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## Systematic Literature Review: Asset Management System for Educational Institutions

Rilo Purnawan<sup>1\*</sup>; Aldy<sup>1</sup>

<sup>1</sup>Faculty of Computer Sciences Esa Unggul University Jl Arjuna Utara No.9, Kebon Jeruk, Jakarta, Indonesia rilopurnawan@student.esaunggul.ac.id

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#### ABSTRACT.

Educational institutions will increasingly rely on asset management (for optimizing operational efficiency, and managing resources to meet sustainability targets). This study attempts to fill a literature gap on asset management in academia, with a specific focus on digital tools, financial strategies, legacy system integration, sustainability metrics in academia, and existing gaps in academic research. We applied the Systematic Literature Review (SLR) method to 33 papers from 2017 to 2024. The results suggest that asset tracking and management is considerably improved through technologies such as Building Information Modeling (BIM), Internet of Things (IoT), and the Digital Twin. However, giant challenges remain, including the integration of new systems with existing legacy infrastructure, cost constraints in implementation, and regulatory obstacles that hinder the adoption of emergent technologies like blockchain. These financial strategies consist of wealth management services and using Business Intelligence (BI) tools to manage resource allocation in educational institutions. Although sustainability metrics kind of integrated into asset management models have the potential to enhance efficiency, minimize environmental harm, there're a limited take up of assets by the usage as the charges are too excessive and standards aren't properly defined. This paper also identifies gaps in the current literature, namely the need for a framework that is relevant for educational practitioners, and calls for more specific empirical studies on the impact of the implementation of digital technology. These findings underscore the need for additional research to overcome existing challenges and find practical solutions to address asset management in educational institutions.

Keywords: SLR, Asset Management, BIM, IoT, Sustainability, Educational Institutions

### 1. Introduction.

Asset management has become an essential function for educational institutions, encompassing the systematic planning, acquisition, operation, and maintenance of various physical assets. These assets include property buildings, laboratory equipment, IT infrastructure, and library collections. Effective asset management is critical for educational institutions (universities and colleges) as it ensures optimal resource utilization, reduces operational costs, and improves the overall quality of education [1-2]. However, managing these assets effectively presents significant challenges due to their diversity, operations scale, and educational institutions' evolving needs [3].

## 1.1. The Growing Need for Digital Transformation.

To tackle these challenges, many educational institutions have started leveraging advanced digital tools and technologies for improved asset management practices. Building Information Modeling (BIM) enables more detailed visible modeling of buildings and efficient campus planning, while Geographic Information Systems (GIS) provides spatial information/existing conditions data for facilities and infrastructure [4-5]. With the implementation of Internet of Things (IoT) sensors, performing real-time monitoring of assets leads to predictive maintenance and better decision making [6-7]. Furthermore, blockchain infrastructure has been presented as a means for secure asset

transactions and transparent record keeping, although its application in the educational context remains limited as yet [8].

Because these tools can be seen as advanced technologies, their role in education is getting a lot of interest, but they do have some impediments to being used in classrooms. Legacy systems are the point of many academic institutions, resulting in a challenge for integrating new technologies like BIM, GIS, IoT, etc. Moreover, a limited budget often restricts an institution's ability to invest in an exhaustive asset management solution [9-10]. Adoption of emerging technologies is further complicated by regulatory and compliance issues, especially in government- owned educational institutions [11]. These challenges demonstrate the importance of an asset management approach that is customized to the unique requirements and limitations of academic institutions. The first stage was a review of the existing literature identify the gap in research regarding the asset management framework that focuses on the educational institution. Although there has been much discussion around how the use of digital tools like BIM and GIS can be implemented in the industrial and commercial sectors, little has been done regarding implementation plans specifically focused towards higher education [12–14].

Additionally, the practicality of several proposed frameworks is challenging to evaluate, given their theoretical nature and absence of empirical validation [15]. While energy efficiency and energy efficiency standards for green buildings in the education sector have drawn increasing attention, not much work has been done on sustainability metrics for asset management practices [16].

