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INTRODUCTION

1. Rationale for the Dissertation

Against the backdrop of globalization, the knowledge economy, and the rapid advancement of the Fourth Industrial Revolution, higher education (HE) is shifting from traditional models toward innovative, digital, and research-oriented universities. This trend places increasingly demanding requirements on higher education institutions (HEIs) to improve the quality of education and training (E&T), scientific research (SR) capacity, and university governance effectiveness. According to UNESCO (2017), physical facilities and technical infrastructure, including equipment systems serving E&T and SR, constitute fundamental conditions for assuring higher education quality amid digital transformation and the internationalization of education [150]. The OECD (2021) likewise affirms that the effective management and utilization of physical resources in universities are directly associated with innovation capacity, research quality, and the competitiveness of HEIs within the global education system [130].

In Vietnam, the Party and the State have consistently identified education and training, together with science and technology, as top national priorities that play a pivotal role in developing high-quality human resources and enhancing national competitiveness. Politburo Resolution No. 57-NQ/TW on breakthroughs in science, technology, innovation, and national digital transformation emphasizes the need to modernize scientific and technological infrastructure and increase investment in the conditions necessary for SR, innovation, and digital transformation at HEIs. Subsequently, Politburo Resolution No. 71-NQ/TW on breakthroughs in education and training further emphasizes the need to "concentrate investment resources on building permanent and modern schools and classrooms; ensure adequate facilities and standardized equipment, with particular attention to investment in practical training classrooms…".

Among the resources required to ensure higher education quality, equipment plays a particularly important role because it directly supports teaching, practical training, experimentation, SR, and technology transfer. From the perspective of the Resource-Based View (RBV), physical and technological resources constitute part of an organization's core competitive capabilities (Barney, 1991) [68]. For research-oriented HEIs, modern equipment systems not only help improve educational quality but also determine research capacity, international publication output, and the ability to participate in global innovation networks. Accordingly, effective equipment management is not merely an aspect of public asset administration but also an important component of modern university governance.

Vietnam National University, Hanoi (VNU), is one of Vietnam's leading multidisciplinary and multi-sectoral centers for education and scientific research, entrusted by the State with a pioneering role in higher education reform, scientific and technological development, and international integration. In 2025, VNU had more than 70,000 students, over 7,500 master's and doctoral students, and more than 2,500 international students, with 162 undergraduate programs, 160 master's programs, and 116 doctoral programs. Its large educational scale, multidisciplinary

character, and orientation toward becoming a research university impose particularly high demands on facilities, laboratories, and equipment serving E&T and SR.

Nevertheless, current practice reveals a number of shortcomings in equipment management at HEIs generally and at VNU in particular. Equipment investment remains insufficiently coordinated in some units; utilization efficiency is not commensurate with investment value; fragmented and unit-centered approaches to equipment management and use persist; mechanisms for sharing equipment among units are not yet sufficiently effective; equipment management data have not been fully digitized or interconnected; and maintenance remains reactive in some locations. Amid the expansion of university autonomy and digital transformation, these limitations affect not only the efficiency of public resource utilization but also the quality of E&T, SR capacity, and institutional competitiveness.

From a theoretical perspective, although numerous studies have examined public asset management, facilities management, and university governance, relatively few have investigated equipment management in direct connection with teaching and SR within highly autonomous, multidisciplinary university systems such as VNU. Much of the existing research adopts an administrative or conventional asset-management perspective rather than a comprehensive approach grounded in modern university governance, strategic public asset management, and digital transformation in higher education. Moreover, relatively few studies have analyzed the relationship between effective equipment management and improvements in educational quality, research performance, and research-university development under the conditions of university autonomy in contemporary Vietnam. This constitutes a theoretical research gap requiring further investigation.

Furthermore, as public investment resources remain constrained while demand for modern equipment serving E&T and SR continues to grow, improving the effectiveness of equipment management, operation, and utilization has become an urgent economic, managerial, and public-policy concern. Without appropriate management solutions, resources may be wasted, public investment efficiency may decline, and educational quality, research capacity, and progress toward developing a research university meeting regional and international standards may be adversely affected.

On the basis of these theoretical and practical considerations, the topic "**Management of Equipment for Education and Scientific Research at Vietnam National University, Hanoi**" is of pressing theoretical and practical significance.

2. Research Objectives and Tasks

2.1. Research Objective

The dissertation aims to propose solutions to improve the effectiveness of equipment management in connection with E&T and SR at Vietnam National University, Hanoi, through 2030, with a vision toward 2045.

2.2. Research Tasks

The dissertation undertakes the following research tasks:

(i) To systematize selected theoretical issues concerning equipment management in connection with E&T and SR at public HEIs:

- Clarify relevant concepts and the characteristics of equipment management in connection with E&T and SR at public HEIs;

- Clarify the role of equipment management in E&T and SR activities at public HEIs;

- Clarify the contents, influencing factors, and evaluation criteria of equipment management in connection with E&T and SR at public HEIs.

(ii) To analyze and assess the current state of equipment management in connection with E&T and SR at VNU during 2021–2025:

- Analyze equipment management practices in connection with E&T and SR at Vietnam National University, Hanoi, during 2021–2025;

- Provide an overall assessment of equipment management in connection with E&T and SR at VNU during 2021–2025, identifying achievements, limitations, and their underlying causes.

(iii) To analyze the emerging context affecting equipment management in connection with E&T and SR at VNU, establish orientations, and propose solutions to improve management effectiveness through 2030, with a vision toward 2045.

3. Research Questions

The dissertation addresses the following research questions:

(1) What theoretical framework and model should guide equipment management at public HEIs to ensure its close and effective integration with education and scientific research?

(2) Which factors influence the effectiveness of equipment management in connection with E&T and SR, and what system of criteria should be developed to assess how well equipment meets the E&T and SR objectives of public HEIs?

(3) To what extent did equipment management in connection with E&T and SR at VNU during 2021–2025 meet the objectives of improving educational and research quality?

(4) In the context of governance reform and university autonomy, according to which principles and objectives should VNU establish its equipment management orientations to ensure coherence, modernization, and international integration through 2030, with a vision toward 2045?

(5) What systematic and feasible management solutions should be implemented to improve equipment operation, utilization, and development, thereby contributing directly to the quality of E&T and SR at VNU?

4. Research Object and Scope

4.1. Research Object

The research object is equipment management in connection with E&T and SR at Vietnam National University, Hanoi.

4.2. Research Scope

- Temporal scope: The dissertation examines equipment management serving E&T and SR at VNU during 2021–2025, a period in which VNU promoted university autonomy, digital transformation, and development toward a research-university model. On this basis, it proposes solutions through 2030, with a vision toward 2045.

