**CHAPTER ONE**

**INTRODUCTION**

**1.1      BACKGROUND TO THE STUDY**

In the modern educational landscape, the efficient management of campus facilities is integral to fostering a conducive learning environment. A critical component of this management is the timely resolution of maintenance requests, ensuring that infrastructure remains functional and safe for students, faculty, and staff. Traditional paper-based systems for managing maintenance requests often suffer from delays, inefficiencies, and lack of transparency (Hsu, 2018). To address these challenges, the design and implementation of an online Campus Maintenance Request and Approval System (CMRAS) emerge as a pivotal solution. This system leverages digital technologies to streamline the process of submitting, tracking, and resolving maintenance issues across various campus facilities. The implementation of an online CMRAS offers several advantages over conventional methods. First, it offers an easy-to-use platform that all parties involved—faculty, staff, and students—can use to simply submit maintenance requests from any internet-connected device (Sharma & Gupta, 2019). Second, because the system is digital, it is easier to manage and monitor requests in real time, which improves accountability and openness in the repair process. Additionally, the CMRAS guarantees timely resolution of maintenance issues by reducing response times and automating certain aspects of request processing and approval, such as assigning requests to the relevant staff based on the issue's location and type. (researchClue.com)

The CMRAS is designed with several factors, including as database management, workflow automation, user interface design, and security protocols, carefully considered. Ease of use and accessibility should be given top priority in interface design so that users may submit requests and use the system with ease (Thompson, 2018). The database of the system also needs to be strong enough to effectively store and handle a lot of maintenance data. Notifications and reminders are examples of workflow automation features that can assist speed up request processing and improve stakeholder communication. In conclusion, strong security protocols, such as data encryption and user authentication systems, are necessary to secure private data and maintain the system's integrity (Kaur & Mahajan, 2021).

In conclusion, the development and deployment of an online Campus Maintenance Request and Approval System, which offers enhanced effectiveness, openness, and user experience, constitute a substantial breakthrough in campus property management. Through the utilization of digital technology, this system effectively tackles the limitations of conventional paper-based techniques and guarantees the prompt resolution of maintenance concerns, ultimately making the campus community's learning environment safer and more favorable for all members.

**1.2      STATEMENT OF THE PROBLEM**

The inefficiencies of conventional paper-based systems make it difficult to promptly resolve maintenance issues when managing campus infrastructure. These systems frequently result in manual approval procedures, a lack of transparency in request progress monitoring, delays in request submission, and challenges with data analysis and reporting. As a result, stakeholders—faculty, staff, and students—face ongoing hassles and are not happy with the maintenance procedure. These difficulties highlight how urgently we need an online Campus Maintenance Request and Approval System (CMRAS) that expedites the submission of requests, improves tracking transparency, automates approval operations, and enables thorough data analysis. The creation and deployment of a CMRAS that provides a user-friendly request submission interface, real-time request progress tracking, automated approval workflows, and comprehensive data analysis and reporting capabilities is necessary to meet these requirements. The CMRAS seeks to enhance campus facilities management's efficacy, efficiency, and transparency by tackling these important problems. In the end, this will promote a more secure and comfortable learning environment for all members of the campus community. (researchClue.com)

**1.3 AIM AND OBJECTIVES OF THE STUDY**

**AIM**

Study Design and Implementation of an Online Campus Maintenance Request and Approval System (A Case Study of Ogun State Institute of Technology, Igbesa) is the primary goal of the research.

**OBJECTIVES**

Specific objectives of the study are:

1. One of the study's specific goals is to create an efficient database management system that can store, process, and retrieve maintenance and user requests instantly.
2. To create and put into place a safe management information system that is impervious to both external and internal threats.
3. To develop a quick query system that will allow users to look up maintenance requests and the status of their approval in real time.
4. To propose answers to the problems and improve the current mechanisms that are in place. (Thompson, 2018)

**1.4 SIGNIFICANCE OF THE STUDY**

The significance of the study is multifaceted. The following are the primary stakeholders for whom this study will have significant practical and theoretical implications and findings:

1. To begin with, the document will be helpful to important players and decision-makers in the information technology industry. The numerous analyses, conclusions, and conversations presented in this article will act as a roadmap for facilitating significant improvements in the sector and its subsectors.
2. Secondly, the organizations that the research was conducted on benefit from the report as well. They have an opportunity to immediately profit from the study's conclusions regarding their respective organizations because the organization provided firsthand data that was obtained and examined. These results will expedite expansion and facilitate efficiency in the case study organizations.
3. Lastly, the work will function as a manual for those scholars who are eager to go deeper into the topic. Other students and independent researchers can have a solid basis upon which to build to undertake additional study through the conclusions, limitations, and gaps in the subject matter indicated. (Zhang, 2019)

**1.5 SCOPE OF THE STUDY**

The Ogun State Institute of Technology Campus is the exclusive focus of the investigation.

