The impact of smart academic community readiness and IoT on university performance: moderation factors of information and technology service management

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ABSTRACT

Introduction. The concept of a smart university has become increasingly vital due to rapid technological advancements, evolving societal demands, and the digital transformation reshaping education. *This study aims* to investigate the impact of academic community readiness (ACR), the application of Internet of Things (IoT), and Information Technology Service Management (ITSM) on improving university performance. Additionally, the study explores whether ITSM moderates the relationship between ACR, IoT implementation, and university performance.

Materials and methods. This research employed a quantitative, correlational approach, with data analyzed using the SmartPLS 3.2.9 program in two steps: analyzing the outer and inner models. The study was conducted at several Islamic colleges in Indonesia, involving 382 randomly selected respondents from three institutions. Data collection was performed using a Google Form distributed via social media platforms such as WhatsApp, email, and Telegram.

Results. The findings indicate that ACR, IoT, and ITSM significantly influence university performance in the context of transitioning to a smart university. ITSM was also found to moderate the relationship between ACR, IoT, and university performance. The direct influence of ACR on university performance was 0.330 (P-value = 0.000 < 0.05), while the influence of IoT was 0.154 (P-value = 0.006 < 0.05). ITSM directly influenced university performance with a value of 0.239 (P-value = 0.000 < 0.05). Furthermore, ITSM moderated the relationship between ACR and university performance (P-value = 0.039 < 0.05) and between IoT and university performance (P-value = 0.019 < 0.05).

Conclusion. The transition to a smart university is crucial for aligning higher education with modern technological advancements, fostering global competitiveness, and addressing the changing needs of students and industries. This study demonstrates that academic community readiness, IoT implementation, and ITSM are key drivers of university performance in this context. By integrating these elements, universities can deliver flexible, high-quality, and sustainable education, equipping students to navigate the challenges of the 21st century effectively.

KEYWORDS

academic community readiness, IoT, ITSM, higher education, smart university, smart campus

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INTRODUCTION

The transformation of universities into smart campuses is crucial to meet the demands of the 21st century, in line with UNESCO's four pillars of education: learning to know, learning to do, learning to live together, and learning to be [1]. Smart campuses can provide flexible, adaptive, and technology-based education, while supporting lifelong learning and achieving the Sustainable Development Goals, particularly in ensuring quality education [2]. For Islamic universities, becoming smart campuses is highly relevant to face the rapidly evolving global challenges and to remain relevant in a society that is becoming increasingly intelligent and connected through technology [3]. If Islamic universities prepare themselves to become smart campuses, they will be able to meet the needs of a society that prioritizes technology and information [4] and people, as customers, will stay behind because they are also getting smarter [5].

Building a smart campus is a complex challenge influenced by multiple factors, ranging from human resource readiness to the adoption of the Internet of Things (IoT) [6]. The readiness of the academic community to transform into an intelligent community plays a pivotal role in determining the success of innovative campus development efforts. Without sufficient preparation from the academic community, initiatives to establish a smart campus may fail to achieve their goals [7]. Therefore, assessing the readiness of the academic community to evolve into an intelligent community is essential to avoid potential obstacles in building a smart university [8].

The implementation of IoT and IT Service Management (ITSM) is equally critical for enhancing the performance of higher education institutions [6]. In the era of Industry 4.0, university services must be accessible, user-friendly, and participatory. Universities must treat their communities—students, faculty, and staff—not just as passive recipients but as active participants in shaping and improving institutional services. Academic community members should have the ability to access necessary information quickly, contribute ideas, and even provide constructive criticism to improve university systems [9]. IoT facilitates this participation by enabling seamless access to services and information, ensuring that the academic community can engage meaningfully with university operations. This has been emphasized in several studies, which highlight the importance of IoT in supporting the development of smart campuses [10].

Various studies have defined "smart universities" differently, depending on the perspective and context. Some researchers describe them from an information technology perspective [11], while others adopt a smart city framework to explain their characteristics [13]. Generally, smart universities are described as institutions that creatively integrate advanced technologies—such as big data, sensors, social media, and machine learning—into their teaching, learning, and administrative spaces to foster innovative ways of working [15]. According to Mbombo [12], a smart university is defined as an institution that leverages technological innovation to fulfill its mission. Furthermore, smart universities are characterized as superior, adaptive, anticipatory, self-directed, and capable of restructuring themselves to meet new challenges [16].