- **1.2. Research purposes.** This SLR study aims to address the gaps identified by analyzing 33 peer-reviewed papers on asset management practices in educational institutions. The specific objectives of this review are as follows:
  - 1. This report provides a comprehensive overview of asset management practices in educational environments, focusing on using digital tools and methodologies [17].
  - 2. Identifying key themes, technologies, and challenges reported in the literature, with particular emphasis on issues related to digital integration, financial planning, and sustainability [18-19].
  - 3. Proposes a conceptual framework designed for the needs of educational institutions, incorporating strategies for digital transformation, predictive maintenance, and sustainability matrices [20].
- **1.3. Research Questions.** To guide this review, the following research questions have been defined.

- **RQ1**: What are the leading digital tools and technologies used for asset management in educational institutions?
- **RQ2**: How are these digital tools integrated with existing legacy systems in educational institutions?
- **RQ3**: What financial strategies are used to optimize asset management in educational institutions?
- **RQ4**: How is the sustainability matrix integrated into asset management practices in educational institutions?
- **RQ5**: What are the key challenges and gaps in current research on asset management frameworks for educational environments?

This systematic literature review addresses these research questions to enrich the current body of knowledge and offer a comprehensive understanding of the challenges and opportunities in asset management for educational institutions. The results are anticipated to provide valuable insights for policymakers, facility managers, and researchers, paving the way for more effective, data-driven, and sustainable asset management practices in the education sector.

### 2. Methodology.

**2.1. Research Design.** This study uses the selected SLR methodology to comprehensively synthesize existing research on asset management practices in educational institutions. The SLR approach is well suited to this topic as it allows for a structured and systematic literature review, thereby identifying key themes, technologies, and research gaps [1-2]. The review focuses on integrating digital tools, financial planning strategies, and sustainability considerations within an asset management framework tailored for the educational context.

### 2.2. Data collection.

Search Strategy. The data collection involved systematically searching relevant academic databases, including Scopus, IEEE Xplore, Google Scholar, and Web of Science. The search was conducted using keywords related to asset management and educational institutions. The main keywords used included: "Asset management in universities"; "Digital tools for asset management in education"; "BIM in educational asset management"; "GIS for campus planning"; "Blockchain in asset tracking"; "Sustainability in educational asset management"

The search focused on articles published between 2010 and 2024 to ensure the review encompasses the latest developments and emerging trends in digital asset management tools. To uphold the quality and reliability of the data sources, only trustworthy peer-reviewed journal articles, conference papers, and industry reports were included [3].

## **2.2.1.** Inclusion and Exclusion Criteria. The inclusion criteria are as follows:

- Focus on asset management practices in educational institutions (e.g., universities, colleges).
- Discusses using digital tools such as BIM, GIS, IoT, and blockchain in asset management.
- Empirical studies, case studies, or theoretical papers published in peer-reviewed journals or conferences.

- Integration of financial planning and sustainability strategies within an asset management framework.

The exclusion criteria are as follows:

- Studies focusing solely on industrial or commercial sector asset management are irrelevant to education.
- Articles published before 2010 may not reflect the latest developments in digital
  - technology.
- Non-peer-reviewed articles, opinions, and editorials.

A total of 75 articles were initially identified through database searches. After applying inclusion and exclusion criteria and screening titles and abstracts, 33 papers were selected for final analysis.

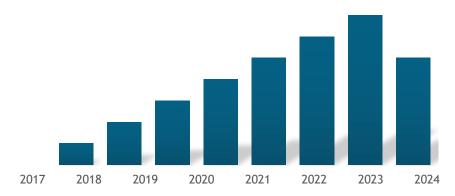


FIGURE 1. Graph of asset management paper publications

## 2.3. Data Extraction and Analysis.

Data Extraction Process. A thorough review of selected papers was conducted to extract relevant information using a standard data extraction form. Key data extracted from each paper included: (1) title and year of publication; (2) research focus and objectives; (3) methodologies and technologies used (e.g., BIM, GIS, IoT, blockchain); (4) main findings and contributions; (5) identified research challenges or gaps.

To minimize bias and have accuracy in extracted data, we had two reviewers independently conduct the data extraction process. Any disagreements between the reviewers were resolved through discussion and consensus [4].

