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Developing a Smart Campus Infrastructure for Apayao State College: A Feasibility Study

Lloyd Mark C. Razalan

Bachelor of Science in Information Technology Department Apayao State College – Luna Campus San Isidro Sur, Luna, Apayao, Philippines

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ABSTRACT

The rapid evolution of technology has transformed higher education, giving rise to the concept of *Smart Campuses*. These institutions leverage advanced technologies to create innovative, interconnected, and sustainable learning environments. This feasibility study explores the potential of implementing a smart campus infrastructure at Apayao State College (ASC) to enhance operational efficiency, elevate educational quality, and promote sustainable practices.

The study examines key components of a smart campus, including information and communication technology (ICT), automated systems, smart energy solutions, and integrated security frameworks. Through institutional analysis, stakeholder interviews, and site assessments, the research evaluates the technical, financial, and environmental feasibility of proposed solutions.

By addressing challenges such as connectivity gaps, funding constraints, and user adaptability, ASC can position itself as a pioneering institution in Philippine higher education. A smart campus transformation will foster dynamic learning, operational efficiency, and long-term sustainability, ultimately enhancing stakeholder satisfaction.

RATIONALE

The concept of a smart campus, often viewed as a microcosm of a smart city, is enabled by digital transformation in higher education. Smart campuses serve as living laboratories for smart technology research, development, and adoption, while supporting teaching, learning, and research functions.

This study analyzes the feasibility of developing a smart campus infrastructure for ASC, guided by a four-layer model: (1) sensing and network layer, (2) data analysis layer, (3) application and service layer, and (4) security maintenance layer (Musa et al., 2021).

The goal is to foster an open university framework that prioritizes sustainability and quality of life. Smartization, as described by Silva-da-Nóbrega et al. (2022), involves adapting institutional management, infrastructure, and community engagement to align with global standards of sustainability and innovation.

By adopting this model, ASC can advance technological innovation and improve education delivery while ensuring a sustainable and future-ready campus environment.

OBJECTIVES

This feasibility study aims to:

1. Assess the readiness and potential of ASC to adopt a smart campus infrastructure.
2. Identify the key technological components required.

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3. Determine the financial implications and potential funding sources.
4. Analyze the benefits and challenges of transitioning to a smart campus.
5. Propose a roadmap for implementation.

REVIEW OF RELATED LITERATURE

The transition towards Smart Campuses has gained momentum globally, as educational institutions seek to harness technological advancements to enhance learning environments and streamline operations. This section provides an overview of key literature pertaining to the development of Smart Campuses, with a specific focus on feasibility studies and their outcomes.

Towards an smart campus: supporting campus decisions with internet of things applications, Bart Valks, Monique H. Arkestejn, Alexander Koutamanis & Alexandra C. den Heijer, Pages 1-20 received 26 Dec 2019, accepted 14 Jun 2020, Published online: 07 Jul 2020: The research emphasizes the importance of smart campuses in universities worldwide to optimize resource usage. It suggest that the internet of things (IoT) can provide valuable real – time data on space utilization, aiding decision – making. However, existing IoT data directly into decision – making processes for more effective campus management.

A Smart Campus Framework: Challenges and opportunities for education based on the sustainable development goals. Pedro Ivo Silva- da Nobrega 1, Adriana Fumi Chim-miki 1, and marysol Castillo – palacio 2 (2022). This research delves into the smartization of universities beyond mere digitalization, aiming to pinpoint crucial elements and notable deficiencies in smart campus dimensions from the user perspective. By employing an importance – performance analysis (IPA) using IBP SPSS 26, the study tested a comprehensive smart campus framework in a Brazilian University, previously validated with latin American expert. The research underscored eight critical dimensions for evaluating a smart campus and provided a prioritized list for academic decision – makers. Notably, it highlighted disparities between perceived importance and actual performance. The study concludes that the smartization process must extend beyond technological attributes (Silva-da-Nóbrega, et.al., 2022), addressing societal, labor market, and sustainability needs. It also emphasizes that smart campuses in developing countries may prioritize different components, such as infrastructure, compared to developed countries. The research recommends further application of the framework in diverse university settings to a more comprehensive understanding.

Building a smart campus to support ubiquitous learning. Yacine Atif, Sujith Samuel Mathew and Abderahmane Lakas (M Musa, et.al. 2021). explores that advanced learning models in smart campus environments, leveraging technology for immerse and adaptive learning experiences. It outlines steps to build this environment and introduces a comprehensive smart campus model. This model integrates physical and digital resources, enabling personalized learning journeys. Learners' profiles and campus structures are adapted for context – aware learning. A social platform facilities knowledge sharing. The approach shows promise in enhancing learning experiences within the proposed smart campus.

Despite the potential benefits, implementing smart campus project comes with challenges. Financial constraints, resistance to change, data privacy concerns, and the lack of technical expertise are common barriers (Lee et al., 2019). These challenges are particularly significant for state colleges and universities (SUCs) in developing regions, where infrastructure and funding are often limited. A case study by Gomez et al. (2018) on Philippine Higher Institutions highlights the need for strong government support and collaboration with the technology providers.

Conducting a feasibility study is a critical step in smart campus development. According to Brown et al. (2020), a comprehensive feasibility study assesses financial, technical, and operational viability, ensuring the proposed solutions align with institutional goals and constraints. For Apayao State College, understanding the unique challenges of the region, such as connectivity issues and resource limitations, will be essential to tailor solutions effectively.