Although definitions vary, the core concept remains consistent: a smart university integrates diverse educational components into a unified system powered by ITSM and IoT. This integration enables faster, more effective, and efficient services for all stakeholders, paving the way for higher education institutions to meet the demands of the digital era.

Previous studies on smart universities have consistently emphasized the importance of IoT implementation across all aspects of campus services. For instance, Downes and Campbell highlighted that IoT applications in university management depend on the availability of wireless networks throughout the campus to ensure network stability [10]. Similarly, Gilman et al. discussed the need for IoT applications in specific areas where the academic community gathers for various activities. These spaces, often overlooked by campus leadership, require enhanced IoT support to provide students and faculty with better access to information and resources related to academic tasks. Consequently, the concept of smart spaces is critical when implementing IoT in a university environment [17]. Additionally, Nie introduced an integration model of IoT and Cloud Management, defining a smart campus as comprising portal architecture, smart management, infrastructure, service models, and the integration of hardware devices within a digital school framework [18].

While readiness research has been conducted in various fields, including health [19], social marketing [21], and smart city development [22], studies on the readiness of academic communities to transition into smart communities within universities are limited. Despite its importance in ensuring the success of smart university initiatives, this area has received little attention [24]. Such research is vital for identifying potential challenges and avoiding failure during the transformation process.

The primary problem explored in this research is: Do the readiness of the academic community, the implementation of IoT, and ITSM influence the improvement of higher education performance? Furthermore, this study aims to investigate the moderating role of ITSM in the relationship between the readiness of the academic community, IoT implementation, and university performance.

LITERATURE REVIEW

Smart University Features

The term "smart" has gained popularity as a descriptor of sophistication and convenience, leading to its widespread use in various contexts. Initially, the term was explored in relation to devices such as smart TVs [25], smart cars [26], and other technologies that emphasize superior features, instrumentation, interconnectivity, and intelligence [27]. However, the concept of "smart" extends beyond daily devices to encompass broader areas such as the environment [28], industries [29], cities [30], and universities [12]. The use of "smart" in these contexts consistently conveys qualities of cleverness, brightness, and intelligence [31]. Similarly, when the term "smart" is paired with "university" or "campus," it signifies an institution that embodies sophistication, modernity, and intelligence [12].

Smart universities differ significantly from traditional universities. Traditional institutions typically rely on manual systems to deliver their services [32]. For instance, in traditional settings, lectures require face-to-face interactions between lecturers and students, with material presented in person during class sessions. Similarly, evaluation systems often involve written tests administered manually in supervised settings. Other services, such as administrative tasks, are managed through manual processes handled by designated campus administration staff [18].

In contrast, smart universities are defined by their adoption of advanced technology across all services [34]. A key feature of a smart campus is its ability to rapidly adapt and respond to changes, meeting user demands and incorporating diverse intelligent systems to support operations [32]. Smart universities integrate technologies such as the Internet of Things (IoT), cloud computing, wireless networks, mobile terminals, RFID, intelligent systems with sensors, interoperability, control systems, system sharing, and intelligent services [18].

Moreover, smart universities emphasize six core intelligence domains that shape their identity: eLearning, iGovernance, iGreen, iHealth, iSocial, and iManagement [35]. These domains highlight the comprehensive and interconnected approach required to meet the challenges of modern education, making smart universities a benchmark for innovation and efficiency in higher education.

Academic Community Readiness

The readiness of the academic community serves as a fundamental pillar in the transformation of universities into smart communities [36]. As technological advancements and the demand for innovation accelerate, universities must evolve into technologically advanced institutions. This transformation requires the active participation of all members of the academic community, including lecturers, students, and administrative staff, to maximize the benefits of smart university features and services, such as virtual collaboration and seamless access to online information [37]. Furthermore, robust connectivity is essential in establishing smart communities within higher education, ensuring uninterrupted access to campus services and real-time updates on campus activities. Both readiness and connectivity are critical factors in enhancing university performance as they navigate the path of digital transformation [38].

In the technological era, universities must prioritize fostering academic community readiness to address future challenges and cultivate an environment conducive to creating a smart community [39]. This readiness enables higher education institutions to achieve their goals of delivering high-quality education and driving innovations that benefit society [40]. However, a lack of awareness and understanding of the importance of innovation within the academic community often hinders the development of smart universities [41]. Such unpreparedness delays the adoption of technological services and negatively impacts institutional performance. Therefore, the active engagement of academics, students, and administrative staff is crucial to realizing the vision of a smart university [42]. Strong institutional support, including adequate resources and targeted training, is vital to empower the academic community to adapt and excel. By raising awareness of the advantages of innovation and fostering active participation in implementing efficient technological services, universities can fully transition into modern, future-ready educational entities [43].

