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Needs assessment for the development of a college of information and communications technology smart building

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Abstract

This needs assessment aims to evaluate the existing infrastructure and learning environment of the College of Information and Communications Technology (CICT) to determine the necessity and strategic value of developing a CICT Smart Building. The study aligns with the university's goal of advancing digital transformation and academic excellence through state-of-the-art facilities. This study employed a quantitative descriptive research design to systematically assess the existing infrastructure and gauge demand for innovative learning spaces within CICT. Data were collected from students and faculty through structured online surveys distributed via Google Forms, allowing efficient, cost-effective, and broad participation. The survey focused on current facility utilization, infrastructure challenges affecting learning and research, and preferences for smart building features such as high-performance computing and IoT-enabled classrooms. A convenience sampling method was used to ensure representation across different year levels and faculty groups. Results revealed critical infrastructure deficiencies, including outdated laboratory equipment, overcrowded classrooms, and a lack of collaborative, research-driven, and technology-enhanced spaces. Stakeholders expressed a strong demand for smart classrooms, advanced computing laboratories, multifunction halls, and innovation hubs to support hybrid learning, research activities, and industry collaboration. The findings support the urgent need for a CICT Smart Building. The integration of smart technologies, modern facilities, and collaborative spaces is essential for elevating the quality of instruction, research productivity, and digital readiness of both students and faculty. The proposed development aligns with the university's Strategic Development Goals (2024–2028). Implementing the CICT Smart Building project will significantly enhance the university's capacity to deliver innovative, industry-aligned IT and Data Science programs. It will also foster interdisciplinary collaboration and prepare graduates for the demands of the digital economy, positioning the institution as a leader in technology-driven education.

Keywords: CICT smart building, collaborative spaces, digital transformation, infrastructure challenges, smart classrooms.

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1. Introduction

The digital transformation of higher education necessitates adopting smart infrastructure and cutting-edge technologies to enhance learning, research, and collaboration. Smart buildings, equipped with sensor-driven automation, energy-efficient systems, and data-driven decision-making, have become essential for modernizing university campuses. In response to this paradigm shift, the College of Information and Communications Technology (CICT) envisions the establishment of the CICT Smart Building an advanced facility designed to drive digital transformation, academic excellence, and industry collaboration.

This initiative aligns with the university's Strategic Development Goals (2024–2028), particularly in enhancing technology infrastructure toward a Smart University and expanding facilities through modernization and new construction. As the university aims to integrate advanced technologies into its educational landscape, assessing the feasibility of the proposed smart building becomes crucial. A well-informed evaluation will ensure that the initiative effectively addresses institutional priorities while meeting the evolving needs of students and faculty. A comprehensive needs assessment is essential to determine the necessity, feasibility, and expected impact of the smart building. This assessment aims to identify infrastructural gaps, emerging technological requirements, and faculty and student expectations. Key considerations include current facility limitations, the increasing demand for intelligent learning environments, and alignment with institutional priorities for digital transformation and global competitiveness.

Smart buildings enhance learning, research, and collaboration by integrating advanced technologies that foster interactive and efficient educational environments. These facilities incorporate smart classrooms and Internet of Things (IoT) systems to create dynamic learning experiences, promote collaboration among students and educators, and facilitate real-time data analysis for informed decision-making [1]. Smart classrooms utilize technology to support flexible teaching strategies, enabling students to engage more effectively in group projects through collaborative learning models that enhance communication and knowledge-sharing [2]. These innovations create technology-enhanced spaces that cater to diverse learning needs. In addition to fostering collaboration, smart buildings integrate practical learning opportunities through innovative course structures, such as those developed around Edge AI platforms, which improve student engagement and understanding of smart technologies [3]. The integration of IoT in buildings also serves as a "learning factory," where real-time data enhances understanding of building performance and energy efficiency [4]. These interdisciplinary approaches bridge the gap between theoretical knowledge and hands-on experience.