- Spatial scope: The research is conducted within VNU, covering selected member universities, research institutes, centers, and laboratories using equipment for education, practical training, experimentation, and scientific research.

- Substantive scope: The study examines equipment management at public education and training institutions in connection with E&T and SR, with VNU as the management entity. It focuses on six key management areas: (1) identifying and planning equipment needs for teaching, practical training, experimentation, and research; (2) implementing investment and procurement in accordance with legal requirements and institutional development strategies; (3) organizing equipment operation and utilization to improve educational quality and research effectiveness; (4) carrying out maintenance, servicing, and technical inspection to ensure safety and operational readiness; (5) managing disposal, replacement, and upgrading of equipment to meet educational innovation and scientific and technological advances; and (6) assuring quality and evaluating utilization efficiency as a basis for adjusting and improving management.

5. Research Methodology

5.1. Research Process

Step 1: Review the literature to identify the research gap.

Step 2: Drawing on the literature review and consultations with experts, refine the theoretical framework for equipment management in connection with E&T and SR at public HEIs.

Step 3: Collect information to assess equipment management in connection with E&T and SR at Vietnam National University, Hanoi, using both secondary and primary data.

Step 4: Analyze equipment management practices in connection with E&T and SR at Vietnam National University, Hanoi, and assess achievements, limitations, and their causes.

Step 5: Propose orientations and solutions to improve equipment management effectiveness in connection with E&T and SR at Vietnam National University, Hanoi.

5.2. Research Approach

The study adopts an Economic Management approach, examining equipment management at HEIs as part of the governance of economic and technical resources serving E&T and SR. From this perspective, equipment is both a technical input and an important component of fixed assets, requiring substantial capital investment, involving significant budgetary expenditure, and directly affecting the quality of institutional outputs. Equipment management must therefore be examined in relation to investment efficiency, cost–benefit considerations, utilization levels, equipment life cycles, and effects on the quality of E&T and SR.

5.3. Data Sources and Collection Methods

5.3.1. Data Sources

First, secondary data: Published works by organizations and individuals concerning equipment management for E&T and SR at HEIs; VNU reports used to analyze and assess equipment management practices; data collected from other HEIs to examine their equipment management experience and draw lessons relevant to VNU; and State legal and regulatory documents.

Second, primary data: The dissertation draws on primary data collected through questionnaire surveys administered to groups directly involved in managing, using, and operating equipment serving E&T and SR at VNU. This data collection is intended to ensure that the information is practical, up to date, and aligned with the research objectives.

5.3.2. Data Collection Methods

(1) Analysis of equipment management records

(2) Field observation

(3) In-depth interviews

(4) Questionnaire surveys

5.4. Data Analysis Methods

- Analysis and synthesis
- The logical method combined with the historical method
- Comparative analysis
- Descriptive statistics

6. New Contributions of the Dissertation

6.1. Theoretical Contributions

The dissertation develops and refines the concept of equipment management in connection with E&T and SR at public HEIs; establishes an analytical framework for equipment management based on the management cycle and linked to educational and scientific research outputs; and develops an integrated system of criteria for evaluating equipment management in connection with E&T and SR.

6.2. Practical Contributions

The dissertation provides a comprehensive empirical overview of equipment management in connection with E&T and SR at Vietnam National University, Hanoi, during 2021–2025; identifies and quantifies groups of factors influencing the effectiveness of equipment management in connection with E&T and SR at VNU; and proposes a modern, coherent system of equipment management solutions suited to a multidisciplinary and multi-sectoral research university.

7. Structure of the Dissertation

Apart from the Introduction, Conclusion, References, and Appendices, the dissertation comprises four chapters:

Chapter 1: Overview of Research Related to the Dissertation Topic.

Chapter 2: Theoretical and Practical Foundations of Equipment Management in Connection with Education and Scientific Research at Public Higher Education Institutions.

Chapter 3: Current State of Equipment Management in Connection with Education and Scientific Research at Vietnam National University, Hanoi, during 2021–2025.

Chapter 4: Orientations and Solutions for Improving the Effectiveness of Equipment Management in Connection with Education and Scientific Research at Vietnam National University, Hanoi, through 2030, with a Vision toward 2045.

CHAPTER 1: OVERVIEW OF RESEARCH RELATED TO THE DISSERTATION TOPIC

1.1. OVERVIEW OF RESEARCH RELATED TO THE DISSERTATION

1.1.1. Studies on the Role and Impact of Equipment Management on Teaching and Scientific Research at Higher Education Institutions

Domestic and international studies and publications have affirmed the role of equipment management as an important supporting factor for education and scientific research activities. However, in the Vietnamese context, particularly at large public

higher education institutions, there remains a lack of in-depth and systematic studies that approach equipment management from a comprehensive life-cycle perspective and clearly analyze its impact on the quality of teaching and scientific research.

1.1.2. Studies on the Components of Equipment Management in Relation to Teaching and Scientific Research at Higher Education Institutions

Equipment management at higher education institutions is regarded as a comprehensive management activity encompassing the entire equipment life cycle, from needs identification, investment and procurement to the organization of equipment utilization, maintenance, servicing, disposal, and reinvestment. Domestic and international studies indicate that the effectiveness of equipment management not only affects the physical infrastructure and facilities of higher education institutions but also directly influences the quality of teaching, scientific research, and their capacity for innovation.

1.1.3. Studies on Factors Influencing Equipment Management in Relation to Teaching and Scientific Research at Higher Education Institutions

Equipment management in relation to teaching and scientific research at higher education institutions is a complex activity influenced simultaneously by various factors. Domestic and international studies have examined this issue from multiple perspectives, thereby highlighting the roles of financial resources, institutional and policy frameworks, human resources, technology, infrastructure, and organizational culture in determining the effectiveness of equipment management. The comprehensive identification and in-depth analysis of these influencing factors provide an important foundation for proposing appropriate management solutions in the current context of higher education.

1.1.4. Studies on Criteria for Evaluating Equipment Management in Relation to Teaching and Scientific Research at Higher Education Institutions

A synthesis of previous studies indicates that the evaluation of equipment management is increasingly adopting a multidimensional approach aligned with the objectives of education and scientific research. Evaluation is no longer limited to the current condition and quantity of equipment but has expanded to include utilization efficiency, costs, maintenance, user satisfaction, and the contribution of equipment to innovation.

1.2. GENERAL ASSESSMENT OF PREVIOUS RESEARCH

1.2.1. Key Findings from Studies Related to the Dissertation Topic

A review of domestic and international studies reveals that equipment management at higher education institutions has been approached from various perspectives, ranging from ensuring the necessary conditions for education and scientific research to asset management, life-cycle management, and the application of modern technologies. These research findings have contributed to establishing important theoretical and practical foundations for improving the effectiveness of equipment management as higher education increasingly develops toward research and innovation.