## 2.4 Thematic Analysis.

The extracted data were coded and themed into key themes including the following: (1) Digitalization: utilize cutting-edge digital tools (e.g. BIM, GIS, and IoT technologies) for the visualization of assets, their monitoring, and decision support; (2) Financial optimization: connecting asset management with financial planning tactics to enhance resource distribution; (3) Integrating sustainability: including green building systems and sustainability performance metrics in an asset management system; (4) Key challenges and

gaps in research include lack of identification of barriers to technology adoption; issues pertaining to data interoperability; and a lack in empirical validation.

## 2.5 Framework Development.

As a result of the thematic analysis: synthesis of findings a conceptual framework was generated for asset management of educational institutions. The literature identificated some key components that we considered for the proposed framework, which are: (1) Data integration layer: BIM, GIS and ERP systems for integrated data capturing and analysis; (2) Predictive maintenance module: IoT sensors and AI-based analytics for real-time asset performance monitoring; (3) Financial cluster: A financial planning module that incorporates personal wealth management strategies and budgeting techniques specific to the educational context; (4) Sustainability matrix: Using metrics of energy efficiency, green building practices and long-term resource planning; (5) This is a framework created for the needs of educational institutions. It provides integrated solutions for digital transformation, financial optimization and sustainability, and offers a holistic, multi-disciplinary approach.

## 2.6 Validity and Reliability.

A series of measures were taken to make the review as valid and reliable as possible: (1) Extensive search strategy: Utilization of numerous academic databases and search terms to include all pertinent studies; (2) Multiple-review process, with 2 different researchers independently reviewing and extracting data: this was done to minimize bias; (3) Well-defined inclusion criteria: Well-defined inclusion and exclusion criteria ensures that only relevant and high quality studies are included; (4) Cross-verification: The thematic analysis findings were cross-verified with the original study to ensure their accuracy and consistency.

### 3. Results and Discussion.

## 3.1. **RQ1:** What digital tools and technologies are the most used for asset management in educational institutions?

The major mentioned digital tools and technologies for asset management in educational institutions are BIM, GIS, IoT and Blockchain as discovered both from systematic reviews of 33 selected papers.

Researches like "Digital System Model for Asset Management in Thai Universities" shows the significant role of BIM in preparing high-detailed 3D models to formulate a framework for maintenance and renovation projects [13]. Campus facilities are mapped and subject to spatial analysis using GIS. An example is the study "Supporting Asset Management with GIS and Business Intelligence Technologies" displaying how University of Turin uses GIS to manage outdoor facilities while impacting resource allocation and cost efficiency [26].

IoT is increasingly used to monitor asset performance in real time, enabling predictive maintenance strategies. In the study "Development of Geospatial Asset Management System for Higher Education," IoT integration with asset management systems was shown to reduce downtime and optimize the use of laboratory equipment [11]. Although less commonly

implemented, blockchain is emerging as a promising tool for secure asset transactions and transparent record-keeping. The study "Blockchain Application in University Asset Management" highlights the potential use of blockchain to enhance data security and reduce fraud in asset tracking [28].

Overall, the findings show an increasing trend of adopting advanced digital tools, with BIM, GIS, IoT, and blockchain being the most frequently used digital tools in asset management applications. The following is a table of articles examining the use of digital tools and technologies in asset management applications.

TABLE 1. Articles related to the use of digital tools and technologies in asset management

Article	Method	Key finding	Gap
[1]	IDEF0	Develop a	Research is limited
	Modeling,	comprehensive	on asset
	SWOT Analysis,	AM framework for	management in
	AHP	university assets,	universities,
		emphasizing	especially in
		structured	developing
		planning.	countries.
[6]	RAMS, PHM,	Digital	The complexity of
	Statistical	transformation	integrating various
	Modeling	improves asset	Industry
		lifecycle	4.0 technologies into
		management	asset
		through Industry	management
		4.0 technologies.	processes.
[7]	Risk Assessment,	Integration of GIS	Data integration and
	Comparison of	and BI tools	interoperability
	Rating Systems	improves data	issues
		visualization and	between GIS and
		decision making in	BIM.
		university asset	
		management.	YY' 1 1 '. '
[11]	Geospatial	Integration of	High complexity in
	System Design,	digital twins and	integrating digital
	Data Integration	GIS dashboards	twin and
		improves spatial	BIM technologies
		decision making	across
		and asset tracking.	multiple asset
[10]	Digital Crystom	Coordialtada	systems.
[13]	Digital System	Geospatial tools	Data interoperability
	Design, Supply	have proven	issues
	Chain Analysis	effective in	between existing
		mapping and monitoring	geospatial
			systems and
		university assets,	university
		improving	asset management.
		resource	
		allocation.	
[17]	Digital Twin	Blockchain	Regulatory barriers
[-,]	Maturity Model	implementation	and
		increases data	limited expertise
		security and	hinder the
1		security and	inniget the

