

## DIGITALISED FACILITIES ASSET MANAGEMENT: A CASE STUDY

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**Abstract.** Building assets constitute a substantial financial investment, often amounting to millions of dollars in business accounts. Effective management of these assets is essential, as their deterioration or failure can disrupt core facility operations and lead to significant repair and replacement costs. Digital tools have become integral to optimizing asset conditions, ensuring safety, and enhancing serviceability. In recent years, there has been a trend where condition assessment (CA) practices are relied on software applications to streamline their processes. This paper examines the impact of digitalizing CA processes, which is one of the core functions of asset management in buildings, through a computerized system using a real-world case study. The CA system was implemented in a university building as a demonstration case to assess the efficiency and cost-effectiveness of the digital process. The findings from this study aim to equip asset managers with the knowledge and confidence to transition to digital asset management systems, ultimately improving operational efficiency and overall asset performance

**Keywords.** Asset Management, Condition Assessment, Digital, Computerised Systems

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### 1. Introduction

Building assets represent a significant financial investment, often valued at millions of dollars in the business accounts (International Infrastructure Management Manual (IIMM), 2021). These assets require substantial effort for maintenance, with annual maintenance costs accounting for approximately 50% of total expenditures (Ismail, 2019). The management of building assets is crucial, as their failure or deterioration can significantly disrupt the core functions of a facility and leading to increased repair and replacement costs. Besides, ensuring the long-term performance of assets is vital for sustainable operation. However, despite its critical importance, asset management (AM) regularly receives insufficient attention in many organizations.

AM is a complex and systematic process particularly when managing the built assets or buildings., AM involves planning, controlling, and optimizing asset-related activities to maintain operational efficiency and extend asset lifespan (Al-Kasasbeh et al., 2021). It is a systematic process of developing, operating, maintaining, upgrading, servicing, and disposing of assets cost-effectively (International Organisation for Standardisation (ISO),2014). Many strategies are being developed to optimise the AM process. The effective AM strategies are designed to achieve the required level of service while minimizing the cost of operation (IIMM, 2021). Besides, This process is fundamentally to oversee the assets throughout their entire lifecycle, rather during their initial phase or usage.

Nevertheless, AM encompass multidisciplinary activities within the lifecycle of the assets that is devised to optimise the performance of the asset/facility. Condition assessment (CA) of assets is one of the core functions of AM that focuses on securing the long lifespan of the assets and its performance (Moretti et al., 2021). Maintenance, financial and future planning are other functions that are integral part of this role.. In present, CA process is often implemented within organizations but is not actually incorporated with strategic-level decisions to achieve proactive benefits. Conventional AM approaches have been widely complained for their inefficiencies, particularly results in frequent defects, increased reactive maintenance and high maintenance costs (Ismail, 2019). Most CA activities are currently performed manually and have not been digitalized. Additionally, the absence of a centralized and real time database with whole lifecycle asset information poses a significant challenge, for asset related decisions such as maintenance, condition, and performance prediction (Al-Kasasbeh et al., 2021). The dependence on manual

and semi-automated approaches has constrained the efficiency of the process, highlighting the need for a shift toward digital or computerized solutions.

In recent years, AM in particular CA has been relied on digital applications to enhance its processes. CA are supported by various digital tools such as AM systems, Building Information Modelling (BIM), Digital Twins (DT), and Artificial Intelligence (AI) (Wijeratne et al., 2024). These tools play a crucial role in optimizing asset conditions, ensuring safety, and improving serviceability (Salem & Elwakil, 2023). By leveraging real-time data and digitalization, modern CA process provide more accurate and timely asset evaluations than traditional manual methods. Various digital platforms not only facilitate inform decisions and data storage but also integrated with maintenance and financial process thereby reducing the likelihood of unexpected failures, reducing associated costs and enhancing the efficiency (Re Cecconi et al., 2017). Despite the increasing availability of software solutions, there are limited studies on a standardized approach for implementing digital Asset Management System (AMS) to perform the CA of the assets within the building. Thereby, this paper aims to explores the impact of digitalizing CA processes through AMS. A digital CA system is introduced and implemented as a demonstration to an educational building. This enabled the evaluation of the impact of digital solutions compared to the manual approach. The study enhances the efficiency of CA methods and contributes to improved asset performance and sustainability. The paper is structured as follows: first, a literature review on the digitalization of AM practices is provided, followed by the research methodology. The findings are then analyzed and discussed, leading to the conclusion. The study's outcomes aim to empower asset managers with the confidence to digitalize their AM processes, enhancing efficiency and effectiveness.