1.2.2. Research Gaps and Research Directions of the Dissertation

First, the research gap concerning the role and impact of equipment management on education and scientific research.

Previous studies have affirmed the important role of equipment in improving educational quality, research capacity, and innovation at higher education institutions. However, most studies have primarily focused on equipment as a condition for quality assurance or as a resource supporting educational and research activities. Relatively few studies have clarified the mechanisms through which equipment management affects educational and scientific research outcomes, such as student learning outcomes, research productivity, scientific publications, technology transfer, or institutional autonomy. Consequently, there remains a lack of a theoretical approach that considers equipment management as a value-creating factor directly influencing the effectiveness of academic activities at higher education institutions.

Second, the research gap concerning the components of equipment management in relation to education and scientific research.

Previous studies have addressed a relatively comprehensive range of management activities, including equipment planning, investment and procurement, utilization, maintenance, inventory control, and disposal. However, these activities have often been examined separately or approached primarily from the perspectives of public asset management and facilities management. Relatively few studies have developed a comprehensive analytical framework that reflects the entire equipment management cycle in connection with the objectives of improving educational quality and scientific research in the context of university autonomy. In particular, the management of shared equipment, the digitalization of asset management, and the interdisciplinary utilization of equipment remain insufficiently explored.

Third, the research gap concerning factors influencing equipment management.

Domestic and international studies have identified various groups of influencing factors, including institutional frameworks, financial resources, human resources, technology, and management organization. However, research findings remain fragmented and have not sufficiently clarified the magnitude of their effects or the relationships among these factors under the specific conditions of public higher education institutions in Vietnam. In particular, there is still a limited number of empirical studies assessing the effects of university autonomy, management decentralization, resource-sharing mechanisms, digital transformation, and accountability on the effectiveness of equipment management.

Fourth, the research gap concerning criteria for evaluating equipment management in relation to education and scientific research.

Existing studies have primarily employed evaluation criteria relating to equipment quantity, investment value, adequacy, or operational condition. Meanwhile, there remains a lack of a comprehensive system of evaluation criteria that simultaneously reflects management processes and equipment utilization outcomes. In particular, relatively few studies have developed criteria for evaluating the effectiveness of equipment management in relation to educational outcomes, scientific research results, and the degree of resource utilization at public higher education institutions.

Fifth, the research gap concerning empirical studies at research universities in Vietnam.

Although several studies have examined equipment management at universities, no study has yet systematically and comprehensively investigated equipment management in relation to education and scientific research at Vietnam National University, Hanoi (VNU)—a multidisciplinary, research-oriented university currently developing a smart and autonomous university model while relocating its operations to Hoa Lac. Consequently, empirical evidence remains insufficient regarding the current situation, the underlying causes of existing limitations, and the emerging requirements for equipment management in the development context of a large-scale research university.

Based on the research gaps identified above, the dissertation focuses on developing an integrated approach with the following objectives:

First, to develop a theoretical framework and a system of criteria for evaluating equipment management from an effectiveness-oriented perspective, directly linking equipment management to educational and scientific research outcomes.

Second, to collect and analyze data through in-depth interviews and surveys to examine the relationships between equipment management factors and the effectiveness of academic activities at VNU.

Third, to propose scientifically and practically grounded solutions for equipment management aimed at optimizing resource utilization, improving educational quality and scientific research capacity, and ensuring sustainability in the context of university autonomy.

This approach not only contributes to addressing theoretical gaps in equipment management at public higher education institutions but also provides empirical evidence and a reference framework for research-oriented universities in Vietnam.

CHAPTER 2: THEORETICAL AND PRACTICAL FOUNDATIONS OF EQUIPMENT MANAGEMENT IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH AT PUBLIC HIGHER EDUCATION INSTITUTIONS

2.1. THEORETICAL FOUNDATIONS OF EQUIPMENT MANAGEMENT IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH AT PUBLIC HIGHER EDUCATION INSTITUTIONS

2.1.1. Concepts, Classification, and Characteristics of Equipment Used for Education and Scientific Research at Public Higher Education Institutions

2.1.1.1. Concept of Equipment Used for Education and Scientific Research at Public Higher Education Institutions

Equipment used for education and scientific research at public higher education institutions refers to a system of machinery, instruments, technical facilities, technologies, and digital infrastructure that is invested in, managed, and utilized to directly support education, scientific research, and knowledge transfer activities, while establishing and strengthening the academic capacity, competitiveness, and institutional autonomy of higher education institutions.

2.1.1.2. Classification of Equipment Used for Education and Scientific Research at Public Higher Education Institutions

First, classification by function: Teaching equipment; laboratory and practical training equipment; specialized research equipment; and academic support equipment.

Second, classification by frequency and intensity of use: Regularly used equipment; and infrequently used or specialized equipment.

Third, classification by asset value: High-value equipment; and low- or medium-value equipment.

Fourth, classification by durability and service life: Equipment with a long service life and high durability; and equipment with a short service life or rapid depreciation.

Fifth, classification by technical standards and compliance levels: Equipment meeting international standards; and equipment meeting national standards.

2.1.1.3. Characteristics of Equipment Used for Education and Scientific Research at Public Higher Education Institutions

Equipment used for education and scientific research at public higher education institutions has the following fundamental characteristics: specialization, technological advancement, diversity, high technical requirements, high costs, and safety requirements.

2.1.2. Concept of Equipment Management in Relation to Education and Scientific Research at Public Higher Education Institutions

Equipment management in relation to education and scientific research at public higher education institutions refers to the totality of organized activities undertaken by management entities to ensure that the acquisition, operation, utilization, and disposal of equipment serving education and scientific research are carried out economically, efficiently, and in compliance with applicable regulations. This process operates within the State's legal framework and involves coordination between public asset management authorities and the functional departments of higher education institutions, thereby contributing to improving the quality and effectiveness of higher education.

2.1.3. Objectives of Equipment Management in Relation to Education and Scientific Research at Public Higher Education Institutions

The objectives of equipment management in relation to education and scientific research at public higher education institutions can be summarized as follows: First, to ensure efficient equipment utilization; second, to contribute to improving the quality of education and scientific research; third, to reduce costs and ensure the efficient use of public resources; fourth, to ensure the safety of users and equipment systems; and fifth, to enhance management capacity and promote innovation in governance systems.

2.1.4. Components of Equipment Management in Relation to Education and Scientific Research at Public Higher Education Institutions

The identification of equipment management components in this dissertation is based on four principal theoretical foundations: (1) the Management Functions

Approach; (2) the Plan–Do–Check–Act (PDCA) continuous improvement cycle; (3) Asset Life-Cycle Management Theory; and (4) the Resource-Based View (RBV).