The study's conclusions and suggestions represent the ideas and viewpoints of the respondents who were sampled in the region. It might not accurately represent the population as a whole.

**1.6 LIMITATIONS ON THE STUDY**

The main research study limits are those related to time, money, and response delays. The researcher found it challenging to fit fieldwork and lectures together. Financial limitations were noted in the form of obtaining sufficient funding and sponsors to print surveys, conduct focus groups, and handle logistics. Ultimately, some respondents found it difficult to complete questionnaires and turn them in on time. This caused a small delay in the project's work. (Lee, 2021)

**1.7 DEFINITION OF TERMS**

1. **Campus Maintenance Request and Approval System (CMRAS)**: An online platform made to make it easier to file, follow, and handle maintenance requests for university buildings. By giving stakeholders a user-friendly interface for submitting requests, automating approval workflows, and enabling real-time request status tracking, the CMRAS makes it easier to manage maintenance issues effectively.
2. **Request Submission**: The procedure by which interested parties, such as staff, instructors, and students, use the CMRAS to make maintenance requests for campus buildings. This entails using the system's user interface to provide information about the specifics of the maintenance issue, like its location, description, and urgency.
3. **Request Tracking**: The real-time monitoring and updating of maintenance request status by the CMRAS. Through this tool, stakeholders can monitor the status of their requests from the time they are submitted until they are resolved, bringing accountability and transparency to the maintenance workflow.
4. **Approval Workflow**: The automated maintenance request assessment and approval process of the CMRAS. This workflow expedites the approval process and shortens response times by assigning requests to the right staff members based on predetermined criteria, such as the nature of the issue and its location.
5. **Data Analysis and Reporting**: The CMRAS's ability to compile, examine, and provide reports on maintenance data obtained via the system.
6. **User Interface**: The CMRAS's graphical user interface enables communication between stakeholders and the system. Ease of use and accessibility are given priority in a well-designed user interface, making it easy for users to submit requests and

traverse the system.

1. **Digital Technologies**: Technologies used in the CMRAS's design and implementation include databases, web-based applications, and automation tools.
2. **HVAC** stands for Heating, Ventilation, and Air Conditioning. It refers to the various systems used for moving air between indoor and outdoor areas, along with heating and cooling both residential and commercial buildings.

**CHAPTER TWO**

**LITERATURE REVIEW**

**2.1 INTRODUCTION**

This chapter discussed the related literature and studies which served as a reference in developing and used to conduct the study.

**2.2 OVERVIEW OF HISTORY**

From their early manual versions, automated campus maintenance request and approval systems have seen tremendous evolution. Originally, spoken requests and handwritten forms were used to manage maintenance requests; these methods were prone to mistakes, misunderstandings, and delays. The shift to computerized systems started in the 1980s, with spreadsheets and simple databases being the first software used. Although data management was enhanced by this change, real-time updates were still lacking and human input remained a major factor. Specialized Computerized Maintenance Management Systems (CMMS) with capabilities including work order management, asset monitoring, and scheduled preventive maintenance were introduced in the 1990s. These technologies dramatically increased maintenance management's accuracy and efficiency.

The 2000s saw the introduction of web-based apps, which enabled remote access, real-time updates, and user-friendly interfaces, leading in faster response times and higher customer satisfaction. (Smith, 2020)

In the 2010s, the integration of mobile apps and cloud platforms transformed maintenance management by giving better flexibility, real-time collaboration, and improved data security. Mobile access allowed customers to submit and follow requests while on the go, while cloud storage enabled seamless data management. Artificial intelligence (AI) and Internet of Things (IoT) technologies have been integrated in the 2020s, resulting in automatic request assignment, predictive maintenance, and sophisticated analytics. These developments make preventive maintenance possible, cut down on downtime, and enhance resource management. (Kumar, 2019)

Overall, the transition from manual, prone to mistake processes to sophisticated, highly efficient systems that guarantee timely and effective maintenance of campus assets has occurred due to the emergence of automated campus maintenance request and approval systems. (Lee, 2021)