The CICT Smart Building will support the Bachelor of Science in Information Technology (BSIT) and Bachelor of Science in Data Science (BSDS) programs by providing high-performance computing resources, a multifunction hall, and collaborative workspaces. Currently, limitations in infrastructure, such as outdated facilities, insufficient computing resources, and a lack of dedicated spaces for interdisciplinary collaboration, hinder the ability of students and faculty to conduct advanced research, develop industry-relevant projects, and engage in hands-on learning experiences. By addressing these gaps, the proposed facility will enhance academic activities, foster a research-driven environment, and facilitate innovation in digital technology. Beyond academic functions, the facility will facilitate international partnerships, industry collaborations, and data-driven research, equipping students with 21st-century digital competencies. By incorporating stakeholder insights, this study aims to provide empirical data to inform institutional infrastructure development, supporting the university's broader vision of becoming a globally competitive Smart University.

Advancements have significantly influenced integrating smart buildings in higher education in the Internet of Things (IoT), artificial intelligence (AI), and cloud computing. Ahmed et al. [5] highlight the transformative role of IoT in intelligent building energy management, showing how sensor-driven analytics can detect inefficiencies and implement real-time optimizations. Heidary et al. [6] explore AI-driven smart buildings to respond to urbanization and climate challenges, addressing interoperability concerns in innovative city ecosystems. Samancioglu [7] introduces the Smart Availability Scale (SAS) to assess university smart campuses based on automation, sustainability, and wayfinding technologies. Krawczyk and Wojciechowska [8] analyze indoor environmental quality (IEQ) in smart buildings, integrating microclimate monitoring with occupant feedback to balance energy efficiency and user satisfaction. These studies reinforce the transformative potential of smart buildings in higher education and provide a strong empirical foundation for the proposed CICT Smart Building.

2. Methodology

2.1. Research Design

This study employed a quantitative descriptive research design to systematically assess the existing infrastructure of the College of Information and Communications Technology (CICT) and evaluate the demand for innovative learning spaces. The research gathered data from students and faculty members to provide a comprehensive, multi-perspective analysis of the necessity and feasibility of the proposed smart building.

A quantitative approach was used to collect, analyze, and interpret numerical data, ensuring objective measurement of facility usage, existing challenges, and desired innovative building features. Quantitative research enables the generalization of findings from a representative sample, helping to identify trends and inform data-driven decisions [9]. By employing this methodology, the study provides empirical evidence to support strategic infrastructure development within the institution.

2.2. Data Collection

Data were collected through structured survey questionnaires administered via Google Forms to enhance accessibility and encourage broad participation. Electronic surveys offer several advantages, including speed, cost-effectiveness,

convenience, flexibility, ease of analysis, global reach, reduced errors, and the ability to accommodate diverse question formats [10].

The survey focused on key areas such as:

- Current facility utilization and perceived limitations – Understanding how existing infrastructure supports academic activities.
- Challenges in learning and research due to infrastructure gaps – Identifying barriers that hinder productivity and innovation.
- Preferences for smart building features – Assessing the demand for high-performance computing resources, IoT-enabled classrooms, and digital collaboration spaces.

The study ensured efficient data collection by leveraging digital survey tools, enabling a comprehensive analysis of infrastructure needs and priorities.

2.3. Sampling Method and Sample Size Determination

A convenience sampling approach facilitated broad participation from the College of Information and Communications Technology (CICT) community. This method enabled efficient data collection while ensuring representation across different year levels and faculty groups. Convenience sampling offers several advantages, including cost-effectiveness, ease of implementation, and reduced time requirements [11].

The sample size was determined using a 7% margin of error to balance statistical reliability and practical feasibility. Table 1 presents the distribution of participants based on this criterion.

Table 1.
Sample Size per Margin of Error.

Year Level	N	Sample Size (7% Margin)
BSIT First Year	574	85
BSIT Second Year	505	83
BSIT Third Year	402	80
BSIT Fourth Year	415	81
BSDS First Year	65	39
CICT Faculty	35	27

This sampling strategy ensures adequate representation while maintaining efficiency in data collection, making it a suitable approach for assessing the perspectives of students and faculty regarding the proposed innovative learning spaces.

3. Results and Discussion

3.1. Stakeholder Demographics

The survey gathered responses from faculty members and students across various year levels within the College of Information and Communications Technology (CICT). Most respondents were students enrolled in the Bachelor of Science in Information Technology (BSIT) and Bachelor of Science in Data Science (BSDS) programs. Faculty members also provided valuable insights regarding facility needs, teaching environments, and research requirements, contributing to a well-rounded assessment of the infrastructure and intelligent learning space demands.