		transparency in	full adoption of
		asset transactions.	blockchain
			in asset
			management.
[22]	System	Blockchain	Regulatory barriers
	Development,	ensures tamper-	and
	Knowledge	proof data	limited expertise are
	Management	management and	hampering
		improves asset	widespread
		tracking.	adoption of
			blockchain .
[29]	Data	Integration of GIS	Data interoperability
	Governance,	and BI facilitates	issues
	Data Mining	comprehensive	between GIS-BIM
		data analysis and	and
		improves decision-	existing BI
		making efficiency.	frameworks.
[31]	Conceptual	Proposes a high-	Lack of standard
	Framework,	level conceptual	value
	Value-Based	construct for value	constructs for
	Decision Making	in infrastructure	diverse
		asset management,	infrastructure
		emphasizing the	organizations.
		importance of	
		stakeholder	
		perceptions of	
		value.	

Here is a diagram illustrating the number of articles discussing the use of technology.

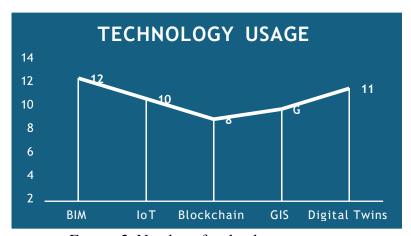


FIGURE 2. Number of technology usage

# 3.2 RQ2: How are these digital tools integrated with existing legacy systems in educational institutions?

Enterprise Resource Planning (ERP) systems are often incompatible with new technologies such as BIM and IoT.

- The study "Conception and Implementation Strategy of University Asset Management System" identified significant barriers to integration, including data interoperability issues and the lack of standard protocols for data exchange between BIM, GIS, and ERP systems [8].
- Likewise, the study "Taxonomy for BIM and Asset Management Semantic

- Interoperability" emphasizes the importance of common data standards to facilitate seamless communication between digital tools and legacy systems [27].
- The "Integration of Asset and Budget Management in Universities" case study shows that successful integration requires a phased approach. It digitizes asset records and gradually integrates IoT sensors for real-time data collection [14].

These findings suggest that while the potential benefits of integrating digital tools are widely recognized, standardized methodologies and improved data interoperability are still needed to realize these benefits fully. The following table presents papers that discuss integrating asset management with existing systems.

TABLE 2. Articles related to asset management integration

	22. Tritiones related to as		
Article	Method	Key Finding	Gap
	Case Study,	Proposes a	The need for
[4]	ISO Standard	conceptual	post-
[,]	Compliance,	framework for	implementation
	Risk	performance	evaluation of
	Assessment	management of	decision
		decision	support tools.
		support tools.	
	Risk	Integration of	Data
[7]	Assessment,	GIS and BI	integration and
r. 1	Comparison of	Tools to improve	interoperability
	Rating Systems	data	issues between
		visualization	GIS and BIM.
		and decision	
		making in	
		university asset	
	T. C	management.	CI 11 '
	Information	Blockchain	Challenges in
[8]	Systems	technology	blockchain
	Design, Life	provides	implementation
	Cycle	transparency	due to
	Management	and security for	regulatory issues and
		asset transactions in	limited
		the higher education	expertise.
		context.	
	BIM, ICT	Blockchain	Regulatory
[10]	Integration,	implementation	barriers and
[12]	Process	provides secure	lack of
	Reengineering	and tamper-	expertise are
	Recingineering	proof asset data	hampering
		management	widespread
		across	adoption of
		university	blockchain in
		departments.	asset
			management.
	Financial	AI-based	Interoperability
[18]	Modeling,	analytics and	issues between
[10]	Factor Analysis	GIS mapping	AI analytics