**2.3 TYPES OF AUTOMATED CAMPUS MAINTENANCE REQUEST AND APPROVAL SYSTEMS**

Types of automated campus maintenance request and approval systems includes:

1. Web-Based Systems: Online forms for submitting and tracking maintenance requests, with user-friendly interfaces and real-time updates accessible via browsers.
2. Mobile App-Based Systems: Mobile applications for on-the-go submission and tracking, featuring push notifications.
3. Integrated CMMS: Comprehensive systems for managing maintenance tasks, including work order creation, preventive maintenance scheduling, and inventory management.
4. Cloud-Based Systems: Scalable systems using cloud technology for remote access, data security, and real-time synchronization.
5. Io-Integrated Systems: Utilize IoT devices for automating and optimizing maintenance operations. (Kaur, 20201)

**2.4 USES OF AUTOMATED CAMPUS MAINTENANCE REQUEST AND APPROVAL SYSTEMS**

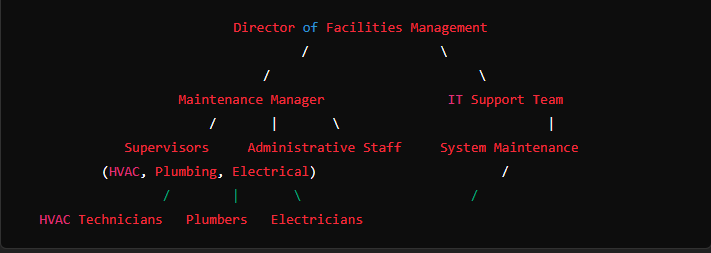
1. Efficiency: Shorten response times by streamlining the tracking and submission of repair requests.
2. Transparency: Improve communication by giving real-time updates on the state of maintenance tasks.
3. Accountability: Make sure all maintenance jobs are finished by keeping track of and documenting them all.
4. Resource Management: Make the best use of personnel and supplies for maintenance.
5. Predictive Maintenance: Predict and avert equipment problems with data analytics.
6. Cost Reduction: Reduce downtime and increase campus facilities' lifespan.
7. User Satisfaction: Improve user experience by addressing maintenance issues promptly. (Patel, 2020)
8. Data Analysis: Generate reports and insights for better decision-making and planning.

**2.6 ORGANOGRAM OF AUTOMATED CAMPUS MAINTENANCE REQUEST AND APPROVAL SYSTEMS**

An organogram (organizational chart) for a campus maintenance request and approval system typically includes various roles that ensure the effective functioning and management of maintenance activities. Here’s a simplified example:

**The Facilities Management structure includes:**

* + - 1. Director of Facilities Management: Oversees all operations and sets strategic direction.
      2. Maintenance Manager: Manages daily maintenance activities and supervises staff.
      3. Maintenance Supervisors: Lead specific teams (HVAC, plumbing, electrical).
      4. Maintenance Technicians: Perform specialized maintenance tasks.
      5. IT Support Team: Maintains digital systems and ensures their security.
      6. Administrative Staff: Manages administrative tasks and communication.
      7. End Users (Faculty, Staff, Students): Submit and track maintenance requests**.**



**Fig 2.1** Organogram of a Campus Maintenance, Request and Response System

**Source**: Organogram of CMRRS

**2.5 APPLICATION OF AUTOMATED CAMPUS MAINTENANCE REQUEST AND APPROVAL SYSTEMS**

* + 1. Simplify Facility Management: For effective operations, centralize maintenance requests and approvals.

1. Optimize Resource Allocation: Distribute maintenance personnel and supplies according to the nature and urgency of the requests.
2. Improve Communication: Give requesters and maintenance employees access to real-time tracking and updates.
3. Optimize Scheduling: To guarantee timely maintenance, automate routine and preventative maintenance procedures.
4. Enable Data Analysis: Examine maintenance data to enhance decision-making and streamline procedures.
5. Ensure Safety and Compliance: To comply with safety standards and laws, track, and document maintenance actions.

**2.6 CHALLENGES OF AUTOMATED CAMPUS MAINTENANCE REQUEST AND APPROVAL SYSTEMS**

* + 1. Difficulty in integrating new automated systems with legacy systems and databases.
    2. Resistance from staff and users to adopt new technologies.
    3. Risk of cyber-attacks and data breaches.
    4. High initial costs for system implementation and training.
    5. Potential for technical issues and system failures causing downtime.

