Challenges Faced by Enterprise Information System in University And Its Opportunities of Enhancement

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***Abstract*—This paper explores the integration of Enterprise Information Systems (EIS) within universities (often referred as School Management System, Education Information System etc in other paper), referred to as University Information Systems (UIS), which streamline essential daily operations including attendance tracking, student and staff portals, financial management, and more. Despite their utility, UIS encounters common challenges shared by other EIS, such as maintenance and** scalability **issues, alongside specific hurdles like limited integration with advanced technologies, hampering efficiency and decision-making processes. Leveraging emerging technologies such as cloud computing, artificial intelligence (AI), machine learning, and blockchain presents promising opportunities for enhancing UIS capabilities. Through an investigation of related work, this paper compares common challenges faced by UIS that are proposed in different papers and proposes potential avenues for improvement, aiming to inspire advancements without prescribing a definitive architecture.**

Keywords—Enterprise Information Systems (EIS), University Information Systems (UIS), School Management System, Education Information System, scalability, Advanced Technologies

I. INTRODUCTION

Universities rely on Enterprise Information Systems (EIS), also called University Information Systems (UIS), to manage daily operations like attendance, portals, and finances. While UIS offers clear benefits, this paper explores its challenges and opportunities for improvement.

By analyzing related academic papers, we will identify common challenges and gaps in understanding UIS. This comparative approach aims to spark innovation in UIS design and implementation, not to propose a single, rigid architecture.

In short, this paper highlights the importance of UIS and explores ways to enhance it through research on existing challenges and solutions presented in other academic works. Our goal is to promote progress in UIS design, not to impose a one-size-fits-all solution.

II. COMPARISON BETWEEN RELATED WORK

This section introduces notable related work that shares similarities with our research focus. Furthermore, they offer perspectives on the challenges faced by University Information Systems (UIS) and their corresponding solutions. The comparison between them and even with us is summarized in Table 1 for ease of reference.

Table 1 Comparison of related paper

Ref	*Main Content*	*Weakness*	*Compare with this paper*
[1]	Concludes the methodology for designing UIS and addresses common challenges in managing it.	The proposed solution mainly focuses on management.	Introduces emerging technology to solve problems.
[2]	Utilizes 3 survey questions to understand respondent perspectives on system benefits, challenges, and improvements.	Limited to primary schools and lacks deep discussion in survey results.	Provides further discussion on challenges and corresponding solutions for universities.
[3]	Proposes a 5-step conceptual model for facilitating decision-making and identifies inhibiting factors affecting system usage.	Focuses mainly on decision-making, lacks emphasis on other system components.	Focuses on each main level or component of the system.
[4]	Investigates the current state of systems across different countries through surveys and proposes features for next-generation systems.	Focuses on decision-making and data analysis. Also addresses scalability and system infrastructure.	Also focuses on scalability and infrastructure of the system.
[8]	Evolve and implement the EIS for more efficient distance learning administration.	Focuses on the implementation of the system instead of the discussion of the management changing strategies.	Enhances the system through proposed innovative technologies.

A. [1] Challenges of Education Management Information Systems on Primary School Administration in Nsukka Local Government Education Authority of Enugu State

SN	Challenges of EMIS on primary school administration are	$\bar{x}$	SD	Remarks
14	Lack of technical support	2.88	0.88	Agree
15	Inadequate user-friendly software for analyzing test results at the school level	2.72	1.45	Agree
16	Lack of ICT support center	3.33	0.99	Agree
17	Lack of training on data analysis skills among administrators	3.18	0.74	Agree
18	Inadequate training on using ICT based management tools	3.19	0.79	Agree
19	Constant power interruption	3.35	0.62	Agree
20	Insufficient computers	3.14	1.15	Agree
21	Lack of adequate resources	3.09	1.20	Agree
22	Lack of awareness	3.49	0.69	Agree
23	Negative attitudes towards EMIS	3.27	0.70	Agree
24	Cost of computer items	3.45	0.99	Agree
	Cluster Mean	**3.19**	**0.92**	**Agree**