Table 2 presents the distribution of respondents based on their academic affiliation.

Table 2.
Distribution of Respondents.

Respondents	f
BSIT First Year	574
BSIT Second Year	505
BSIT Third Year	402
BSIT Fourth Year	415
BSDS First Year	65
CICT Faculty	35

This distribution highlights the diverse representation of stakeholders, ensuring that the study captures a comprehensive perspective on the necessity and feasibility of innovative learning spaces within the college.

3.2. Utilization of Existing Facilities

Table 3 presents the frequency and percentage distribution of respondents' utilization of existing college facilities. The data provide insights into the demand for various spaces, highlighting the extent to which students rely on current infrastructure. This information is particularly relevant to assessing the feasibility of constructing a new building for the College of Information and Communications Technology (CICT). A high utilization rate of key facilities, such as classrooms and computer laboratories, may indicate space constraints and the need for expanded infrastructure to accommodate the growing academic and extracurricular demands of students. Conversely, lower usage of certain facilities may suggest areas for potential repurposing or optimization within the proposed development plan.

Table 3.
Frequency Distribution Regarding the Utilization of Existing College Facilities.

Existing Facilities	f
Classroom	394
Computer Laboratories	384
Large space for extracurricular activities and events (rooftop)	269
Accreditation Rooms	82
Learning Resource Center	72
OJT Rooms	55
CICT-LSG Office	1
Total Recorded Responses	1257

Table 3 presents the frequency distribution of respondents' utilization of existing college facilities, reflecting the varying levels of demand for different spaces. The data indicate that classrooms (f=394) and computer laboratories (f=384) are the most frequently utilized facilities, highlighting their critical role in academic activities. The high frequency of use suggests potential overcrowding, which may negatively impact the quality of instruction and student learning experiences. This underscores the need for expanded instructional spaces to accommodate the growing student population and academic demands.

The large space for extracurricular activities and events (rooftop) was used by 269 respondents, demonstrating a significant demand for communal areas that support student engagement beyond academics. The frequent use of this space suggests the necessity of dedicated multipurpose areas to better facilitate student activities, events, and organization meetings.

Although specialized facilities such as Accreditation Rooms (f=82) and OJT Rooms (f=55) recorded lower utilization, their existence remains essential for specific academic and administrative functions. Notably, the Learning Resource Center (f=72), despite having fewer respondents indicating its use, requires particular attention. The lower number of users may not necessarily indicate a lack of interest but rather a limitation in available space, restricting accessibility and usability. This suggests an urgent need for an expanded and better-equipped Learning Resource Center to accommodate more students and enhance research and learning opportunities.

The CICT-LSG Office recorded the lowest usage (f=1), which is a critical observation. This extremely low utilization suggests that the facility is not only underused but also likely inadequate in size to accommodate multiple student organizations. A small and constrained space may discourage student groups from using the facility, limiting opportunities for collaboration and student leadership development. Expanding or relocating the CICT-LSG Office to a more spacious and accessible area would better serve student organizations and encourage greater engagement.

These findings are essential in evaluating the feasibility of constructing a new building for the College of Information and Communications Technology (CICT). The high demand for classrooms and computer laboratories reinforces the necessity for additional instructional spaces, while the Learning Resource Center's limited accessibility and the inadequate CICT-LSG Office highlight the urgent need for expansion. Additionally, the frequent use of the rooftop space for extracurricular activities suggests that a new building should incorporate dedicated areas for student organizations and events.

Overall, the data strongly support the need for a new CICT building to address space constraints, improve learning environments, and provide adequate resources for both academic and extracurricular activities.

3.3. Challenges with Current Facilities

Table 4 presents the challenges encountered by the respondents in utilizing various facilities within the college. Understanding these challenges is crucial in assessing the feasibility of establishing a new building for the College of Information and Communications Technology (CICT). Identifying issues such as overcrowding, limited accessibility, and inadequate resources provides valuable insights into the current infrastructure's capacity to meet student needs. The findings from this table will help determine whether existing facilities can be optimized or if additional spaces are necessary to support academic activities, research, and student engagement effectively. Addressing these challenges through infrastructure expansion would enhance the overall learning experience and foster a more conducive educational environment.