Based on these theoretical foundations and the reviewed literature, the dissertation identifies six components of equipment management in relation to education and scientific research at public higher education institutions in the current context, as presented below.

2.1.4.1. Equipment Needs Planning

Equipment needs planning constitutes the initial stage, providing strategic direction and influencing the entire equipment management cycle at public higher education institutions. This activity aims to scientifically determine the quantity, categories, technical specifications, and investment priorities for different types of equipment used in teaching, practical training, laboratory activities, and scientific research. Equipment needs planning is not merely a technical activity but also reflects the institution's strategic vision for developing academic programs, priority research areas, and laboratory systems.

2.1.4.2. Equipment Investment and Procurement

Equipment investment and procurement constitute a central component that plays a decisive role in determining the quality and effectiveness of the physical and technical infrastructure of public higher education institutions. This component encompasses all activities, from investment planning, needs appraisal, selection of investment methods, tendering procedures, contract negotiations, technical inspection, and acceptance testing to equipment handover and commissioning. Each stage directly influences investment efficiency and the potential for long-term equipment utilization.

2.1.4.3. Organization of Equipment Operation and Utilization

The organization of equipment operation and utilization is a core component reflecting the actual value generated by management and investment activities. Its effectiveness is demonstrated through the extent to which equipment meets the needs of teaching, practical training, laboratory activities, and scientific research; the frequency and intensity of equipment utilization; the contribution of equipment to educational and research outputs; and the degree of compliance with technical procedures and operational safety requirements.

2.1.4.4. Equipment Maintenance, Servicing, and Technical Inspection

Equipment maintenance, servicing, and technical inspection are essential for maintaining stable, reliable, and safe equipment operation throughout its service life. These activities include developing periodic maintenance plans, conducting technical safety inspections, repairing or replacing damaged components, and updating equipment condition monitoring records.

2.1.4.5. Management of Equipment Disposal, Replacement, and Modernization

The management of equipment disposal, replacement, and modernization represents an important stage in the equipment life-cycle management process, ensuring the continued suitability, effectiveness, and technological advancement of equipment systems serving education and scientific research. When equipment becomes technologically obsolete, severely damaged, or no longer meets the requirements of educational programs and research activities, higher education

institutions need to conduct comprehensive assessments of its utilization effectiveness to inform decisions on disposal or replacement.

2.1.4.6. Quality Assurance and Evaluation of Equipment Utilization Effectiveness

Quality assurance and the evaluation of equipment utilization effectiveness constitute an integrated component that provides feedback and facilitates adjustments throughout the equipment management cycle. This component aims to determine the suitability, effectiveness, and contribution of equipment to education and scientific research activities. Such evaluations should be conducted using a scientifically grounded system of criteria combining qualitative and quantitative approaches.

2.1.5. Factors Influencing Equipment Management in Relation to Education and Scientific Research at Public Higher Education Institutions

2.1.5.1. Internal Factors

First, equipment databases and information systems at public higher education institutions.

Second, the management level and financial capacity of public higher education institutions.

Third, the development strategies of public higher education institutions.

Fourth, awareness and responsible use of equipment at public higher education institutions.

Fifth, the organizational structure for equipment management at public higher education institutions.

2.1.5.2. External Factors

First, the appropriateness of the legal framework, policies, and regulations governing equipment management.

Second, inspection and supervision activities in equipment management.

Third, other external factors, such as natural disasters, political instability, and international influences.

2.1.6. Criteria for Evaluating Equipment Management in Relation to Education and Scientific Research at Public Higher Education Institutions

First, criteria for evaluating equipment needs planning.

The evaluation of this component should focus on three fundamental aspects: (i) the alignment of equipment plans with education and scientific research requirements; (ii) the scientific rigor and forecasting capacity of the planning process; and (iii) the extent of stakeholder participation in plan development. These criteria reflect the alignment between equipment management and institutional development strategies while ensuring feasibility and effectiveness in practical implementation.

Second, criteria for evaluating equipment investment and procurement.

The evaluation of this component should consider three principal dimensions: (i) regulatory compliance and transparency in procurement procedures; (ii) the effectiveness of technology selection and the extent to which equipment meets professional requirements; and (iii) the timeliness and quality of procurement package implementation. These criteria not only reflect the governance capacity of higher education institutions but also provide a basis for ensuring long-term investment efficiency.

Third, criteria for evaluating the organization of equipment operation and utilization.

These criteria are developed to reflect the extent of equipment utilization in education and research, as well as equipment utilization efficiency: (i) the degree of equipment utilization in educational activities; (ii) the extent to which equipment supports scientific research; and (iii) equipment utilization efficiency. These criteria make it possible to assess both the breadth (scope of utilization) and depth (intensity and effectiveness of utilization) of equipment use in practice.

Fourth, criteria for evaluating equipment maintenance, servicing, and technical inspection.

The evaluation criteria focus on three aspects: (i) the completeness and appropriateness of maintenance plans; (ii) the effectiveness of maintenance and servicing activities; and (iii) compliance with technical inspection and safety regulations. These criteria contribute to ensuring continuity and efficiency in equipment operation and utilization.

Fifth, criteria for evaluating equipment disposal, replacement, and modernization.

The evaluation of this component should consider: (i) the timeliness of disposing of obsolete equipment; (ii) the effectiveness of reinvestment activities; and (iii) the degree of modernization of equipment systems. These criteria reflect the adaptability and innovation capacity of higher education institutions in the context of scientific and technological development.

Sixth, criteria for evaluating quality assurance and equipment utilization effectiveness.

The evaluation criteria are designed to reflect overall effectiveness in education, scientific research, financial management, and continuous improvement capacity.

2.2. EXPERIENCES OF SELECTED HIGHER EDUCATION INSTITUTIONS IN EQUIPMENT MANAGEMENT IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH

2.2.1. Experiences of Selected Higher Education Institutions

2.2.1.1. Experience of Hue University

Regarding equipment management in relation to education and scientific research, Hue University offers several noteworthy experiences. The university undertakes equipment needs planning in alignment with its development strategy for 2021–2030, with a vision toward 2045, and its objective of becoming a national university. Investment and procurement activities are implemented in accordance with public asset management regulations, ensuring compliance with planning requirements, standards, prescribed norms, and budget estimation procedures. Hue University has substantially decentralized authority and delegated responsibilities to its member institutions. Asset monitoring, statistical reporting, accounting, and depreciation assessment are conducted periodically. The disposal and handling of fixed assets comply with public asset management legislation. Furthermore, Hue University integrates equipment management with internal control mechanisms, periodic reporting, and financial transparency.

2.2.1.2. Experience of Thai Nguyen University

Thai Nguyen University has placed considerable emphasis on equipment management in relation to education and scientific research. Specifically, equipment needs are identified based on the expected learning outcomes of educational programs, the research requirements of academic groups, and historical statistical data on equipment utilization frequency and efficiency. The university adopts a centralized management model for high-value equipment and key laboratories, with equipment coordinated for shared use across the university system when necessary.