Figure 1 : [1] Challenges of EMIS on primary school [1]

This paper investigates the process of designing and managing information systems for universities. It elucidates the management approach for Academic Information Systems (AIS). Furthermore, it conducts a requirement study to delineate the functionalities needed for various user perspectives, such as students, teachers, and officers. In addition, the paper delves into the challenges encountered such as AIS management, including issues of data privacy, system security, and user resistance. It highlights the importance of adhering to standards, thorough documentation, and ongoing optimization to ensure the sustained effectiveness. While the challenges addressed in this paper are ubiquitous in UIS, the proposed solutions primarily focus on management strategies, such as establishing feasible restoration timelines and identifying pertinent leadership questions. In contrast, our work centers on leveraging new technologies, such as cloud computing, to mitigate the risk of hardware-related system failures to an exceedingly low probability.

B. *Management Information Systems for Higher Education Institutions*

The paper presents a survey-based examination of the challenges and significance of Information Systems within the primary school administration of Nsukka Local Government Education Authority in Enugu State. Various challenges are identified in the survey, including a lack of technical support, insufficient software infrastructure, inadequate ICT resources, and negative perceptions towards system adoption. Furthermore, the paper proposes user-suggested solutions to mitigate these challenges, including awareness campaigns, training initiatives, and equipment procurement. While the research focuses on primary school contexts, the findings suggest potential generalization to university settings to some degree. However, the paper primarily analyzes survey results and aligns them with existing research without delving deeply into providing detailed procedural steps like [1]. In contrast, our work will assess the efficacy of these solutions for addressing similar challenges within university environments.

C. *[3] School Management Information Systems: Challenges to Educational Decision-Making in the Big Data Era*

The paper delves into the obstacles encountered by educational institutions in cultivating data-driven school cultures. Furthermore, the study highlights prevalent challenges including issues with data quality, low self-efficacy among users, delayed information availability, and insufficient executive support. To address these challenges and facilitate informed decision-making processes, the paper proposes a comprehensive five-phase conceptual model. Despite its focus on decision-making impediments, the paper does not extensively discuss other system components such as underlying infrastructure and scalability concerns. Moreover, unlike the reference [1], which primarily concentrates on elaborating the conceptual model, this paper does not delve deeply into problem formation. While our forthcoming research does not propose a conceptual model, it aims to leverage technology to elucidate how enhancements in infrastructure, decision-making processes, and scalability can effectively address these challenges within educational institutions.

D. *[4]Transforming education by using a new generation of information systems*

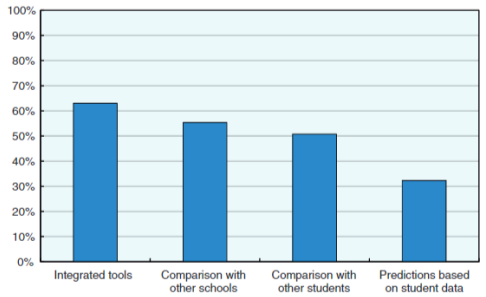

Figure 2: Integrated analysis tools and enabled comparisons [4]

The paper is drawing upon a survey of 64 education data systems across 30 countries, conducted by the OECD CERI as part of the Innovation Strategy for Education and Training project. This investigation includes an analysis of factors such as the integration of analysis and reporting tools, as well as the scope of data captured for students and teachers. Upon these insights, the paper advocates for the development of next-generation systems capable of supporting dynamic learning environments, facilitating rapid evaluation of interventions, and fostering continuous improvement in teaching and learning practices. While the paper underscores the transformative potential of new information systems in education, it primarily focuses on the features of existing and future systems related to decision-making without providing a detailed roadmap for achieving these objectives. In contrast, our research goes beyond merely addressing decision-making functionalities of UIS; we specifically identify technologies conducive to overcoming these challenges and offer insights into their implementation.