Table 4.
Frequency Distribution Regarding the Challenges Encountered in Utilizing Various CICT Facilities.

Challenges Encountered	f
Slow and outdated computers in the laboratories	310
Insufficient chairs and computers	267
Lack of available space for in-college curricular and co-curricular activities	130
Limited spaces for meetings and brainstorming sessions	296
Lack of privacy during faculty consultations	67
Unavailability of after-class study spaces	145
Limited resources for hybrid and digital learning	109
Non-optimal space for organizational meetings	61
Total Recorded Responses	1385

Table 4 presents the frequency distribution of challenges encountered by respondents in utilizing various facilities within the College of Information and Communications Technology (CICT). The data highlight several infrastructure-related issues that affect students' academic experiences, co-curricular activities, and overall learning environment.

The most frequently reported challenge is slow and outdated computers in the laboratories (f=310), followed closely by insufficient chairs and computers (f=267). These findings emphasize the urgent need for upgraded computer laboratories with modern equipment and adequate seating capacity to accommodate the growing number of students. Without these improvements, students may face difficulties in completing coursework, conducting research, and participating in technology-driven learning activities.

Additionally, limited spaces for meetings and brainstorming sessions (f=296) and a lack of available space for in-college curricular and co-curricular activities (f=130) indicate that the existing infrastructure does not adequately support collaborative learning and student engagement. This limitation can hinder teamwork, problem-solving exercises, and extracurricular involvement, all of which are essential for holistic student development.

Furthermore, unavailability of after-class study spaces (f=145) and limited resources for hybrid and digital learning (f=109) suggest that students struggle to find suitable environments for independent study and technology-enhanced learning. As digital learning becomes increasingly integral to education, expanding access to well-equipped study areas and hybrid learning resources is essential.

The lack of privacy during faculty consultations (f=67) and non-optimal space for organization meetings (f=61) highlight additional concerns regarding the adequacy of existing facilities. The limited space for faculty consultations may discourage students from seeking academic guidance, while the inadequacy of organization meeting spaces suggests that student groups lack dedicated areas for planning and engagement.

These challenges collectively underscore the pressing need for a new CICT building that can address space constraints, improve resource availability, and enhance the overall learning environment. Expanding classroom and laboratory facilities, creating dedicated student collaboration areas, and integrating modern technological resources would significantly improve both academic and extracurricular experiences. The findings strongly support the feasibility of constructing a new building to accommodate student needs, foster academic excellence, and enhance student engagement within the CICT community.

3.4. Priority Features for the Proposed CICT Smart Building

Table 5 presents the priority facilities proposed for the new College of Information and Communications Technology (CICT) building, based on their perceived importance. The ratings reflect the respondents' evaluation of essential infrastructure that would enhance academic instruction, research, and student engagement.

Table 5.
Priority Facilities for the Proposed CICT Building Based on Importance Ratings.

Proposed Facilities for the New CICT Building	Average Mean Rating	Verbal Description
Smart Classrooms (interactive boards, hybrid learning)	3.80	Very Important
Advanced Computer Laboratories (AI/ML resources, cloud computing)	3.90	Very Important
Multifunction Hall (for training, events, and collaborations)	3.80	Very Important
Extended Faculty Room (for research and instructional development)	3.90	Very Important
Meeting Rooms (for consultations and brainstorming)	3.70	Very Important

Table 5 presents the priority facilities proposed for the new College of Information and Communications Technology (CICT) building, based on their perceived importance. The results indicate that all the proposed facilities were rated as "Very Important," demonstrating a strong consensus on the necessity of upgrading the college's infrastructure to meet evolving educational demands.

The highest-rated facilities, Advanced Computer Laboratories (3.90) and Extended Faculty Room (3.90), highlight the critical need for enhanced technological resources and dedicated faculty spaces for research and instructional development. The demand for smart classrooms (3.80) equipped with interactive boards and hybrid learning capabilities underscores the importance of modern teaching methodologies that integrate digital tools for a more engaging and flexible learning environment.