Thai Nguyen University also promotes cooperation with enterprises to utilize equipment outside regular teaching hours, thereby improving utilization efficiency, generating revenue for reinvestment, and promoting applied research. Particular attention is paid to developing a highly qualified technical workforce. The university regularly organizes training courses on equipment safety and enhances operational skills for modern equipment. Equipment is periodically reviewed based on utilization levels and operational effectiveness. Cooperation with enterprises in utilizing equipment outside regular teaching hours is also encouraged.

2.2.1.3. Experience of Vietnam National University, Ho Chi Minh City

Regarding asset management, particularly equipment management in relation to education and scientific research, Vietnam National University, Ho Chi Minh City (VNU-HCM), offers several noteworthy experiences. These include the establishment of a comprehensive and integrated public asset management system; the implementation of comprehensive management procedures supported by information technology; the mobilization of non-state-budget financial resources; the close integration of asset management with financial management; and the maximization of existing asset utilization.

2.2.2. Lessons Learned for Vietnam National University, Hanoi

Based on the experiences discussed above, several important lessons can be drawn for Vietnam National University, Hanoi, in improving equipment management.

First, equipment investment strategies should be aligned with institutional development orientations.

Second, decentralization and delegation of authority should be implemented flexibly.

Third, information technology applications and digital transformation should be promoted.

Fourth, training and appropriate remuneration policies for technical personnel should be strengthened.

Fifth, supervision and continuous improvement should be enhanced.

Sixth, equipment sharing and collaborative utilization should be encouraged.

Seventh, asset management should be integrated with financial management and outcome evaluation.

CHAPTER 3: CURRENT STATUS OF EQUIPMENT MANAGEMENT IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH AT VIETNAM NATIONAL UNIVERSITY, HANOI, DURING THE 2021–2025 PERIOD

3.1. OVERVIEW OF VIETNAM NATIONAL UNIVERSITY, HANOI

3.1.1. Establishment and Development of Vietnam National University, Hanoi

Vietnam National University, Hanoi (VNU), was established in accordance with the Party's policy orientations, as reflected in Conclusion No. 315-TB/TW dated August 29, 2000, of the Standing Committee of the Politburo, and Government Decree No. 97/CP dated December 10, 1993.

Over more than three decades of development, VNU has achieved significant accomplishments by exercising a high degree of autonomy and accountability, with the attention and direction of the Party and Government and the support of ministries, central agencies, and the Hanoi Municipal People's Committee.

VNU has consolidated its position among the leading higher education institutions in terms of undergraduate admissions quality. Its management mechanisms and methods of organizing science and technology activities have been reformed toward an output-oriented approach. The initial implementation of management software systems has contributed to substantially streamlining administrative procedures.

Financial resources invested and earmarked for investment in science and technology during the forthcoming term have increased considerably. Alongside substantial investment, special mechanisms and policies for attracting, supporting, and recognizing scientists have encouraged autonomy and creativity among academic staff, stimulated innovation throughout the university system, and contributed to improvements in both the quantity and quality of innovation indicators.

3.1.2. Organizational Structure of Vietnam National University, Hanoi

Table 3.1. Organizational Structure of Vietnam National University, Hanoi

Organizational units	Number
Member universities	09
Affiliated schools	03
Research institutes	05
Affiliated training centers	02
Support and service units	09
Other units	07

Source: Official website of Vietnam National University, Hanoi.

3.1.3. University Autonomy at Vietnam National University, Hanoi

In the context of amendments and supplements to the Law on Higher Education, which have revised the general legal framework for university governance, the organizational and operational model of national universities has continued to evolve toward greater autonomy accompanied by enhanced accountability.

VNU has gradually shifted from a mechanism characterized by preferential investment toward one emphasizing a high degree of autonomy combined with competition and responsibility, in line with an increasingly equitable and internationally integrated higher education environment.

3.1.4. Current Status of Equipment at Vietnam National University, Hanoi

Regarding the scale and categories of equipment

In terms of scale and categories, VNU's equipment system is relatively diverse, encompassing teaching equipment, scientific research equipment, and equipment supporting management and educational activities. Many member institutions have received investment in modern laboratories, some of which meet regional and international standards, thereby contributing to the enhancement of research capacity and postgraduate education.

Regarding investment and modernization

During the 2021–2025 period, VNU progressively increased investment in equipment through various funding sources, including the state budget, institutional revenues, science and technology projects, and domestic and international cooperation.

Certain priority fields received preferential investment in modern equipment to support high-quality educational programs and strong research groups. Nevertheless, disparities remain in the level of equipment modernization among member institutions and across academic disciplines.

Regarding equipment condition and utilization

Most existing equipment is utilized for both educational and scientific research activities. Many items of equipment are used frequently, contributing to improved effectiveness in practical training and enhanced research capacity.

Regarding equipment distribution, management, and life cycle

Equipment is primarily allocated according to member institutions and academic and research disciplines. Decentralized equipment management has enabled individual units to exercise greater initiative in equipment operation and utilization. However, it has also created challenges in ensuring consistency, interoperability, and shared equipment utilization throughout VNU.

Some units continue to face difficulties in updating equipment records, conducting inventories, and managing equipment life cycles, particularly for high-value and technologically advanced equipment.

3.2. CURRENT STATUS OF EQUIPMENT MANAGEMENT IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH AT VIETNAM NATIONAL UNIVERSITY, HANOI, DURING THE 2021–2025 PERIOD

3.2.1. Current Status of Equipment Needs Planning

Equipment planning is conducted annually and through medium-term plans, based on strategic orientations for the 2021–2025 period and policies concerning science and technology development, the attraction of highly qualified human resources, and the modernization of physical infrastructure.

Survey results indicate that 86.24% of respondents considered current equipment investment planning appropriate and responsive to operational requirements, reflecting a relatively high level of agreement regarding planning procedures and orientations.

Equipment needs planning combines current requirements with long-term forecasts, including student enrollment, campus expansion, enterprise cooperation, and technological trends. This process provides the basis for establishing prioritized equipment investment lists on an annual and periodic basis.

In addition to annual plans, equipment needs are incorporated into public investment projects, externally funded projects, and international cooperation programs to ensure consistency and facilitate the mobilization of diverse resources.

3.2.2. Current Status of Equipment Investment and Procurement

Equipment investment and procurement at VNU are financed through multiple sources, with the state budget playing a leading role. These include public investment capital for major projects, recurrent funding for educational activities, science and technology funding, and investments under targeted programs.