Internet of Things (IoT)

The Internet of Things (IoT) is a technology designed to address the challenges of the digital era by streamlining tasks and overcoming digital-based difficulties [44]. Closely tied to machine-to-machine (M2M) technology, IoT enables communication between devices—commonly referred to as smart devices—developed to solve various human challenges [45]. IoT connects devices through internet networks, allowing for remote control and facilitating work systems for individuals, groups, and organizations [46]. Its four key components are sensors, which gather data; connectivity, which ensures seamless communication between devices; data processors, which analyze the data to produce meaningful information; and user interfaces (UI), which enable effective interaction between users and the system [47].

Initially developed for personal use, IoT has now expanded to organizational settings, including companies and universities, where it has become essential [48]. In higher education, IoT enhances accessibility and connectivity, enabling students, lecturers, and staff to access campus services more efficiently. Universities that adopt IoT enjoy increased operational efficiency, as processes like student data management, tuition payments, and course registration are streamlined [49]. Furthermore, IoT optimizes critical campus services, such as digital libraries, smart classrooms, and security systems. A well-integrated IoT infrastructure allows universities to deliver high-quality, technology-driven services, meeting stakeholders' needs while evolving into modern, future-ready educational institutions [50].

IT Service Management

IT Service Management (ITSM) is a set of organizational capabilities designed to deliver value to customers through efficient and effective IT services [51]. Some researchers define ITSM as the process of implementing and managing IT services to meet business needs, achieved through the appropriate combination of people, processes, and information technology [52]. Another perspective describes ITSM as a method for managing IT systems using structured guidelines and instructions to ensure that the objectives of IT implementation are met efficiently and effectively [53]. ITSM is an organizational approach to designing, building, integrating, managing, and developing high-quality IT services [52]. These services aim to simplify customer access to information provided by an organization, emphasizing the close relationship between IT and service delivery [54].

The implementation of ITSM offers several key benefits to institutions and organizations. These include (1) aligning IT operations with customer priorities, (2) prioritizing customer satisfaction, (3) fostering collaboration across various departments, (4) enhancing coordination for greater efficiency, and (5) accelerating service delivery to end users [57].

In higher education, ITSM enhances the efficiency of campus services such as student registration, facility maintenance, network management, and technical support, improving the overall experience for students and staff. By implementing ITSM, universities can boost the quality and performance of their institutions, providing an integrated service framework that strengthens the academic environment. This approach also helps advance the maturity of IT service management, ensuring that higher education institutions stay competitive and adaptable in the evolving digital landscape [58].

MATERIALS AND METHODS

Type and Purpose of Research

This study employs a quantitative approach with a correlational design. This approach was selected because it aligns with the study's objective: to examine the relationships among variables and determine the effect or correlation between them [59]. The variables measured in this research include four key elements: academic community readiness, IoT implementation, ITSM, and smart university performance.

The relationships among these variables are formulated into several research objectives: (1) to examine the effect of academic community readiness on smart university performance, (2) to assess the effect of IoT implementation on smart university performance, (3) to analyze the role of ITSM in moderating the relationship between academic community readiness and smart university performance, and (4) to explore the role of ITSM in moderating the relationship between IoT implementation and smart university performance.

Research Samples

This research was conducted at several Islamic tertiary institutions in Malang city Indonesia, namely UIN MALIKI, UNISMA, and UMM. Data is collected through a survey method distributed through social media such as WhatsApp, email, and Telegram. The research sample comprised lecturers, staff, and students at the three universities. In selecting the sample, the researcher used a simple random sampling method in which everyone in the target population had the same opportunity to be chosen [60]. From the results of distributing the questionnaire, this study obtained data from 386 respondents consisting of 132 lecturers, 123 employees, and 131 students.

Research Instruments

There are four research variables to be measured in this study: academic community readiness, IoT implementation, ITSM, and university performance. To calculate the four variables above, the researcher compiled several question items based on theories relevant to this study. To measure community readiness variables, researchers use the approach of Statistics Indicators Benchmarking the Information Society (SIBIS) theory [61], which consists of four variables: internet usage behavior, usefulness, e-government, and variables for adding human resources which are then broken down into 8 question items.