E. *[8] Implementing an Enterprise Information System to Reengineer and Streamline Administrative Processes In a Distance Learning Unit*

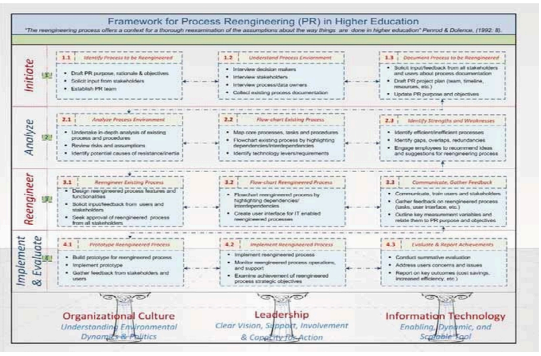

Figure 3: Integrated analysis tools and enabled comparisons [8]

The process of creating and overseeing information systems for universities is examined in this paper. It highlights an organized management strategy for Academic Information Systems (AIS), regardless of whether they are created in-house or acquired from outside sources. Along with a comprehensive prototype, the study comprises a requirement analysis to determine the functionalities that are essential from the perspectives of different users, including students, teachers, and staff or the faculty. The paper additionally discusses the difficulties that higher education institutions encounter in managing AIS, such as user resistance, system security, and data privacy. It emphasizes how crucial it is to follow guidelines, provide comprehensive documentation, and optimize continuously in order to maintain efficacy over time. Although the paper concentrates on management strategies, our work focuses on using cloud computing to reduce system failures caused by hardware.

III. COMMON CHALLENGES FACED IN UIS

A. Management and Maintenance of Infrastructure

- The Cost: The management and maintenance of infrastructure present significant challenges for an exemplary University Information System (UIS), primarily due to the substantial investments required in staff and resources. Our team posits that while these expenditures are essential for ensuring operational efficiency, they divert valuable resources away from system enhancements. Evidence from [5] indicates that a considerable portion of university budgets, 78%, is allocated to hardware expenses, with 49.60% attributing the highest expenditure to electricity for UIS operation.
- Unforeseen Service Interruption: Unforeseen service interruptions impose additional challenges, necessitating immediate restoration efforts from dedicated IT teams. As proposed by [2], addressing such interruptions requires a comprehensive approach and established Standard Operating Procedures (SOPs), underscoring the demanding nature of these tasks. Moreover, ensuring system resilience calls for well-trained IT teams, contributing to heightened human resource costs.
- Increasing Requirements Day by Day: The escalating demand for server access and data storage necessitates continuous monitoring and investment in equipment. Consequently, this growth in requirements translates to increased costs in electricity, maintenance, and human resources, further straining UIS budgets and operational capabilities.

B. Poor Utilization of Data

- Human Factor: A significant barrier lies in the divide between technical and non-technical staff, exacerbated by a lack of professional training in data analytics. This sentiment is echoed by [1], which highlights respondents' concerns regarding insufficient training in data analytics and ICT support. Additionally, [3] emphasizes the role of inadequate training as a hidden factor contributing to this divide.
- The Greater Competitive Environment: In a rapidly evolving competitive landscape, UIS must align with critical objectives outlined by [6], including personalization, evidence-based learning, improved school efficiency, and continuous innovation. To dynamically adjust university strategies and enhance student performance, UIS must evolve beyond mere data storage to become engines of informed decision-making.

C. Considerations of the Scalability and Performance

- Scalability and Performance: Nowadays, the modern universities rely heavily on the EIS as mentioned in [1]. Therefore, the fluctuations in demand happened frequently for the resources along the peak periods such as registrations. Hence, the possibility of error occurring on the system is getting higher.

  Other than that, the university also needs to scale to accommodate the rapidly growing volumes of the users and data as the university will have the expansion in future.

  In addition, the performance bottlenecks may occur as the concurrent user accesses and the heavy workloads might happen because of the scalability problems mentioned above.