## **2. Digitalised Asset Management Systems**

### **2.1 ASSET MANAGEMENT**

The AM is the systematic and coordinated practices of an organisation to aimed at optimally and sustainably achieving its objectives through the cost-effective management of assets throughout their lifecycle (IIMM, 2021). ISO 55001 is the designated standard for AM and has been published in three documents for overall assets in an entity. ISO defines AM *"as a systematic and coordinated activity through which an organization realizes value from its assets in delivering its objectives"* (ISO 2014). It emphasizes the importance of integrating AM into strategic planning to ensure efficiency, sustainability, and long-term performance of assets. IIMM (2021) highlighted key principles of AM as 1) providing a defined level of services that meets stakeholders needs, monitoring performance in relation to those level of services, 2) managing the impact of demand changes through demand management, infrastructure investment and other strategies 3) taking a lifecycle approach to developing cost-effective management strategies for the long term that meet that defined level of services 4) identifying, assessing and appropriately controlling risks and 5) a long term financial. In the building, AM is more complex due to the management of large number of complex and diversified assets and their component: element to the detail level.

The functions of AM encompass a range of activities aimed at enhancing asset performance, minimizing risks, and ensuring long-term value creation. Key functions include: (ISO 55000, 2014, Campbell et al. (2016), IIMM,2021,(Matos et al., 2022), (Salem & Elwakil, 2023)

1. Asset Lifecycle Management – Managing assets from acquisition to disposal, ensuring their optimal use throughout their lifecycle
2. Condition assessment: Assets were rated on a predefined scale to determine their current condition and predict their useful life

3. Maintenance and Reliability Management – Implementing preventive and predictive maintenance strategies to enhance asset longevity and reduce failures
4. Strategic Planning and Decision-Making – Aligning asset management with organizational objectives to support long-term value creation
5. Risk Management – Identifying, assessing, and mitigating risks associated with asset performance, reliability, and sustainability
6. Performance Monitoring and Optimization – Using real-time data, key performance indicators (KPIs), and predictive analytics to improve asset efficiency
7. Financial and Cost Management – Ensuring cost-effective investments, budgeting, and resource allocation for asset operations
8. Data and Information Management – Developing centralized and reliable databases to store historical as-built information for better decision-making

AM is an interdisciplinary field that has been developed to enhance and optimize the management of assets throughout their lifecycle. However, this study mainly focuses on the CA process. The CA process is typically physical inspection conducted to assess the current state of a building and estimate the extent of its deterioration (Faqih & Zayed, 2021). The assessment typically begins at the component level, where each element is rated using a predefined scale, and then an overall building condition value is derived (Lupășteanu et al., 2022). Visual inspection is the primary tool used in this process, although several other testing methods are employed to rank the condition of building elements. Finally, a report is generated that integrates the expected lifespan of each building element along with financial planning and other relevant considerations (Faqih & Zayed, 2021). In general, CA is conducted every 2 to 3 years and mostly a manual process. CA generates and requires vast amounts of data and relies on real-time information for informed decision-making on asset lifecycle (Al-Kasasbeh et al., 2021). Given the frequent handling of large datasets, it is important to use computerised methods to ensure efficiency, accuracy, and consistency in the assessment process. However, with technological advancements, many have transitioned to a digital approach.

## 2.2 DIGITALISED AM APPLICATIONS

Asset managers have transitioned from manual systems to computerized systems and, more recently, into a complete digitalized environment. Most AM functions now employed computerized systems, enhancing the operation. In catering to this demand, several commercialized software solutions have been introduced in the field to support AM functions. Here, the computerised systems related to both AM and FM functions are identified as both terms are generally used interchangeably. The most common digital and computerised platforms widely used in the practice are Computerized Asset Management systems (CAMS), Computerized Maintenance Management Systems (CMMS), Computerized Facilities Management (CFM) systems, and Computer-Aided Facilities Management (CAFM) systems. The CFM and CAFM are included as AM falls within the broader scope of FM.