		provide	and geospatial
		accurate	data systems.
		predictive	
		insights for	
		asset	
		maintenance.	
	Systematic	Digital twins	Data
[24]	Review,	and big data	interoperability
[27]	Decision	analytics	issues between
	Framework	enable	digital twins
		predictive	and traditional
		maintenance	analytics tools.
		and optimize	,
		asset	
		performance.	
	BIM	The integration	Regulatory
[27]	Taxonomy	of blockchain	barriers and
[27]	Development	and AI ensures	limited
	1	secure data	expertise in the
		handling and	application of
		improves	blockchain and
		decision	AI in asset
		making.	management.

## 3.3 RQ3: What financial strategies are used to optimize asset management in educational institutions?

Financial optimization is a recurring theme in the studies reviewed, focusing on aligning asset management practices with institutional budget planning. The study "Asset Management Based on Wealth Management in Islamic Schools" discusses strategies to utilize existing assets to generate additional income, which can be reinvested in core educational activities [3]. In "Integration of Asset and Budget Management in Universities", the authors emphasize the importance of aligning financial strategy with asset life cycle planning to ensure efficient resource use and timely maintenance activities [14]. Wealth management approaches to prioritize investments in asset upgrades and replacements. The study "Measuring Performance of Strategic Asset Management Plan through a Balanced Scorecard" proposes using performance metrics to evaluate the financial impact of asset management decisions and optimize budget allocations [21].

These findings underscore the importance of integrating financial planning into an asset management framework. This will enable educational institutions to maximize resource utilization and achieve long-term sustainability. The following is a table of articles discussing financial planning in asset management implementation.

TABLE 3. Articles related to financial planning in asset management

Article	Method	Key Finding	Gap
[3]	Qualitative Analysis, In- depth Interviews	Wealth management strategies increase funding capacity in Islamic educational	Financial constraints and limited access to advanced management tools in educational

		environments.	institutions.
[14]	K-means	BI tools enhance	Challenges in
	Clustering, Data	data-driven	aligning BI
	Analysis	decision making	tools with
		and streamline	existing data
		asset reporting	governance
		processes.	frameworks and
			asset reporting
			standards.
[19]	Case Study,	BI tools	Difficulty in
	Good	streamline asset	aligning BI
	Governance	reporting and	tools with
	Evaluation	improve	existing data
		governance	governance
		through better	standards.
		data integration.	XX: 1 · · · · · 1
[20]	Quantitative	IoT-based risk	High initial
	Survey,	assessment tools	costs and
	Financial	optimize asset	technical
	Analysis	monitoring and	complexity
		reduce	limit the
		maintenance	adoption of IoT- based risk
		costs.	
			assessment tools.
[22]	System	Blockchain	Regulatory
[22]	Development,	ensures tamper-	barriers and
	Knowledge	proof data	limited
	Management	management and	expertise are
	- Tunagement	improves asset	hampering
		tracking.	widespread
			adoption of
			blockchain.

# 3.4 RQ4: How is the sustainability matrix integrated into asset management practices in educational institutions?

Integrating sustainability metrics into asset management practices is increasingly recognized as a critical element in supporting green building standards and reducing the carbon footprint of academic institutions.

- The study "Development of a Model Linking Physical Asset Management to Sustainability" proposes a framework that integrates environmental indicators into asset life cycle analysis, emphasizing energy efficiency and sustainable building practices [10].
- In "Fuzzy Multicriteria Evaluation and Trends of Asset Management Performance", the authors use a multicriteria approach to assess the sustainability performance of asset management systems in educational buildings. They highlight the importance of integrating energy consumption data and green certification [16].
- "Optimization in Decision Making in Infrastructure Asset Management" discusses IoT sensors and AI-based analytics to monitor energy usage and identify carbon emission reduction opportunities in campus facilities [23].