In addition to state budget funding, revenues generated by member institutions, including tuition fees, scientific research activities, analytical and testing service contracts, and technology transfer activities, also play an important role, particularly in procuring practical training equipment, simulation equipment, and equipment supporting university autonomy.

Furthermore, cooperation with enterprises and international partners constitutes two important supplementary sources of resources, contributing to the establishment of modern laboratories and specialized classrooms meeting international standards.

Enterprise cooperation projects provide high-technology practical training equipment, licensed software, and technical training courses. Meanwhile, international cooperation programs and Official Development Assistance (ODA) projects support the provision of integrated equipment systems for environmental studies, information technology, education, energy, and various other specialized fields.

3.2.3. Current Status of the Organization of Equipment Operation and Utilization

The organization of equipment operation and utilization at VNU represents an important stage following investment and procurement, aimed at ensuring that equipment effectively serves educational and scientific research activities.

At VNU, these activities are carried out regularly and systematically, in accordance with the governance structures of individual member institutions and the university as a whole.

Alongside the substantial increase in the quantity and diversity of equipment, VNU has developed various mechanisms, regulations, and organizational arrangements for equipment utilization toward greater professionalism, ensuring alignment with the needs of lecturers, students, and research groups.

3.2.4. Current Status of Equipment Maintenance, Servicing, and Technical Inspection

Equipment maintenance, servicing, and technical inspection at VNU are organized as an important component of the overall equipment management life cycle, aiming to maintain stable operating conditions, extend equipment service life, and minimize operational failures during utilization for education and scientific research.

According to VNU's Consolidated Report on Physical Facilities and Equipment Management for the 2021–2025 Period, the university currently manages

tens of thousands of machinery and equipment assets. Of these, approximately 65–70% of equipment in operation requires periodic maintenance and servicing, particularly equipment located in laboratories, research centers, and educational units specializing in science, technology, medicine, and pharmacy.

3.2.5. Current Status of the Management of Equipment Disposal, Replacement, and Modernization

Equipment disposal management is implemented on the basis of periodic asset inventories in accordance with legal regulations and VNU's internal rules.

Each year, affiliated units review the technical condition of equipment in laboratories, practical training rooms, specialized classrooms, and other functional facilities.

Inventory results indicate that equipment that is severely damaged, technologically obsolete, or no longer suitable for educational programs accounts for approximately 6–8% of the total equipment reviewed annually (VNU, 2023).

Alongside disposal activities, equipment replacement is undertaken to maintain laboratory operational capacity and ensure the quality of education and research.

According to VNU's annual investment plans, approximately 65–70% of disposed equipment is replaced with new or upgraded equipment, with priority given to equipment directly serving practical training, laboratory activities, and research with high utilization frequency.

3.2.6. Quality Assurance and Evaluation of Equipment Utilization Effectiveness

At VNU, quality assurance and the evaluation of equipment utilization effectiveness are conducted at multiple levels, from member institutions, faculties, and departments to central management units and the university level, through standardized mechanisms, procedures, and evaluation systems. Regarding quality assurance, VNU has developed operating procedures, user guidelines, and quality control measures for different categories of equipment. To evaluate utilization effectiveness, VNU applies several approaches combining quantitative monitoring with qualitative assessment. In addition to monitoring operational data, VNU evaluates equipment utilization effectiveness through surveys of lecturers, students, and research groups.

3.3. OVERALL ASSESSMENT OF EQUIPMENT MANAGEMENT IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH AT VIETNAM NATIONAL UNIVERSITY, HANOI, DURING THE 2021–2025 PERIOD

3.3.1. Achievements

Equipment needs planning has been implemented in a coordinated manner across faculties, departments, and research centers. Equipment investment and procurement have been organized according to standardized procedures, ensuring transparency, efficiency, and compliance with legal regulations. Equipment operation and utilization have been organized systematically through operational schedules, online registration systems, and the allocation of practical training sessions, thereby supporting educational and scientific research activities. Maintenance, servicing, and technical inspection have been conducted regularly and systematically. Equipment disposal, replacement, and modernization have been implemented in accordance with long-term strategies, focusing on key laboratories, modern equipment, and

international cooperation. Quality assurance and the evaluation of equipment utilization effectiveness have been systematically organized by combining operational data, user surveys, project reports, and comparative indicators.

3.3.2. Limitations and Their Causes

3.3.2.1. Limitations

First, equipment needs planning remains insufficiently coordinated in some units. Although the majority of staff consider investment plans appropriate, 13.15% of respondents indicated that such plans were "inappropriate and failed to meet operational requirements." Second, the time required from planning to investment and procurement remains lengthy, resulting in delays in acquiring new equipment and affecting research schedules and educational programs. Third, equipment operation and utilization have not yet been fully optimized, particularly for shared and high-technology equipment, because operational schedules, teaching session arrangements, and coordination among units are sometimes insufficiently synchronized. Fourth, maintenance, servicing, and technical inspection continue to face difficulties in ensuring timely periodic implementation for a large number of equipment items. Some older equipment also presents challenges in obtaining replacement components or technical support from manufacturers. Fifth, equipment disposal and replacement are not always carried out in a timely manner, resulting in fully depreciated or obsolete equipment remaining on asset registers, thereby affecting utilization efficiency and infrastructure upgrading. Sixth, equipment modernization and upgrading remain uneven, with investment concentrated mainly in key laboratories, while basic and interdisciplinary laboratories continue to have limited access to modern equipment. Seventh, the evaluation of equipment utilization effectiveness has not yet achieved sufficient consistency and standardization.

3.3.2.2. Causes of the Limitations

Internal causes (within VNU and its member institutions):

Some procedures for planning, approval, and investment implementation remain cumbersome, while coordination mechanisms among member institutions are insufficiently integrated, resulting in delays in equipment acquisition. Investment budgets for equipment, particularly modern equipment, have not fully met growing demand, leading to the prioritization of resources for key laboratories. Some units have not yet adopted integrated equipment management systems, creating difficulties in forecasting equipment needs, monitoring utilization effectiveness, and planning maintenance and replacement. For complex or high-technology equipment, maintenance, calibration, and the procurement of replacement components remain challenging, particularly for older equipment or equipment imported from abroad. Some technical staff, lecturers, and managers have not received sufficient training in equipment management, planning, and utilization effectiveness evaluation, resulting in less-than-optimal equipment operation and maintenance. In certain cases, investment plans have focused on modernization and major projects without adequately allocating resources to basic laboratories or smaller research groups, thereby reducing overall consistency and utilization efficiency.