CMMS was introduced in 1960s and later in reevaluated with many features. This is one of the key software applications acts as a repository of information or data related to maintenance concepts, asset counts, spare parts, personnel information and planning methods (Mohd Noor et al., 2021). CMMS capture, store, retrieve and transmit data and information related to maintenance procedures for equipment, plant and infrastructure (Amadi-Echendu & de Wit, 2015). CMMS helps in better management of the maintenance activities (Ismail, 2019). CMMS includes functions such as equipment data management, maintenance preventive/predictive, human resource, work order and complaint system, maintenance scheduling and planning,

inventory management, procurement, financials (Campbell et al., 2016; Mohd Noor et al., 2021). These applications help in optimising the AM activities and make informed decisions. Mainly CMMS support in reducing downtime and frequency of failures of the machines by improving the efficiency and effectiveness of the maintenance force (Ismail, 2019).

Similarly, computer-aided facilities management (CAFM) has emerged to improve the usability of the activities. CAFM systems gather and archive information on buildings facilities, creating a comprehensive database of asset information (Tuan Ibrahim & Mariah, 2022). CAFM offers functions such as reactive maintenance, planned preventative maintenance management, space and move management, resource scheduling (Wong et al., 2018). Wijeratne et al. (2024) highlighted that FM platforms including CAFM and CMMS, provides functions such as asset life cycle and maintenance management and provide greater efficiencies for asset maintenance and replacement scheduling, OPEX and CAPEX predictions via better data availability, Forming work order, Assimilating energy use with the building performance and Hazards management and disaster review. CMMS and CAFM software applications help in manage and record information of daily operations of an organization as in database. This helps in analyzing the current trend and predicting future aspects of the asset performances.

Salem and Elwakil (2023) prioritised that digital tools have been assisted in asset inspections, fund allocation and asset prioritization decisions. The authors noted that most of these systems are simple condition monitoring criteria based on the current condition of the assets. As Al-Kasasbeh et al. (2021), an accurate and well-developed building inventory serves as a powerful tool for asset condition monitoring, enabling proactive maintenance strategies and informed decision-making. By maintaining comprehensive and up-to-date asset records, organizations can enhance efficiency, extend asset lifespan, and optimize resource allocation. Computerized Asset Management (CAM) tools enable data-driven decision-making and, more importantly, provide a centralized database to organize all asset related information. This structured approach enhances decision making processes, improves asset performance tracking, and supports proactive maintenance strategies. Further, IIMM (2021) described AM information system as a computer-based tool which supports AM functions. The system enabled to store large quantities of asset data coupled with complex analysis and reporting functions. According the IIMM (2021), this provides functions such as asset register, performance management, financial management, maintenance management, strategic planning, risk management, capital investment planning and project management requirement. Similarly, CAM systems has assisted in many ways to perform the CA of the assets while these applications embedded with various features.

Building Information Modeling (BIM) has been widely proposed as a technology to support AM in various ways. Numerous studies have explored the integration of BIM with AM functions, demonstrating its potential to enhance asset performance by improving data accessibility, streamlining maintenance processes, and enabling more efficient decision-making throughout the asset lifecycle. Ismail (2019) proposed a model for integrating BIM technology for defect diagnosis, reduce maintenance requirement by identifying condition index and provide details in the best course required for maintenance and in the selection of materials and methods for the repair of IBS. Re Cecconi et al. (2017) proposed a BIM integration to leveraging space management, management of rooms occupancy, management of mechanical equipment status; qualitative condition assessment of buildings; and appraisal of the service life of building components. Al-Kasasbeh et al. (2021) proposed BIM based AM for strategic decision making including a wide range of functionalities, including the accurate acquisition, storage, processing, and reporting of asset information promptly. It has also increased operational efficiency by aiding in the planning, execution, and coordination of maintenance operations. BIM plays an important role, once it facilitate multi-disciplinary coordination, gather information and enable information accessibility, which can be used to support AM (Matos et al., 2022). Despite the BIM, industry 4.0 technologies such as internet of things (IoT), Digital Twin (DT), Augmented reality (AR),

Virtual reality (VR) and Artificial intelligence (AI) has been integrated into the AM applications creating more digital platforms for better AM functions.