The findings show that despite increasing attention to sustainability, many existing frameworks have not fully integrated a comprehensive sustainability matrix,

indicating the need for further research. The following table presents papers discussing integrating sustainability matrices in asset management.

TABLE 4. Articles related to the integration of sustainable matrices in asset management

Article	Method	Key Finding	Gap
[6]	RAMS, PHM, Statistical Modeling	Digital transformation improves asset lifecycle management through Industry 4.0 technologies.	The complexity of integrating various Industry 4.0 technologies into asset management processes.
[10]	RAMS, PHM, Statistical Modeling	Digital transformation improves asset lifecycle management through Industry 4.0 technologies.	The complexity of integrating various Industry 4.0 technologies into asset management processes.
[16]	Fuzzy AHP, Multi-attribute Utility Technique	Enhanced lifecycle management with BIM and IoT, improving efficiency and decision making.	Challenges in integrating digital twin and BIM with existing legacy systems.
[17]	Digital Twin Maturity Model	Blockchain implementation increases data security and transparency in asset transactions.	Regulatory barriers and limited expertise hinder the full adoption of blockchain in asset management.
[21]	Balanced Scorecard	BIM and predictive analytics improve decision making and asset lifecycle management.	The complexity of BIM integration with legacy asset management systems.
[30]	Survey Analysis, BMS Implementation	Enhanced cybersecurity reduces risks and ensures compliance with industry standards.	The challenges of maintaining strong cybersecurity while integrating multiple advanced technologies.
[31]	Conceptual	Proposes a	Lack of

	Framework Value-Based Decision Making	high-level conceptual construct for value in infrastructure asset management, emphasizing the importance of stakeholder perceptions of value.	standard value constructs for diverse infrastructure organizations.
[32]	Empirical Survey, PLS Path Modeling	Empirical analysis shows a positive relationship between PAM core practices and operational performance, emphasizing ISO 55001 compliance.	There is a need for more empirical validation of the relationship between PAM practices and performance outcomes.

# 3.5 RQ5: What are the key challenges and gaps in current research on asset management frameworks for educational environments?

Analysis of the reviewed literature reveals several challenges and gaps in current research. Integration issues: Many studies have shown difficulties integrating advanced digital tools with legacy systems and the lack of standard data protocols for seamless communication between technologies [8,27]. Lack of empirical validation: Although many frameworks have been proposed, only a few have been empirically validated in real educational settings [10,12]. Limited focus on blockchain: Despite its vast potential, blockchain technology has not been widely explored in the context of asset management in educational institutions, thus providing an opportunity for further research [28]. Sustainability integration: Although sustainability is a priority for many institutions, current frameworks often fail to integrate a comprehensive sustainability matrix, particularly regarding long-term resource planning and energy efficiency [10]. These challenges indicate the need for future research to focus on developing standardized integration methodologies and empirical studies and improving the integration of sustainability metrics into asset management frameworks in educational institutions. The following is a table of articles related to key challenges in asset management.

TABLE 5. Articles related to key challenges in asset management

Article	Method	Key Finding	Gap
[9]	Style Analysis, Performance	Style Analysis, strategy improves utilization and supports better decision- making in educational institutions	Style Analysis, comprehensive data governance framework within existing systems in educational institutions.