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The literature underscores the transformative potential of smart campus infrastructure in enhancing education and operations. However, the successful implementation of such initiatives depends on addressing challenges through strategic planning, stakeholder collaboration, and adaptive technologies. Apayao State College provide a foundation for exploring innovative yet practical solutions tailored to the institutions needs and context.

METHODOLOGY

The feasibility study will adopt a mixed – method research approach, comprising both qualitative and quantitative methods:

Surveys and Interviews – Collected insights from ASC students, faculty, staff, and administrators on expectations and challenges.

Technical Assessment – Partnered with smart technology experts to evaluate existing infrastructure and required upgrades.

Financial Analysis – Assessed costs for hardware, software, maintenance, and training while identifying potential funding sources.

RESULTS AND DISCUSSION

A. Institutional Readiness

Table 1. A comprehensive assessment of ASC's readiness to transmission to a smart campus infrastructure

Dimension	Strengths	Areas for Improvement
Technological Readiness	Existing IT infrastructure, adequate networking	Upgrades and compatibility assessments needed
Financial Readiness	Budget allocation, potential cost savings	Refined cost projections, explore partnerships
Operational Readiness	Dedicated IT team, existing policies	Additional training, updated protocols
Organizational Readiness	Faculty and staff support, stakeholder backing	Change management strategies needed
Risk Assessment	Security measures in place, benefits outweigh risks	Develop contingency planning

Table 1 shows Apayao State College readiness to transaction to a smart campus infrastructure. While there are areas for improvement, the strengths identified provide a solid foundation for a successful implementation

B. End-User Acceptance and Training Needs

Table 2. Readiness and Acceptance Among End Users. Uncover level of readiness and acceptance among faculty, staff, and strengths for a smart campus. It also identifies the training needs to ensure that all end users can effectively use the new technologies.

End User Group	Strengths	Areas for Improvement
Faculty	Enthusiasm for integration, prior digital experience	Additional training, clear communication

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Staff	Basic familiarity, positive outlook	More training, structured communication
Students	Tech-savvy, eager for advanced tools	Orientation sessions, ensure accessibility

Training needs:

1. Faculty training:

- Enhance proficiency in a smart classroom technology
- Master learning management systems and digital teaching tools

2. Staff training

- Utilize administrative and operational software
- Embrace Internet of things (IoT) devices and relevant technologies for their roles

3. Students training

- Familiarize with smart campus resources and learning platforms
- Embrace digital tools for enhanced learning experiences

4. Ongoing professionals' development

- Establish continuous training and professional development programs
- Keep users updated with evolving technologies

Table 2 displays that there is a positive inclination towards the implementation of a Smart campus at Apayao State College. However, targeted training programs are crucial to ensure that all end users, including faculty, staff, and students, can effectively utilize the new technologies.

C. Conceptual Framework

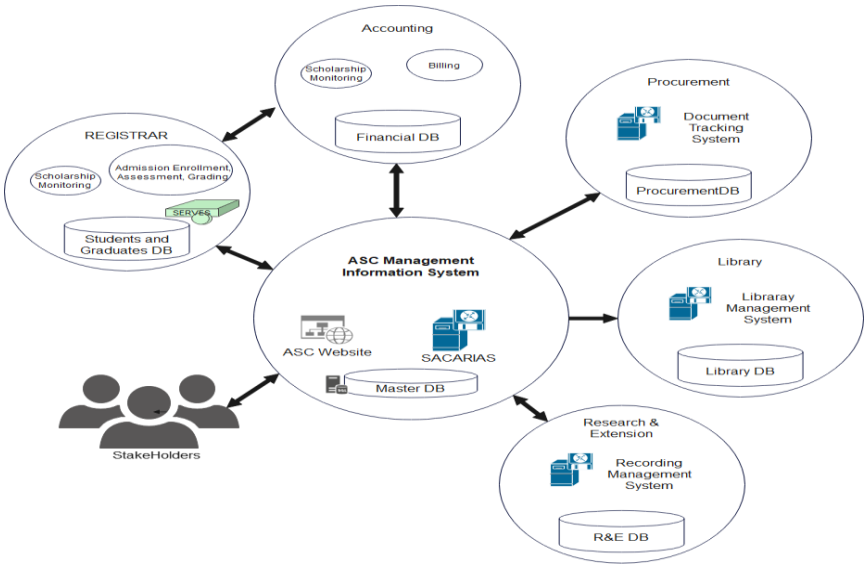

Figure 1: Conceptual Framework

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Figure 1 provides a visual representation of the study. At its core, it depicts the various elements that constitute the current campus infrastructure.

It's worth noting that we have taken a significant step towards enhancing this system. We have recently procured a dedicated cloud database solely for our campus operations.

Wherein it is where our schools website is hosted. We also have the SACARIAS system mainly use by the registrar, accounting, faculty for the online enrollment, scholarship, assessment, grading, and billing of students. We also have the Library Management System wherein all archive books are stored. There is also a system for Procurement, a Document Tracking System. And under the Research & Extension, a recording Management System.

CONCLUSION AND RECOMMENDATIONS

This feasibility study centers on the intersection of emerging development concepts, information technology, and public demand. It will conduct a systematic and comprehensive study of the smart campus system from multiple perspectives, including infrastructure, platform data analysis, and smart campus system services. The goal is to build a smart campus platform that serves students, teachers, campus administrators, and stakeholders. This research holds significant theoretical and practical value for the reform of Apayao State College.

To gather a more comprehensive understanding of smart campuses and smart cities, the researcher should broaden their survey scope beyond just students, utilizing open-ended questions for all participants. Additionally, for more accurate data collection on people's understanding of smart city applications within a smart campus, the researcher should consider methods beyond Google Forms, such as employing data collection models.

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