However, in practice, most available tools are not delivering a holistic software solution covering all AM functions. Most tools are implemented for maintenance management of the facility. Ismail (2019) observed that many maintenance management systems place little emphasis on decision-making and asset defect diagnosis. It is also argued that the full functionality of CAMMS is not being utilized in practice. Majority of the CA software applications offers ratings options for building elements and the overall asset, facilitating data storages and a limited analysis that go beyond predicting service life and cost. Accordingly, many facilities implement these systems but fail to leverage their advanced capabilities, limiting their potential benefits in optimizing asset performance and decision-making (Campbell et al., 2016). Similarly, Wong et al. (2018) highlighted that while many FM software applications share similar asset and maintenance management functions, they often fail to address the full diversity of the requirements. Furthermore, the impact of technology implementation on the overall efficiency of the system has not been clearly identified. While various digital tools for CA functions have been introduced, there is limited research on how effectively these technologies contribute to optimizing workflows, improving decision-making, and enhancing overall asset performance. This gap highlights the need for further studies to assess the real-world benefits and challenges of integrating technology into asset and facilities management

### **3. Methodology**

This study employs a case study approach to examine the implementation of a computerised digital Asset Management (AM) system in a university facility. Case study research is particularly useful for investigating real-world applications within their contextual settings, allowing for an in-depth analysis of CA challenges and the impact of digital solutions (Yin, 2018). A state university with a 25-acre physical footprint, six faculties, 35 departments, and nine centers was selected as the case institution. The university's facilities management team currently oversees CA process.

The CA is performed to a four-storey building in the university premises. The assessment specifically focuses on ten rooms located on the third and fourth floors of the building given its complexity. These rooms represent diverse functional areas, encompassing administrative spaces, teaching facilities, and communal areas. The selected rooms on the third floor include the Department Office (Room 1), AV Studio (Room 2), Graphic Design Studio (Room 3), Computer Lab 01 (Room 4), and the Corridor (Room 5). These spaces serve academic and operational purposes, making them suitable for assessing asset management efficiency across different functions. On the fourth floor, the Auditorium (Room 6), Staffroom 1 (Room 7), Staffroom 2 (Room 8), Common Classroom (Room 9), and Corridor (Room 10) were selected. These rooms accommodate both educational and administrative activities, making their condition and performance critical to the building's overall functionality.

#### **3.1 DATA COLLECTION TECHNIQUE AND ANALYSIS**

The primary data collection technique used in this study is visual inspection observation, a method widely employed in CA practices to assess infrastructure conditions and maintenance needs (Patton, 2015). Observations were conducted to evaluate the general condition of the building, with a focus on identifying critical defects that require immediate attention and developing predictive insights for long-term maintenance and budget planning. The implementation of the digital AM system followed a structured process to ensure systematic asset inspection, data entry, analysis, and reporting. The process began with introducing the system to the data collection team (five members), providing training on asset entry, inspection protocols, and report generation. A comprehensive asset inspection was conducted within

selected rooms on the third and fourth floors, assessing existing defects and maintenance needs. Asset details were then entered into the system, where each asset was assigned a unique identification (ID) for tracking. The team identify the severity and condition of each building components according to the set instructions. The instructions were defined in the computerised systems. A severity rating (1–3 scale) was used to categorize asset conditions, while a defect level rating (1–4 scale) was assigned based on expert assessments. Images of defects were captured and uploaded for documentation. Finally, the system generated detailed reports highlighting asset conditions, maintenance priorities, and recommendations for predictive maintenance and budget planning. This structured approach enhanced asset tracking, defect identification, and long-term efficiency of Assets. The collected data was analysed to generate detailed reports on the current asset conditions, maintenance requirements, and potential risk areas. Descriptive statistics and qualitative assessments were applied to interpret asset conditions, prioritise urgent repairs, and recommend strategies for sustainable asset management.

#### **4. Data Analysis and Discussions**

A digital platform was introduced for CA process that involves asset information recording, inspection, asset of condition, predicting budget, cost and maintenance within buildings on the university premises. This study focuses on the initial introduction of the digitalized system as a demonstration case on one of the buildings in university premises. Initially, the system was deployed solely to assess the condition of a limited set of building elements. While the system is designed to manage over 25 components/elements such as assets associated with electrical, finishes, superstructure, fire service etc. The implemented digital system is designed to optimize CA function in the built environment. This system offers a range of advanced capabilities, including asset inspection, condition assessment, and predictive analysis for estimating costs and determining the useful life of assets over time. Additionally, it facilitates efficient data storage, enabling the seamless organization and retrieval of historical records. A key feature of the system is real-time data capturing, which enhances decision-making by providing up-to-date and accurate information. These functionalities collectively improve asset management, ensuring sustainability and long-term operational efficiency.

##### **4.1 CONDITION ASSESSMENT**

As highlighted in the methodology section, a detailed and systematic approach was undertaken to assess the condition of building assets and their components, enabling informed decision-making. When asset details, including their condition, are input into the system, it generates multiple reports relevant to evaluating asset conditions and supporting decision-making processes. These reports include assessments of individual assets and the overall condition of the building, estimated replacement costs for asset elements based on the replacement need over a period, projected useful life of building components, and specific replacement and maintenance requirements.