Meanwhile, the variability of IoT implementation is measured by Kazenga theory which consists of four categories: electronic appliances, information management facilities, device communication, and human capacity [62], from which it is developed into 8 question items.

To test the implementation of ITSM, the researcher borrowed Addy's theory, which says that IT service management consists of two main parts: service delivery and service support [63]. The two indicators it was then developed into 5 question items.

Meanwhile, to measure smart-university performance, the researcher borrows the theory of Ng et al., which classifies smart-university services into six sections; iLearning, iGovernance, iGreen, iHealth, iSocial, and iManagement [35], which were later arranged into 12 question items.

Research Models and Hypotheses

Based on the theoretical explanation of the relationships between the variables outlined in the previous sub-chapter, the following research model can be developed:

The Figure 1 shows how the relationship between variables in this study is modeled. From this model, it can be seen that there are four hypotheses which are formulated as follows:

H1. The readiness of the campus academic community to become a smart community significantly affects the success of becoming a smart Islamic campus.

H2. Exemplary IoT implementation has a significant effect on improving the performance of smart universities.

H3. ITSM has a significant effect on improving the performance of smart universities.

H4. ITSM moderates the relationship between smart community readiness and smart university performance.

H5. ITSM moderates the relationship between IoT deployment and smart university performance.

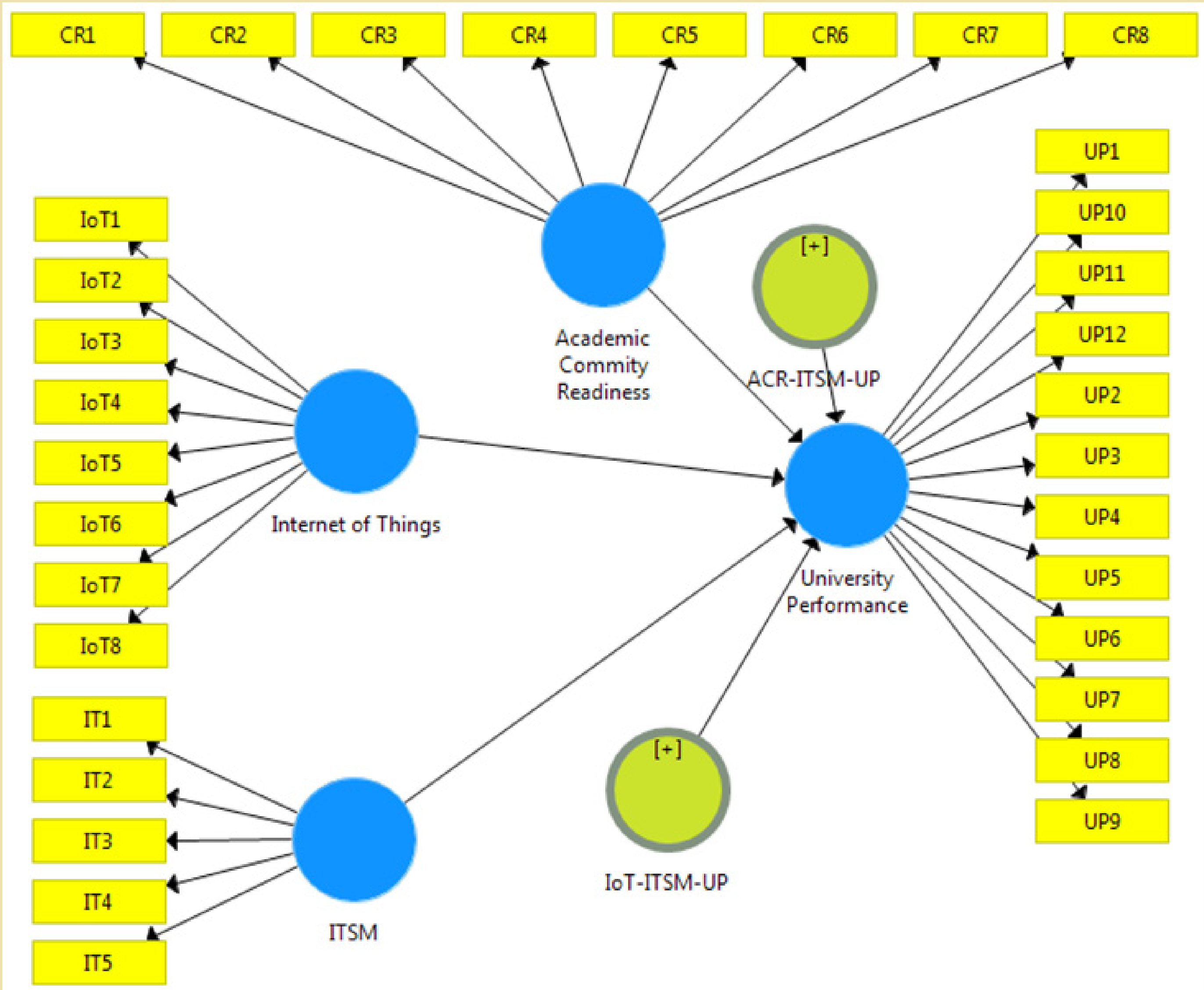

Figure 1 The model of research design and hiphotesis

Analysis of Research Data

In this study, data analysis will be conducted in two steps: the analysis of the outer model and the inner model [64]. The outer model test aims to determine the relationship between latent variables and their indicators using the help of the PLS Algorithm procedure [65]. This study evaluates the outer model using validity and reliability testing. Cronbach's Alpha is employed to measure data reliability, with a minimum acceptable value of 0.7, while the ideal value ranges between 0.8 and 0.9. In addition to Cronbach's Alpha, composite reliability values are also used, which are interpreted similarly to Cronbach's Alpha. Reflective indicators should be removed from the measurement model if their outer standard loading values fall below 0.4 [66].

The researchers will also look at the validity of the items in the research instrument by looking at the factor loading values. The factor loading value shows the correlation between the indicator and the construct. An indicator with a low loading value indicates that the indicator does not work in the measurement model and an expected loading value > 0.7 [67].