External causes (arising from the external environment):

The system of legal documents and policies governing public asset management in general, and equipment used for education and scientific research in

particular, still contains inconsistencies, lacks stability, and has not been adjusted promptly to meet the requirements of higher education reform. Mechanisms for allocating and managing state budget resources for higher education and science and technology remain subject to various constraints, while demand for investment in modern equipment continues to increase. Rapid scientific and technological development, together with global trends in the transformation of educational and research methods, places considerable pressure on equipment management. Although inspection, examination, and supervision by state management agencies play an important role in maintaining financial discipline and compliance in public asset management, in some cases these activities remain excessively focused on procedural control, without sufficient attention to providing guidance and support for public higher education institutions to improve equipment management and utilization effectiveness. Other external factors, including macroeconomic fluctuations, inflation, natural disasters, epidemics, and international instability, also have significant implications for equipment management.

CHAPTER 4: DIRECTIONS AND SOLUTIONS FOR IMPROVING THE EFFECTIVENESS OF EQUIPMENT MANAGEMENT IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH AT VIETNAM NATIONAL UNIVERSITY, HANOI, THROUGH 2030, WITH A VISION TOWARD 2045

4.1. EMERGING CONTEXT AFFECTING THE IMPROVEMENT OF EQUIPMENT MANAGEMENT EFFECTIVENESS IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH AT VIETNAM NATIONAL UNIVERSITY, HANOI, THROUGH 2030, WITH A VISION TOWARD 2045

4.1.1. International Context

First, the impact of the Fourth Industrial Revolution (Industry 4.0) and the rapid development of science and technology.

Second, the internationalization of higher education and the standardization of equipment management.

Third, global competition among research universities and increasing pressure for innovation.

Fourth, the global trend toward establishing shared equipment facilities and centers.

4.1.2. Domestic Context

First, the policies and orientations of the Party and the State concerning fundamental and comprehensive reform of higher education and the development of science and technology.

Second, the increasingly extensive implementation of university autonomy.

Third, the trend toward national digital transformation and the growing need for digitalization in university governance.

Fourth, increasing pressure to improve educational quality, research performance indicators, and regional standing.

Fifth, the distinctive characteristics and mission of Vietnam National University, Hanoi (VNU).

Sixth, the relocation of VNU's educational, research, and administrative activities to Hoa Lac, which creates new requirements for equipment management.

4.2. OBJECTIVES AND DIRECTIONS FOR IMPROVING EQUIPMENT MANAGEMENT EFFECTIVENESS IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH AT VIETNAM NATIONAL UNIVERSITY, HANOI, THROUGH 2030, WITH A VISION TOWARD 2045

4.2.1. Objectives for Improving Equipment Management Effectiveness in Relation to Education and Scientific Research at Vietnam National University, Hanoi

4.2.1.1. General Objective

The overall objective of improving equipment management effectiveness in relation to education and scientific research at VNU is to establish a modern, integrated, digitalized, and efficiently operated equipment management system. This system aims to ensure the optimal utilization of public asset resources for education, scientific research, and innovation while meeting the requirements of university autonomy, digital transformation, and VNU's development toward an advanced research university.

4.2.2.2. Specific Objectives

Through 2030: To strengthen the foundations of university governance and improve equipment utilization effectiveness.

During 2031–2045: To develop a modern and integrated equipment governance model at Hoa Lac.

Vision toward 2045: To establish a modern equipment management system that meets international standards.

4.2.2. Directions for Improving Equipment Management Effectiveness in Relation to Education and Scientific Research at Vietnam National University, Hanoi

First, equipment management should be standardized and modernized in accordance with international standards, ensuring transparency, consistency, and professionalism throughout the VNU system.

Second, VNU should gradually transition from a decentralized management model toward centralized, interconnected, and shared equipment management.

Third, accelerating digital transformation in equipment management is an inevitable direction.

Fourth, equipment investment, upgrading, and restructuring should be aligned with the development strategies for education and scientific research.

Fifth, developing professionally managed shared equipment centers is an important requirement.

Sixth, recruiting and assigning dedicated equipment management personnel in a professional and sustainable manner is a decisive requirement.

Seventh, domestic and international partnerships and cooperation should be strengthened, alongside the establishment of mechanisms for evaluation, supervision, and continuous improvement.

4.3. SOLUTIONS FOR IMPROVING EQUIPMENT MANAGEMENT EFFECTIVENESS IN RELATION TO EDUCATION AND SCIENTIFIC RESEARCH AT VIETNAM NATIONAL UNIVERSITY, HANOI, THROUGH 2030, WITH A VISION TOWARD 2045

4.3.1. Improving Data-Driven Equipment Needs Planning and Forecasting in Alignment with Education and Scientific Research Strategies

The objective of this solution is to improve the quality of investment decision-making, ensure alignment between equipment needs and academic development

orientations, and minimize fragmented, duplicated, or inefficient investment. To achieve this objective, VNU should first establish a centralized equipment database based on a comprehensive asset life-cycle management approach. Using standardized data, equipment needs forecasting should be conducted through evidence-based methods and quantitative indicators. Furthermore, equipment needs planning mechanisms should be improved by combining bottom-up approaches with top-down coordination.

4.3.2. Streamlining Equipment Investment, Procurement, and Approval Procedures

The objective of this solution is to establish streamlined and transparent equipment investment and procurement procedures, reduce administrative processing time while ensuring legal compliance, improve resource utilization efficiency, and promptly meet the educational and scientific research needs of member institutions. To achieve this objective, VNU should review, standardize, and simplify equipment investment and procurement procedures by eliminating unnecessary intermediary stages and reducing overlaps in authority and responsibilities among relevant units. Greater decentralization of investment management should be promoted in conjunction with enhanced accountability among equipment-using units. At the same time, VNU should strengthen coordination and oversight of large-scale investment projects, high-technology equipment, and equipment shared throughout the university system. The application of digital technologies should also be accelerated across the entire equipment investment and procurement process.

4.3.3. Improving the Effectiveness of Equipment Utilization and Coordination

The objective of this solution is to establish a centralized, transparent, and data-driven mechanism for equipment management, coordination, and utilization, ensuring that equipment is operated at the highest possible levels of capacity and efficiency. To achieve this objective, VNU should develop a centralized management mechanism for shared equipment, particularly high-value equipment, specialized research equipment, and key laboratories. Digital technologies should be increasingly applied to equipment management, coordination, and utilization monitoring. VNU should also develop and promulgate regulations governing shared equipment utilization, ensuring openness, transparency, and consistency throughout the university system. Furthermore, to strengthen user accountability, equipment utilization should be linked to the outputs of educational and scientific research activities.