Figure 1 visually represents the results of the condition assessment. As shown in Figure 1(a), the overall CA of ten rooms was shown. The findings indicated that most rooms are in condition categories 1 and 2, signifying a relatively good state. However, Rooms 5 and 10 were identified as being in critical condition, requiring immediate attention. To gain a more comprehensive understanding, it is vital to analyse the condition based on individual building components. Figure 1(b) provides a breakdown of the condition of different building elements, with an average condition rating assigned to each category. The results reveal that finishes, special features, and the superstructure exhibit varied condition types and defects, suggesting inconsistencies in maintenance and potential structural concerns. On average, air conditioning and electrical systems were rated at condition 2, indicating they are generally in fair condition but may require

periodic maintenance. However, the fire protection system was rated as condition 3, which is critical and necessitates urgent intervention to ensure safety and its operation. The inspections overall identified 39 defect types across 100 inspection points. Among these, 35% of the elements were found to be in excellent condition, 45% in good condition, 13% in average condition, and only 5% in poor condition. These findings highlighted that while most assets are well-maintained, certain critical areas require immediate attention to prevent further deterioration.

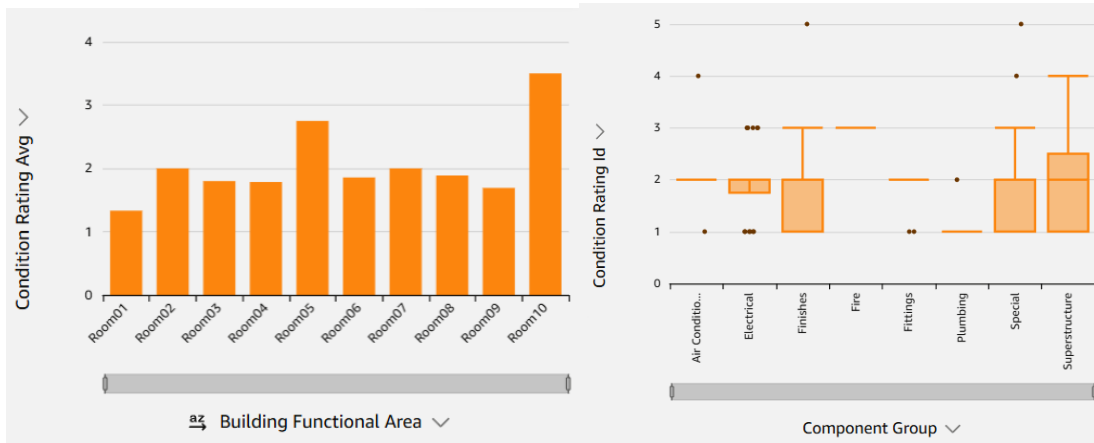


Figure 1 (a): Condition of the rooms

Figure 1 (b): Condition of the assets

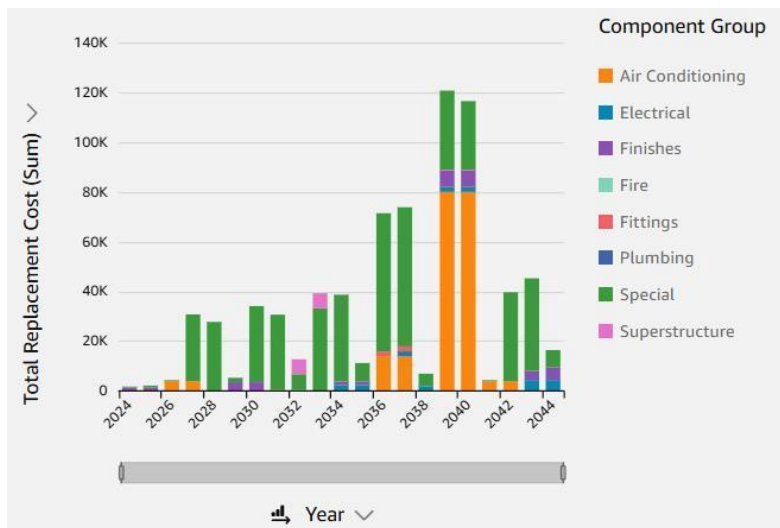


Figure 2: Replacement of the assets

The system also estimates the cost of replacing building elements over a 20-year period, providing valuable insights for long-term financial planning. Figure 2 illustrates the projected expenditures required for these elements over the next two decades. The analysis indicates that in the immediate future, financial resources should be allocated primarily to the "special category" elements such as, as they are expected to require significant investment in the next few years. However, by the year 2040, a substantial portion of the budget will need to be directed toward the replacement and maintenance of the air conditioning system, highlighting its