In the next stage, the researcher will test the inner model to predict causality relationships between latent variables or variables that cannot be measured directly [68]. The inner model describes the causal relationship between latent variables built based on the substance of the theory. Tests on the structural model were conducted to examine the relationships between latent constructs, using the R Square value to evaluate endogenous constructs [69]. The R Square value represents the coefficient of determination for the endogenous construct, indicating how well the independent variables explain the variance in the dependent variable. According to Chin, R Square values are categorized as 0.67 (strong), 0.33 (moderate), and 0.19 (weak) [70].

RESULTS

Validity and Realibility Test

Table 1 shows the results of the outer model analysis, which consists of convergent validity values seen in the loading factor, Cronbach's alpha, composite reliability, and AVE value. The outer loading section shows the validity of the items per indicator, which the value received is > 0.70. The data above indicates several items with a value of less than 0.70, such as CR6, IoT2, and UP1. To overcome this problem, researchers can usually delete or replace these items with other items. However, in this study, these items were kept with the consideration that when viewed from the AVE value of each variable, the value is more significant than 0.5 and has met the requirements because the AVE value received must be greater than 0.5. In the AVE value column, it can be seen that the four variables above have AVE values in the range of 0.634 – 0.658, so they are considered to have met the requirements of construct validity [71].

Meanwhile, variable reliability can be seen from Cronbach's alpha value, rho_A value, and composite reliability, where the discounts in the three categories above are accepted if it is more significant than 0.7.

Table 1

Factor loading, Cronbach's alpha, rho_A, Composite reliability, and AVE

Dimensions	Factor Loading	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
CR1	0,786	0,918	0,929	0,933	0,639
CR2	0,869				
CR3	0,885				
CR4	0,858				
CR5	0,837				
CR6	0,657				
CR7	0,789				
CR8	0,680				
IT1	0,828	0,870	0,882	0,906	0,658
IT2	0,882				
IT3	0,830				
IT4	0,710				
IT5	0,796				
IoT1	0,759	0,916	0,929	0,932	0,636
IoT2	0,540				

IoT3	0,831				
IoT4	0,865				
IoT5	0,859				
IoT6	0,834				
IoT7	0,791				
IoT8	0,848				
UP1	0,523	0,946	0,951	0,953	0,634
UP10	0,803				
UP11	0,857				
UP12	0,736				
UP2	0,799				
UP3	0,777				
UP4	0,745				
UP5	0,800				
UP6	0,834				
UP7	0,867				
UP8	0,872				
UP9	0,876				

The analysis results indicate that all variables in the three categories have values greater than 0.7, demonstrating that they meet the validity and reliability requirements. The Cronbach's alpha values range from 0.870 to 0.946, exceeding the threshold of 0.70, which confirms reliability. Similarly, from the composite reliability perspective, the values range from 0.906 to 0.953, also exceeding 0.70, further confirming reliability [71].