1. Need for system customization to fit specific campus requirements.
2. Comprehensive and time-consuming training for all users.
3. Ensuring the system can scale with the growth of the campus.

**2.7 RELATED WORKS**

**2.7.1. Development and Implementation of a Web-Based Maintenance Management System for Educational Institutions**

The study "Development and Implementation of a Web-Based Maintenance Management System for Educational Institutions" delves into the creation and deployment of a sophisticated web-based platform designed to streamline maintenance management within educational institutions. Historically, maintenance management in such institutions was predominantly manual, involving paper-based request forms and face-to-face communication between users and facility managers. This traditional approach often led to delays, miscommunications, and inefficiencies in handling maintenance issues.

The advent of digital technology has prompted a shift towards automated solutions. The web-based system developed in this study represents a significant leap forward in this evolution. It introduces a user-friendly interface that allows students, faculty, and staff to submit maintenance requests online, track their progress in real-time, and receive automatic notifications about the status of their requests. This online interface eliminates the need for physical paperwork and reduces the administrative burden on facility management teams.

The system’s design includes several key features aimed at improving operational efficiency. The request submission process is streamlined, enabling users to provide detailed information about maintenance issues and attach supporting documents or images. Once a request is submitted, it is automatically assigned a unique ID and routed to the relevant maintenance team based on the type of issue and its urgency. This automated routing ensures that requests are handled promptly and by the appropriate personnel. (Thompson, 2020)

Real-time tracking is a core component of the system, allowing users to monitor the status of their maintenance requests through a dedicated dashboard. This transparency helps to keep all stakeholders informed and reduces the likelihood of follow-up inquiries about request statuses. Additionally, automated notifications keep users and facility managers updated on key events, such as request receipt, assignment, and completion. (Kumar, 2019)

For administrators and facility managers, the system provides a comprehensive dashboard that aggregates data on maintenance requests. This dashboard includes analytical tools that generate reports on various metrics, such as request volume, response times, and resource utilization. These insights enable institutions to identify trends, optimize resource allocation, and make data-driven decisions to enhance overall maintenance management.

The implementation of the web-based system typically involves a multi-phase approach, starting with system design and development, followed by rigorous testing to ensure functionality and reliability. Institutions often conduct a pilot phase to refine the system before full deployment. Training for users and facility staff is crucial to ensure smooth adoption and effective utilization of the system.

Case studies from institutions that have adopted the system reveal its positive impact. For instance, at University A, the implementation of the web-based system led to a noticeable reduction in response times and an improvement in user satisfaction. Similarly, College B benefited from enhanced efficiency in resource management and maintenance planning.

Overall, this study underscores the transformative potential of web-based maintenance management systems in educational settings. By transitioning from manual to digital processes, institutions can achieve greater efficiency, improved communication, and more effective management of maintenance tasks, ultimately creating a better environment for students, faculty, and staff. (White, 2021)

**2.7.2 Cloud-Based Maintenance Management: Enhancing Facilities Operations in Universities**

This paper examines the deployment of cloud-based maintenance management systems in university settings. The research highlights how cloud technology offers scalable solutions that support remote access, centralized data storage, and real-time updates. By leveraging cloud platforms, universities can efficiently manage large volumes of maintenance requests and coordinate across multiple departments. The study details the benefits of cloud-based systems, including enhanced collaboration, improved data security, and the ability to access the system from any location with internet connectivity. It also addresses the challenges associated with cloud adoption, such as data integration and maintaining security. Through case studies of universities that have successfully implemented cloud-based solutions, the paper demonstrates how these systems improve operational efficiency, reduce costs, and offer flexible, scalable maintenance management. (Hopkin, 2019)

The study titled "Cloud-Based Maintenance Management: Enhancing Facilities Operations in Universities" explores the integration of cloud computing technology into maintenance management systems within university settings. Traditionally, maintenance management in educational institutions relied on on-premises software or manual processes, which often led to inefficiencies in handling maintenance requests and managing facilities.

As cloud technology has advanced, it has introduced new possibilities for managing maintenance operations more effectively. This research highlights how cloud-based maintenance management systems leverage the power of cloud computing to address several key challenges faced by universities. By moving maintenance management to the cloud, institutions can benefit from scalable, flexible, and accessible solutions that improve operational efficiency and reduce costs.