anticipated wear and lifecycle costs. This report plays a crucial role in asset management and budget planning, enabling decision-makers to proactively allocate funds and schedule maintenance. By understanding future financial demands, institutions can implement a strategic approach to resource distribution, ensuring the safety and functionality of critical building components while minimizing unexpected financial burdens.

#### 4.2 MANUAL VS. DIGITALIZED ASSET MANAGEMENT PROCESS

This section aims to discuss the feasibility of transition to digitalised system. The process of manual and digital approach for CA can be documented with distinct workflows and operational efficiencies. The university is currently following the manual process which is illustrated in Figure 4. In this process, defect reporting, work order management, and asset updates rely on manual documentation and communication. In contrast, 5 depicts the digitalized approach, which leverages automation to streamline defect logging, work order assignment, and real-time updates. The below section outlines each process.

As seen in Figure 4, the manual process begins when a defect is identified and recorded on paper or a spreadsheet. The inspector then compiles defect records into a report, which is sent to the maintenance team for review. The maintenance team assesses the defect details, determines priority, and then raises a work order manually. Once approved, the work order is assigned to a contractor through email, phone, or printed documents. The contractor receives the work order, schedules the repair, and executes the task, updating the maintenance team as necessary. If additional materials, approvals, or clarifications are required, the contractor may need to communicate back and forth with the maintenance team, resulting in multiple interactions before work is finalized. Once the work is completed, the contractor submits a completion report manually, which the facility team verifies before updating the asset's condition in records. If any follow-up work is required, a new work order is generated, restarting the process.

As seen in Figure 5, the digital approach for CA begins when a defect is logged directly into a digital system via a mobile application. The system automatically compiles and stores the defect details, making them immediately available to the maintenance team. Upon review, the maintenance team raises a work order in the system, which is automatically assigned to a contractor based on predefined criteria. The contractor receives a real-time notification and can accept, schedule, and update work progress directly within the system. Any additional approvals, material requests, or clarifications are processed within digital platform, eliminating the need for separate communication channels. Work updates are logged in real-time, and once the repair is completed, the contractor submits a digital completion report, which the maintenance team reviews and verifies within the system. The system then automatically updates the asset condition in the records. If further work is required, a new work order can be generated within the same workflow.

