

With the rapid development of modern electronic technologies, network platforms have become indispensable for various tasks. Using equipment management systems can help both users and managers monitor and share maintenance records in real-time. Introducing advanced maintenance management information systems and utilizing information technology can allow for real-time monitoring and data analysis of equipment maintenance, usage, and servicing. This system's records and analyses can improve the efficiency of maintenance management and provide data support for preventive measures and maintenance decision-making.

3.5. Improving Equipment Maintenance Fund Management

In the process of equipment management in universities, the management of maintenance and upkeep funds plays a crucial role. Proper and efficient management of these funds not only helps ensure the normal operation and prolonged lifespan of the equipment but also improves the overall management level of the university, preventing waste and enhancing resource utilization. As modernization in education and the demand for scientific research in universities increase, maintenance expenses are also rising. Improving the management of these funds is becoming increasingly important.

4. Conclusion

The maintenance and repair of instruments and equipment are crucial components of asset management in universities and constitute a systematic project. To fully realize the value and benefits of university equipment, it is essential to implement reasonable planning, meticulous maintenance, and scientific management. This requires further research and improvement in areas such as mindset, personnel, and systems, alongside innovation and reform. Only through these efforts can we create an environment conducive to the smooth operation of daily office work, teaching, and research activities. Timely repairs are a necessary condition for ensuring the normal operation of teaching instruments and equipment.

It is important to place significant emphasis on the repair work of instruments and equipment. With the cooperation between departments and functional units, the maintenance and repair process can be carried out in an orderly and effective manner. This will ensure that the equipment purchased by the university plays a key role in practical teaching and scientific research, thereby enhancing its value and usability.

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