IV. OPPORTUNITIES FOR ENHANCEMENT

A. Cloud Computing

Evidence from [5] underscores the underutilization of cloud computing in the university IT landscape, with a staggering 71.40% of IT departments never considering its adoption and only 8.80% of universities actively employing cloud computing solutions.

Despite these challenges, the benefits of cloud computing are abundant:

- Service Continuity: Cloud service providers assume responsibility for ensuring machine robustness, reducing the need for extensive IT monitoring teams and ultimately lowering operational costs.
- Cost Effectiveness: The Pay-as-you-go models avoid the need of extensive upfront investments, while the economies of scale of the service providers make cloud computing pricing highly cost-effective.
- Reduced Technical Debt: Cloud computing minimizes technical debt by providing Saas, Paas infrastructure and decreasing reliance on legacy systems.

Cloud computing represents an inevitable trend, necessitating meticulous planning for successful migration:

- Technical Architecture: We advocate for an initial adoption of hybrid structures, gradually

transitioning to full cloud integration to mitigate risks of data loss and system corruption.

- Platform Selection: Leading cloud service providers such as AWS, Azure, GCP, and Alibaba Cloud offer robust migration services like AWS Snowball, along with hybrid infrastructure support in networking services.
- Location Consideration: The choice of cloud location is crucial, influenced by regulatory compliance and performance considerations, as highlighted by [7].

B. Integration with Advanced Technology

The emergence of advanced technologies has revolutionized data analysis and utilization, facilitating more accurate and efficient processes.

Commercial Software: Various commercial software solutions for Student Information Systems and Learning Platforms offer comprehensive functionalities and one-stop service. However, integrating different software and customization pose challenges, hindering cross-platform analysis.

Business Intelligence: Tools like Tableau, Alteryx, and PowerBI provide user-friendly interfaces, enabling deep data analysis without requiring extensive IT knowledge. This accessibility makes them attractive options for universities, as highlighted in both [1] and [3].

Artificial Intelligence and Machine Learning Algorithms: Open-source frameworks such as scikit-learn, TensorFlow, and LightGBM offer complex and accurate models. These frameworks empower IT teams to seamlessly integrate advanced algorithms into UIS, aligning with the dynamic strategic adjustments advocated in [3].

C. Maintenance

When the UIS grows rapidly among the modern universities, the issues that might face it will keep increasing, especially the system maintenance. Therefore, the enhancement of maintenance should be put on the agenda.

- Preventive Maintenance Procedures: Provide a thorough preventive maintenance schedule that covers hardware inspections, software updates, and automatically triggered routine system checks for the UIS. By taking a proactive stance, possible problems can be found and addressed before they become more serious ones. It can also ensure the facilities and equipment are always in the best condition.
- System Performance: Use monitoring tools such as performance dashboard to keep an eye on the key performance indicators (KPI) for the maintenance operations. Hence, the functionality and condition of the servers, networks, databases, and applications that make up the UIS infrastructure can be always under monitoring. With real-time monitoring, you can quickly identify potential security risks, resource usage anomalies, and performance bottlenecks.
- Feedback Mechanism: Provide a way for the system users, including staff to voice concerns about maintenance, offer recommendations for enhancements, and discuss their experiences with the UIS maintenance procedure. Ensuring user satisfaction and identifying areas for improvement are facilitated by actively seeking feedback.

V. CONCLUSION

This paper examined opportunities and challenges of Enterprise Information Systems (EIS) in higher education, focusing on University Information Systems (UIS). Common hurdles like data utilization, scalability, and infrastructure management were identified.

The exploration emphasized the transformative potential of integrating cutting-edge technologies with cloud computing, offering benefits like reduced technical debt and improved service continuity. Additionally, advanced technologies have the potential to revolutionize data analysis within UIS. Other than that, the paper highlights the importance of proactive measures like performance monitoring, preventative maintenance, and user feedback to ensure optimal UIS functionality. This fosters continuous development without imposing a rigid architecture.

In conclusion, while UIS faces challenges, new technologies offer immense potential for improvement. This paves the way for further exploration of how to leverage these advancements.

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