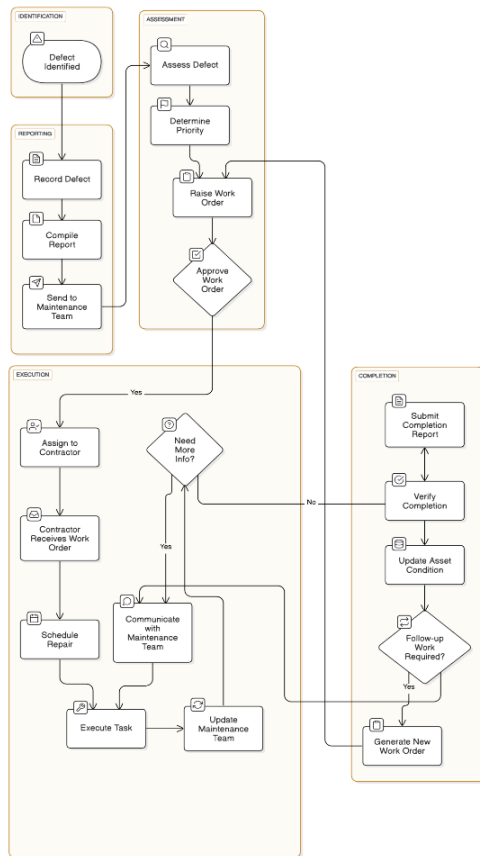


Figure 4: Manual process

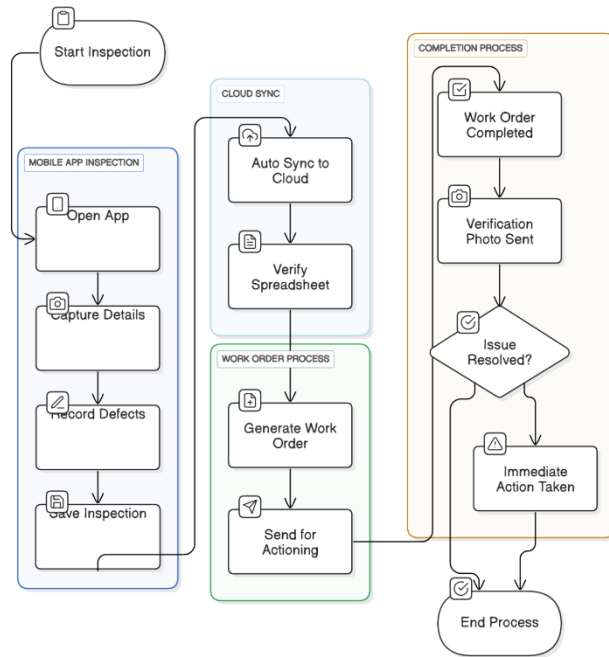


Figure 5: Digital process

#### 4.3. DATA-DRIVEN COMPARATIVE ANALYSIS: MANUAL VS. DIGITALIZED ASSET MANAGEMENT

The comparative evaluation of manual and digitalized asset management systems is grounded in the ability to monitor asset performance and maintenance efficiency through quantifiable metrics. A key advantage of digitalized AM is its ability to collect, process, and analyse data systematically, enabling the identification of trends and performance deviations over time. Unlike manual record-keeping, which relies on static documentation and subjective assessments, digitalized systems facilitate real-time monitoring of asset conditions, defect occurrences, and maintenance interventions. The integration of automated tracking mechanisms ensures the continuous capture of asset degradation patterns, providing actionable insights into optimal maintenance scheduling and resource allocation.

To evaluate the practical advantages of digitalized CA compared to traditional manual methods, various metrics were employed to quantify its benefits. Key measurable factors employed in this study are defect identification rates, defect reporting times, resolution times and cost. Furthermore, non-quantifiable benefits were also recognized. The quantitative benefits were identified and estimated based on data availability. The observations in manual process and the average timestamps recorded in the digital system were also collected to quantify several metrics for both manual and digital process.

One of the key metrics analysed was defect reporting time and response time. Figure 6 presents a comparative analysis of the time required to document defects using manual and digital system. The defect reporting time includes the duration from site inspection to defect identification and formal documentation before initiating corrective action. The data from the

case study indicated that paper-based approaches require significantly more time compared to digitalized processes. On average, the manual reporting process takes approximately seven minutes per defect, whereas the digital system enables near-instantaneous recording and uploading of defect data. This improvement greatly enhances operational efficiency. Furthermore, the results reveal that digitalized tracking systems identified a significantly higher number of defects over the observation period, ensuring a more comprehensive approach to AM. Further, this ensures the standard record keeping of the data.