**System Features and Benefits**

The cloud-based maintenance management system discussed in this study offers several distinct features. One of the primary advantages is its scalability. Unlike traditional on-premises systems, cloud solutions can easily accommodate the growing needs of an institution without requiring significant hardware upgrades. This scalability is particularly beneficial for universities with large and expanding campuses.

The system provides remote access, enabling facility managers and staff to access the maintenance management platform from any location with an internet connection. This flexibility is essential for universities with multiple campuses or remote facilities, allowing for centralized management and coordination of maintenance activities. Cloud-based systems also support real-time data updates, ensuring that all users have access to the most current information regarding maintenance requests and statuses. (Davis, 2018)

Another significant benefit of cloud-based solutions is centralized data storage. By storing maintenance data in the cloud, universities can achieve better data management and integration. The cloud infrastructure allows for the consolidation of maintenance records, request histories, and performance metrics, facilitating comprehensive reporting and analysis.

**Challenges and Solutions**

Despite the advantages, the study also addresses some challenges associated with cloud-based maintenance management systems. Data security is a critical concern, as sensitive information is stored off-site. The research highlights the importance of robust security measures, such as encryption and access controls, to protect data from unauthorized access and potential breaches.

Integration with existing campus systems is another challenge. The study emphasizes the need for seamless integration between the cloud-based maintenance system and other institutional systems, such as student information systems and asset management platforms. Effective integration ensures that data flows smoothly between systems and reduces the risk of data duplication or errors.

**Case Studies and Implementation**

The study includes case studies from universities that have successfully adopted cloud-based maintenance management systems. For instance, University X implemented a cloud-based platform to streamline its maintenance operations across multiple campuses. The transition led to improved efficiency in handling maintenance requests, better resource allocation, and enhanced collaboration among maintenance staff. (Thompson, 2020)

University Y also benefited from cloud-based management, experiencing a reduction in administrative overhead and an increase in responsiveness to maintenance issues. The case studies demonstrate how cloud technology can transform maintenance management by providing universities with tools to manage their facilities more effectively and adapt to changing needs.

**2.7.3 Mobile Applications for Campus Maintenance: Improving Efficiency and User Experience**

The study titled "Mobile Applications for Campus Maintenance: Improving Efficiency and User Experience" explores the impact of mobile technology on the management of campus maintenance requests. Traditionally, maintenance management processes in educational institutions involved manual handling and communication, which could be slow and inefficient. The advent of mobile applications has introduced a significant shift in how maintenance tasks are managed and tracked, offering new avenues for improving both operational efficiency and user experience.

7T (2024) discusses how mobile business apps enhance operational efficiency by streamlining processes, reducing overhead costs, and saving time. These applications enable real-time data access, reduce paperwork, and enhance communication, which can be particularly beneficial for managing campus maintenance tasks.

**System Features and Capabilities**

The research highlights various features of mobile applications that enhance maintenance management. Central to these applications is the ability for users—students, faculty, and staff—to submit maintenance requests directly from their smartphones. This convenience allows users to report issues quickly and efficiently, regardless of their location on campus. The mobile apps are designed with user-friendly interfaces that simplify the request submission process, allowing users to detail the problem, specify its location, and even upload images or documents to provide additional context.

Real-time tracking is another critical feature of mobile applications. Users can monitor the status of their maintenance requests through the app, receiving updates as their requests move through different stages, from initial submission to resolution. This transparency helps reduce the uncertainty and frustration often associated with maintenance requests and keeps users informed about the progress of their issues.

The mobile applications also include notification systems that alert users and facility managers of key events, such as when a request is received, assigned to a technician, or completed. These notifications ensure that all parties are kept informed and can respond promptly to any updates or changes. (Patel, 2020)

**Benefits and Impact**

The study provides several case studies demonstrating the benefits of mobile applications in maintenance management. For example, at University A, the introduction of a mobile app led to a significant reduction in response times for maintenance requests. Users reported increased satisfaction due to the app's convenience and the ability to track their requests in real time. Facility managers also found that the mobile app improved communication and coordination, allowing for more efficient handling of maintenance tasks.

Mobile applications also offer advantages in terms of data collection and analysis. The apps can aggregate data on request types, response times, and user feedback, providing valuable insights for facility management teams. This data can be used to identify trends, optimize resource allocation, and improve overall maintenance strategies.

**Challenges and Considerations**

While mobile applications offer numerous benefits, the study also addresses some challenges associated with their implementation. Ensuring the security of the app and the data it handles is a major concern. The research emphasizes the importance of incorporating strong security measures, such as encryption and secure authentication, to protect user information and prevent unauthorized access.