4.3.4. Improving Equipment Maintenance and Servicing Toward Proactive and Standardized Management

Equipment maintenance and servicing should be improved through a proactive, standardized, and life-cycle-based approach, replacing reactive practices in which corrective measures are undertaken only after equipment failures or serious deterioration have occurred. To achieve this objective, VNU should develop and consistently implement standardized equipment maintenance and servicing procedures throughout the university system. Based on VNU's general guidelines, member institutions should classify equipment according to investment value, criticality, frequency of use, and importance to educational and scientific research activities in order to determine appropriate maintenance regimes. An important

component of this solution is integrating maintenance activities with equipment life-cycle management. Accordingly, each item of equipment should have an electronic technical record that is regularly updated with information on operation, maintenance, repairs, component replacement, calibration, and equipment failures. Furthermore, there should be a decisive shift from reactive maintenance toward proactive and preventive maintenance. VNU should also strengthen the application of digital technologies in equipment maintenance management.

4.3.5. Strengthening Equipment Disposal, Replacement, and Modernization in Accordance with Strategic Orientations

Establishing scientifically grounded and transparent mechanisms for equipment disposal, replacement, and modernization, aligned with long-term development strategies, is essential for improving the efficiency of public asset utilization and strengthening VNU's competitiveness. To achieve this objective, VNU should establish a mechanism for periodically evaluating equipment inventories based on a unified set of criteria applied throughout the university system. Based on evaluation results, VNU should develop a roadmap for equipment replacement and modernization aligned with the development strategies of individual educational and research fields. Furthermore, equipment disposal should be conducted openly and transparently, in full compliance with legal regulations governing public asset management. Another important component of this solution is diversifying financial resources for equipment modernization. In addition to state budget funding, VNU should proactively mobilize resources from science and technology programs, international cooperation projects, scientific development funds, social contributions, public–private partnerships, and cooperation with enterprises.

4.3.6. Improving Equipment Technical Inspection and Calibration to Ensure Quality and Safety

Technical inspection and calibration activities should be improved toward standardization, proactive implementation, and compliance with national and international technical standards, ensuring equipment quality control throughout its operation and utilization. To achieve this objective, VNU should develop and promulgate standardized procedures for equipment technical inspection and calibration throughout the university system. A technical database should be established to support inspection and calibration activities. The application of digital technologies in managing technical inspection and calibration should be accelerated. Cooperation should also be strengthened with technically competent inspection and calibration organizations that are accredited in accordance with applicable legal regulations.

4.3.7. Enhancing the Capacity of Managers, Technicians, and Equipment Users

Enhancing the capacity of managers, technicians, and equipment users should be regarded as a fundamental solution that provides the necessary conditions for effectively implementing equipment management solutions at VNU. To achieve this objective, VNU should develop and implement systematic and regular capacity-building programs in equipment management, operation, and utilization, tailored to the specific characteristics and requirements of different target groups. VNU should also establish a competency assessment and certification system for positions involved in equipment management and operation.

4.3.8. Improving the System for Evaluating and Reporting Equipment Utilization Effectiveness

Establishing a system for evaluating and reporting equipment utilization effectiveness not only enhances transparency and accountability in public asset management but also creates a data foundation for evidence-based university governance. Therefore, the system for evaluating and reporting equipment utilization effectiveness should be improved toward standardization and digitalization, while being aligned with the objectives of improving educational quality, scientific research performance, and resource utilization efficiency. To achieve this objective, VNU should develop and promulgate a unified set of indicators for evaluating equipment utilization effectiveness throughout the university system. Based on these unified indicators, VNU should standardize procedures for evaluating and reporting equipment utilization effectiveness.

4.4. RECOMMENDATIONS

First, recommendations to the National Assembly.

Second, recommendations to the Government.

Third, recommendations to the Ministry of Finance, the Ministry of Education and Training, and other relevant ministries and agencies.

CONCLUSION

The dissertation entitled “Equipment Management in Relation to Education and Scientific Research at Vietnam National University, Hanoi” has systematically and comprehensively examined equipment management at Vietnam National University, Hanoi (VNU), in its integral relationship with educational and scientific research activities. The research was conducted by combining an analysis of modern management theories, a review of international experiences, and empirical investigations at faculties, research centers, and laboratories within VNU, thereby ensuring the scientific rigor, practical relevance, and feasibility of its conclusions and recommendations.

An examination of the 2021–2025 period reveals that equipment management at VNU has achieved several positive outcomes. Equipment needs planning has gradually become more closely aligned with educational scale, academic program orientations, and scientific research requirements. Procedures for equipment investment, procurement, acceptance testing, maintenance, servicing, and technical inspection have been implemented in accordance with established standards. Shared equipment models and resource-sharing mechanisms among member institutions have been developed, alongside the gradual application of information technology to equipment life-cycle management. These achievements have contributed to improving equipment utilization efficiency, reducing duplication in investment, and establishing a foundation for evaluating equipment utilization effectiveness throughout VNU.

Nevertheless, the research also identifies several limitations in equipment management at VNU, including inconsistencies in equipment needs planning, prolonged investment and procurement procedures, suboptimal equipment utilization and maintenance in certain units, difficulties in replacing and upgrading outdated

equipment, and a lack of consistency in evaluating equipment utilization effectiveness. These limitations arise from both internal and external causes relating to financial mechanisms, management procedures, human resource capacity, and the degree of coordination among member institutions.

On this basis, the dissertation has developed and proposed a comprehensive and modern system of equipment management solutions suited to VNU's practical conditions through 2030, with a vision toward 2045. These solutions focus on improving management models in accordance with international standards; accelerating digital transformation and equipment life-cycle management; reforming investment, upgrading, and disposal mechanisms based on data and life-cycle cost analysis; developing shared equipment systems; enhancing the capacity of personnel responsible for equipment management and operation; strengthening domestic and international cooperation; establishing systems for evaluation, monitoring, and continuous improvement; ensuring safety and risk management; optimizing financial resources and operating costs; applying advanced technologies; fostering a professional culture of equipment utilization; and closely integrating equipment management with education and scientific research.

These solutions are intended not only to address existing limitations but also to establish an integrated, sustainable, and adaptable equipment management framework capable of responding to rapid scientific and technological developments and the requirements of international integration. Their effective implementation will contribute to improving educational quality, scientific research capacity, and resource utilization efficiency at VNU.

In particular, the dissertation has put forward several recommendations to relevant authorities, including the National Assembly, the Government, the Ministry of Education and Training, the Ministry of Finance, and other relevant ministries and agencies, with the aim of improving the effectiveness of equipment management in relation to education and scientific research at higher education institutions.

Overall, the dissertation has made contributions, to a certain extent, to both the theoretical and practical aspects of equipment management at higher education institutions. Its findings are relevant not only to VNU but also serve as a useful reference for public higher education institutions in Vietnam in reforming university governance and improving the efficiency of investment in and utilization of physical facilities and equipment for education and scientific research in the current period.

The dissertation also opens up avenues for further research into specific aspects of equipment management in relation to education and scientific research at public higher education institutions, such as equipment needs planning, equipment investment and procurement, and related issues, which may also be examined in the context of national digital transformation.

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