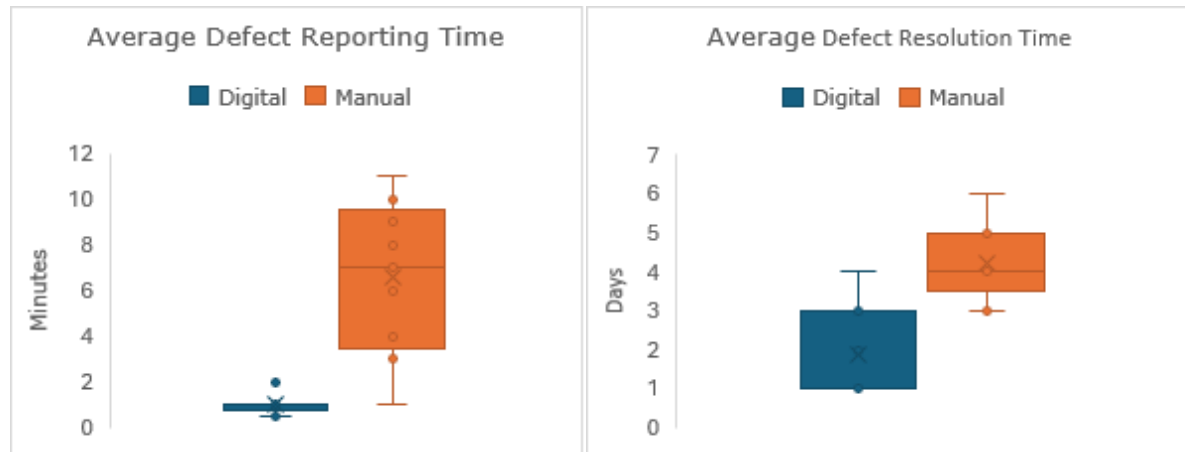


Figure 6: Average defect reporting time and defect resolution time

The maintenance efficiency was further evaluated by analyzing the time taken to address identified defects. Figure 5 illustrates the comparative response times for assets managed manually versus those tracked using digitalized systems. The findings indicated that digital AM systems significantly reduce the time required to resolve maintenance issues. This efficiency gain is largely attributed to the automation of defect logging, which eliminates delays associated with manual data entry, physical report submission, and maintenance task prioritization. The response times not only enhance the operational efficiency but also translate into cost savings by reducing labour hours. Additionally, the ability to identify defects more effectively allows for better maintenance planning, minimizing costs associated with reactive maintenance. The digitalized systems facilitate cost reductions by shifting from reactive to predictive maintenance strategies. The capability to analyse historical data and predict asset degradation trends enables proactive interventions, thereby reducing unplanned maintenance and extending the lifespan of critical assets. In contrast, manual CA relies heavily on reactive maintenance, often leading to higher costs due to emergency repairs and premature asset replacements—issues that could have been mitigated through early detection and planned maintenance strategies. By integrating digital AM, organizations can optimize maintenance operations, enhance defect identification accuracy, and implement cost-effective strategies that contribute to the long-term sustainability of building assets.

## 5. Discussion and Conclusions

AM information plays an important role in data-driven decision-making. Of them CA is a critical function that led safe and effective management of assets over its lifecycle. Timely storage and updating of asset information enhance decision-making processes, reducing downtime and failures while extending asset lifespan. Consequently, AM is closely linked with maintenance management, ensuring a safer and more efficient workplace. The comparative analysis of manual versus digitalized asset management has demonstrated significant differences in defect identification, maintenance response efficiency, and cost-effectiveness. By systematically monitoring asset conditions and tracking maintenance interventions, digitalized systems offer

quantifiable improvements over traditional manual record-keeping. The findings provide strong evidence for the benefits of transitioning toward a data-driven approach in asset management.

The study found that digitalized AM identified more defects compared to manual inspections over a six-month period. This discrepancy is primarily due to the structured and standardized nature of digital inspections, which ensure that assets are assessed systematically. In contrast, manual inspections were more prone to oversight, particularly for minor defects that could evolve into major failures if left unaddressed. The increased defect detection rate highlights the importance of automated monitoring in mitigating long-term maintenance risks. Maintenance response times also demonstrated a stark contrast between manual and digitalized asset tracking. On average, defects logged in the digitalized system were addressed within 48 hours, while those recorded manually required an average of 96 hours before intervention. The delay in manual processing can be attributed to the reliance on paper records and administrative bottlenecks, whereas digitalized systems facilitated instantaneous logging and automated prioritization of repairs. Faster response times have direct implications for asset longevity, as timely interventions prevent further deterioration and reduce the likelihood of unplanned downtime. From a financial perspective, cost analyses indicate that digitalized AM resulted in an average cost reduction over 6 months compared to manual methods. The ability to forecast asset degradation allowed for early intervention and preventative maintenance, reducing the occurrence of emergency repairs, which are typically more expensive and carries a higher risk to the organisation. In contrast, manual tracking led to a higher percentage of reactive maintenance expenditures, with 62% of total maintenance costs attributed to urgent repairs, compared to only 40% under the digitalized system. These findings suggest that predictive maintenance strategies facilitated by digitalized asset tracking improve financial planning and resource allocation.

While digitalized systems present clear advantages in terms of accuracy, efficiency, and cost control, it is important to acknowledge potential challenges associated with their implementation. Initial setup costs, staff training requirements, and simple reluctance to change existing processors may pose barriers to adoption. However, the long-term benefits of reduced maintenance costs and improved asset reliability outweigh these initial investments. Furthermore, digitalization enables the integration of emerging technologies such as machine learning for predictive analytics and Internet of Things (IoT) sensors for real-time monitoring, which could further enhance asset performance management. In summary, the results of this study indicate that transitioning from manual to digitalized asset management yields substantial benefits in defect identification, maintenance efficiency, and cost savings. While challenges exist, the long-term advantages make a compelling case for adopting digital solutions in facilities management. Future research should focus on refining predictive maintenance models and exploring the integration of automated asset condition monitoring to further enhance decision-making in asset lifecycle management.

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