[15] Audit, Compliance Assessment Malytics and Al-based maintenance optimize asset lifecycles and reduce operational costs.  [19] Case Study, Good streamline asset reporting asset properation of predictive maintenance approaches is due to high initial costs and complexity.  [19] Good streamline asset reporting and improve governance through better data integration.  [24] Systematic Review, Decision Framework Pramework enable predictive analytics of an adjustive asset performance.  [24] Strategic Predictive and optimize asset performance.  [25] Strategic Review, Scientific Ampping Solutions reduce risks and support data-driven strategies.  [25] BIM Taxonomy Development Strategies Predictive and Al ensures secure data handling and improves blockchain and Al ensures secure data handling and improves potimizing resource allocation.  [28] Blockhain Framework Pradictive monitoring, adopting predictive management productive in the productive of the productive optimizing adopting predictive and Cloud predictive management and Al ensures secure data handling and improves allockchain and Al ensures secure data handling and improves allocation of the predictive and Cloud predictive predictive and Al ensures secure data handling and improves allocation of the predictive allocation.  [28] Blockchain Praditional Praditional Traditional and Methods, Comparative Analysis significantly to social cohesion and management, disrupting dis	Г	D C	D 11 41	T 1 1 1
Compliance Assessment		Performance	Predictive	Limited
Al-based approaches is direcycles and reduce operational costs.  [19] Case Study, Good streamline asset reporting a search of the properational costs.  [24] Case Study, Good streamline asset reporting and improve governance through better data integration.  [24] Systematic Review, Decision analytics enable predictive and optimize asset performance.  [24] Strategic Enhanced cybersecurity and qualities and optimize asset performance.  [25] Strategic Enhanced cybersecurity solutions reduce risks and support faramework.  [25] BIM Taxonomy Development and Al ensures secure data handling and improves becision making data an application of blockchain and predictive performance.  [27] BIM Taxonomy Development and Al ensures secure data handling and improves objects on the predictive performance and optimize asset performance.  [28] Blockchain Pramework predictive secure data handling and improves becision making Pramework performance and Al ensures secure data handling and application of blockchain and performance and performance and application of predictive predictive costs and technical systems enable real-time asset management predictive In Systems and allocation.  [28] Blockchain Pramework predictive systems enable real-time asset monitoring prodictive lost systems and allocation. ERP solutions. The difficulty in integrating traditional and modern asset and modern asset management practices without high mine approache	[15]			
Case Study,	[10]	Compliance		of predictive
Case Study, Good Good Governance Bevaluation   Bit tools streamline and improve governance enable digital twins and optimize asset management framework.		Assessment	maintenance	maintenance
Case Study, Good Good Streamline aligning BI olos with eart of the complexity.			optimize asset	approaches is
Case Study, Good Good Streamline aligning BI olos with eart of the complexity.				
[19] Case Study, Good Good Governance Evaluation Streamline and improve governance through better data interpration.  [24] Systematic Digital twins and big data interoperability issues between digital twins predictive and traditional analytics casset performance.  [24] Strategic Enhanced Cybersecurity Apping Computing Solutions reduce risks and support data-driven strategies.  [25] BIM The integration Giblockchain and AI ensures secure data handling and improves blockchain and Decision making Design Systems enable real-time asset monitoring , optimizing , op				
[24] Case Study, Good Governance Evaluation  Systematic Evaluation  Systematic Review, Decision Framework  [25] Strategic Review, Scientific Mapping  Strategic Taxonomy Development  [27] BIM Taxonomy Development  [28] Blockchain Temework  BilM Taxonomy Development  [28] Blockchain Framework  BilM Taxonomy Development  [28] Blockchain Framework  Blockchain Framework Design  Blockchain Framework Decision Blockchain Blockchai				
[24] Case Study, Good Good Good Governance Evaluation Streamline asset reporting and improve governance through better data integration.  [24] Systematic Review, Decision Framework enable enable performance.  [25] Strategic Enhanced cybersecurity and cloud computing solutions reduce risks and support data-driven strategies.  [25] BIM Taxonomy Development Taxonomy Development Strategies Secure data handling and AI ensures secure data handling and price in the application of blockchain and AI in asset management monitoring, optimizing resource allocation.  [28] Blockchain Framework pesign systems enable real-time asset monitoring, optimizing optimizing predictive looks and significantly to social cohesion and Methods, Comparative Analysis Sirical significantly to social cohesion and environmental without the sistence of the color of sufficiently in tools with existing BII tools with aligning BI tools with colos with existing BII tools with existance standards.  Data interoperability existence standards.  Data interoperability issues between digital twins and traditional and interoperability issues between digital twins and traditional and technical barriers to adopting predictive IoT systems and English BII tools with an interoperability and traditional and malytics tools.				
[24] Good Governance Evaluation streamline and improve governance through better data integration.  [24] Systematic Review, and big data interoperability interoperability integration pecision predictive maintenance and optimize asset performance.  [25] Strategic Enhanced computing solutions reduce risks and support data-driven strategies.  [25] BIM Taxonomy Development Development Design Framework pesign optimizing resource allocation.  [28] Blockchain IoT-based predictive framework pesign optimizing resource allocation.  [33] Mixed Methods, Comparative Analysis Significantly to social cohesion and Mixed Methods, Comparative Analysis significantly to social cohesion and Mixed means and practices without significantly to social cohesion and modern asset management practices without significantly to social cohesion and modern asset management practices without significantly to social cohesion and modern asset management practices without significantly to social cohesion and mimprove governance stantands.		Case Study		Difficulty in
Governance Evaluation  Bovernance Evaluation  Bovernance Evaluation  Governance Evaluation  Bovernance Evaluation  Bota  Interoperability  issues between digital twins  and traditional  malytics tools.  High costs and technical barriers to  bovernance Evaluation  Framework  Development  Bovernance  Framework  Development  Bovernance  Standards.  Bota  Interoperability  issues between  digital twins  and traditional  Banalytics tools.  High costs and  Evaluation  Evaluation  Evaluation  Evaluation  Bovernance  Evaluation  Bover	5103			
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### 3.5 Interpretation of Results.