Similarly, the Multifunction Hall (3.80) was also rated as very important, indicating the necessity of a versatile space for training, events, and collaborative activities. The Meeting Rooms (3.70), though slightly lower in rating, still received strong support, reinforcing the need for designated areas where students and faculty can conduct consultations, brainstorming sessions, and project discussions.

These findings strongly support the feasibility of constructing a new CICT building, as they reveal significant infrastructure gaps that must be addressed to enhance academic delivery, technological competency, and faculty research capabilities. Expanding and modernizing CICT facilities will not only improve student learning experiences but also support faculty development and interdisciplinary collaboration, ensuring that the institution remains at the forefront of technological education.

3.5. Additional Suggestions

In addition to the proposed features, respondents provided qualitative feedback on additional facilities they would like to see incorporated into the new CICT building. One of the key suggestions was the establishment of a Dedicated Data

Science Laboratory, equipped with high-performance computing resources to support advanced analytics and machine learning projects. This reflects the growing demand for specialized facilities that cater to emerging fields in technology and data science. Additionally, respondents emphasized the need for Drinking Fountains and Water Refilling Stations, which would not only enhance convenience for students and faculty but also promote sustainability by reducing plastic waste. Another notable suggestion was the inclusion of Quiet Study Areas, designed to provide a conducive environment for focused research, independent learning, and academic work. These recommendations highlight the necessity of a well-equipped and student-centered infrastructure that supports both technological advancements and the overall well-being of the academic community.

3.6. Implications and Strategic Direction

The findings underscore the urgent need for a modernized CICT building that integrates innovative technologies, advanced computing resources, and collaborative workspaces to enhance teaching, research, and industry engagement. Data-driven insights from faculty and students will be the foundation for strategic planning, ensuring that the proposed facility aligns with the university's commitment to academic excellence, innovation, and global competitiveness.

The development of the CICT Smart Building marks a transformative step toward the university's vision of becoming a Smart University where cutting-edge technology, sustainability, and education converge. By addressing existing infrastructure gaps and incorporating forward-thinking design, this initiative will foster an environment that empowers students, enhances faculty research capabilities, and strengthens industry collaborations, ultimately positioning the institution at the forefront of digital transformation in higher education.

4. Conclusion and Recommendations

The findings of this needs assessment strongly support the development of a CICT Smart Building as a strategic investment in the university's digital transformation efforts. The study highlights critical gaps in the existing infrastructure, including outdated laboratory equipment, limited collaboration spaces, and insufficient facilities for research and innovation. These challenges hinder the effective delivery of IT and Data Science programs while restricting opportunities for interdisciplinary collaboration, industry engagement, and global academic partnerships. Furthermore, space constraints, particularly the high demand for classrooms and computer laboratories, significantly affect instructional quality.

Stakeholder feedback indicates a strong demand for smart classrooms, advanced computing laboratories, multifunctional halls, and dedicated faculty and student collaboration spaces. Integrating cutting-edge technology such as interactive learning tools, high-performance computing resources, and hybrid learning environments will enhance instructional quality, research productivity, and student preparedness for the digital economy. Aligning with the university's Strategic Development Goals (2024-2028), the proposed smart building is expected to modernize CICT's facilities, foster academic excellence, and drive industry-focused innovation.

To address these pressing needs, the following recommendations are proposed. First, infrastructure expansion should be prioritized through the construction of the CICT Smart Building, equipped with modern classrooms, advanced laboratories, and collaborative spaces. Second, facility enhancements such as a dedicated Data Science Laboratory, drinking fountains, and quiet study areas should be incorporated to support academic and research activities. Third, resource upgrades must be implemented, including modernizing laboratory equipment, increasing the number of chairs and computers, and enhancing hybrid learning capabilities.

Additionally, fostering student collaboration and industry partnerships requires the development of more study areas, meeting rooms, and innovation spaces. A detailed feasibility study and phased development approach should be undertaken to ensure that the project meets the evolving needs of the academic community while adhering to sustainability and cost-effectiveness principles.

The establishment of the CICT Smart Building will position the university at the forefront of digital transformation, fostering a future-ready learning ecosystem that equips students and faculty with the tools, spaces, and resources necessary to thrive in an increasingly technology-driven world.

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