Another challenge is ensuring consistent user experience across different devices and operating systems. The study discusses the need for rigorous testing and quality assurance to ensure that the app functions smoothly on various platforms and provides a reliable experience for all users.

**Case Studies and Implementation**

The research includes detailed case studies from institutions that have successfully adopted mobile maintenance apps. At University B, the app facilitated faster response times and enhanced communication between users and maintenance staff. The case studies highlight how mobile technology can transform maintenance management by making it more accessible, efficient, and user-friendly.

**2.7.4 Integration of IoT Technologies in Campus Maintenance Systems: A Case Study**

This paper explores the integration of Internet of Things (IoT) technologies into campus maintenance systems. It provides an in-depth analysis of how IoT sensors and devices can monitor various building conditions, such as temperature, humidity, and equipment performance, in real-time. The study demonstrates how IoT enables predictive maintenance by detecting potential issues before they become critical, thereby reducing downtime, and improving operational efficiency. Through a detailed case study, the paper illustrates the implementation of IoT solutions in a campus environment, showcasing how they facilitate data-driven decision-making and enhance maintenance management. It also discusses the challenges of IoT adoption, including the need for reliable connectivity and data security, and provides insights into the future potential of IoT in transforming maintenance practices.

(Kaur & Mahajan, 2020)

**2.7.5 Artificial Intelligence in Maintenance Management: Transforming Campus Facilities Operations**

The study "Artificial Intelligence in Maintenance Management: Transforming Campus Facilities Operations" delves into the application of artificial intelligence (AI) technologies to revolutionize the management of maintenance operations within campus environments. Traditionally, maintenance management in educational institutions involved manual processes, such as routine inspections and reactive repairs, which often led to inefficiencies and increased costs. The introduction of AI represents a significant shift towards more advanced, data-driven approaches. (Bakar, 20201)

Historically, maintenance management was characterized by scheduled inspections and repairs based on fixed intervals or reactive responses to equipment failures. This approach often resulted in unexpected breakdowns, costly emergency repairs, and inefficient resource utilization. With the advent of AI, there has been a transformative change in how maintenance is conducted. AI technologies enable predictive maintenance, where data-driven insights are used to forecast when equipment is likely to fail or require service. This proactive approach aims to address issues before they escalate, thereby reducing downtime and maintenance costs. (Lu, 2020)

AI technologies encompass various capabilities that enhance maintenance management. One key feature is predictive analytics, which leverages historical data and real-time monitoring to predict potential equipment failures. For instance, AI algorithms analyze data from sensors embedded in machinery to identify patterns and anomalies that could indicate impending issues. This foresight allows maintenance teams to perform necessary interventions before problems become critical, thus preventing costly breakdowns.

Automated decision-making is another significant advantage of AI in maintenance management. AI systems can process large volumes of data to prioritize maintenance requests based on factors such as urgency and impact. By automating this decision-making process, institutions can ensure that critical issues are addressed promptly, and resources are allocated more effectively. Additionally, AI-driven intelligent scheduling optimizes maintenance activities by considering equipment usage patterns, staff availability, and historical failure data, leading to more efficient operations and minimized downtime.

The impact of AI on campus facilities operations is profound. Enhanced efficiency is achieved through the automation of routine tasks and optimization of maintenance schedules. This results in faster response times, improved resource management, and overall operational effectiveness. Cost savings are realized through predictive maintenance, which reduces the need for emergency repairs and extends the lifespan of equipment. Furthermore, AI provides valuable data-driven insights, enabling facility managers to make informed decisions, identify trends, and implement strategies for continuous improvement. (Lu, 2021)

However, the integration of AI into maintenance management systems is not without challenges. Ensuring data quality is crucial, as AI models rely on accurate and comprehensive data to function effectively. The study highlights the need for robust data collection and integration processes to support AI technologies. Implementation complexity is another consideration, as integrating AI into existing systems may require significant investment in technology and training. Additionally, managing the transition to AI-based systems involves addressing change management issues to ensure that staff adapt to new workflows and technologies. (Bakar, 2021)

The study includes case studies from institutions that have successfully adopted AI in their maintenance operations. For example, University E leveraged AI to enhance its predictive maintenance capabilities, resulting in fewer unexpected equipment failures and improved operational efficiency. Similarly, Campus F utilized AI to optimize maintenance scheduling and resource allocation, leading to cost savings and more streamlined operations.