The results of this SLR show a clear trend toward adopting digital tools such as BIM, GIS, IoT, and blockchain in asset management in educational institutions. These technologies can address long-standing asset tracking, maintenance, and data integration challenges. However, while the results show significant progress in asset management, several issues remain, particularly regarding system integration, empirical validation, and sustainability.

The emphasis on BIM and GIS for spatial visualization and analysis fits the growing need for efficient infrastructure planning and management in educational institutions. BIM's ability to create detailed 3D models has proven effective in optimizing space usage and improving maintenance schedules. GIS, similarly, enables more effective spatial mapping and analysis, which is critical in managing large-scale university/college environments. However, there are challenges in integrating these tools with legacy systems, as many educational institutions, especially universities, still rely on traditional ERP systems that are not designed to handle real-time data streams from IoT sensors or blockchain.

#### 4 Conclusions.

This SLR study aims to explore asset management practices in educational institutions, focusing on digital tool adoption, integration with existing systems, financial strategies, sustainability metrics, and identifying research gaps. Analysis of 33 peer-reviewed papers reveals several key trends and patterns, as follows:

- Adoption of digital tools: There is a clear trend towards adopting advanced digital technologies such as BIM, GIS, IoT, and blockchain in asset management. These technologies have been shown to improve asset visualization, enable real-time monitoring, and improve the accuracy of asset tracking. BIM and GIS, in particular, are widely used for spatial analysis and infrastructure management, IoT offers predictive maintenance capabilities, and blockchain provides secure record-keeping.
- 2. System integration challenges: One of the review's significant findings was the ongoing challenge of integrating modern digital tools with legacy systems, such as traditional ERP systems. Data interoperability, inconsistent data formats, and a lack of standard protocols hinder the seamless integration of BIM, GIS, IoT, and blockchain. The need for a standard data exchange framework is clear, as it will facilitate more efficient integration and better data utilization.
- 3. Financial optimization strategies: The review emphasizes aligning asset management
  - practices with an institution's financial planning. Effective financial strategy, such as risk assessment, wealth management, and performance metrics, can improve resource allocation and support long-term sustainability. Integrating asset lifecycle planning into budget decisions allows institutions to prioritize maintenance and renewal, optimizing the use of financial resources.

- 4. Integration of sustainability metrics: The application of sustainability considerations in asset management practices is increasingly emphasized in the literature. Educational institutions are beginning to adopt green building standards, energy efficiency measures, and environmental impact assessments. However, many existing frameworks do not fully integrate comprehensive sustainability metrics, indicating the need for further development in this area. The use of IoT sensors for energy monitoring and AI-based analytics to identify inefficiencies are promising trends that can improve sustainability.
- 5. Research gaps and future directions: The review identified several gaps in current research, including limited focus on empirical validation of digital tools, challenges in integrating new technologies with legacy systems, and the lack of a comprehensive framework that includes financial and sustainability considerations. Furthermore, exploration of blockchain technology in educational asset management remains limited despite its great potential to improve data security and transparency.

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