Test of Research Hypothesis

Answering the first hypothesis regarding the influence of academic community readiness on university performance, Table 3 shows a P-value of 0.00 < 0.05 and a T-statistic of 3.818. This indicates a significant direct effect of academic community readiness on university performance, confirming that the first hypothesis is accepted.

Table 2

Results of path coefficient analysis with SmartPLS

Dimensions	Original Sample	Sample Mean	Standard Deviation	T- Statistics	P-Values	Status
ACR -> UP	0,330	0,317	0,086	3,818	0,000	accepted
ITSM -> UP	0,239	0,243	0,048	4,946	0,000	accepted
IoT -> UP	0,154	0,158	0,055	2,778	0,006	accepted
ACR-ITSM -> UP	0,314	0,205	0,098	3,139	0,039	accepted
IoT-ITSM ->UP	0,253	0,235	0,087	3,759	0,019	accepted

For the second hypothesis regarding the effect of IoT implementation on university performance, Table 3 shows a P-value of 0.000 < 0.05 and a T-statistic of 4.946, indicating a significant impact of IoT implementation on university performance. Therefore, the second hypothesis is accepted.

Similarly, for the third hypothesis concerning the effect of ITSM on university performance, Table 3 demonstrates a significant direct impact with a P-value of 0.006 and a T-statistic of 2.778. This confirms that ITSM implementation has a significant direct effect on improving university performance, and thus, the third hypothesis is accepted.

For the fourth and fifth hypotheses, which examine whether ITSM moderates the relationship between academic community readiness and IoT implementation on university performance, Table 3 shows positive and significant results with P-values of 0.039 and 0.019 < 0.05, respectively. This indicates that ITSM moderates the relationship between academic community readiness and IoT implementation with university performance, confirming that both hypotheses are accepted.

To determine the magnitude of the influence of exogenous variables on endogenous variables, the researcher refers to the R-squared value. Based on the analysis results, the obtained values are as listed in Table 3.

Table 3

R-squared value

Dimension	R Square	R Square Adjusted
University Performance	0,752	0,749

Table 3 shows that the R-squared value is 0.752, indicating that the influence of ACR, IoT, and ITSM on Smart University Performance is strong. In the context of research, this indicates that the model used has high predictive power, and the relationship between the independent and dependent variables is highly significant.

DISCUSSION

The findings of this research reveal that academic community readiness, IoT implementation, and ITSM have a direct impact on university performance. Furthermore, ITSM moderates the relationship between academic community readiness, IoT implementation, and university performance. The study highlights the pivotal role of academic community readiness in shaping the performance of higher education institutions. Understanding the influence of academic community readiness is crucial for fostering development, driving innovation, and achieving institutional success. A well-prepared academic community helps minimize errors and promotes growth. When faculty members, researchers, and students are equipped to embrace new ideas and approaches, they create an environment that fosters innovation and progress.

The findings align with previous studies that underscore the importance of assessing community readiness prior to implementing various developmental initiatives, such as urban development [22], social marketing [21], science and technology development [36], and the growth of higher education institutions.

A smart academic community is rooted in the foundation of academic community readiness. The willingness to engage in research and stay updated with the latest advancements enables higher education institutions to remain at the forefront of knowledge dissemination. To achieve optimal performance, these institutions must prioritize academic community readiness by providing necessary resources, fostering a culture of continuous learning, and encouraging collaboration among faculty members and students. Understanding the impact of academic community readiness on the performance of higher education institutions is essential for their development and success [72]. By cultivating an environment that values research and innovation, institutions can thrive in today’s dynamic educational landscape.

Furthermore, the implementation of IoT has a significant influence on university performance. Enhanced connectivity enables universities to transform their campuses into innovative, intelligent environments. This research supports previous studies demonstrating that IoT can improve operational efficiency and resource management in tertiary institutions [73].

This research also revealed that ITSM implementation has a substantial impact on university performance. By integrating IoT technology with intelligent management systems, universities can create an innovative and smart campus environment. ITSM also addresses various operational challenges faced by higher education institutions, enabling a more effective and efficient problem-solving process. These findings align with previous studies showing that ITSM implementation improves connectivity among different systems within higher education institutions [74], facilitating seamless integration of data and information. This integration accelerates and enhances decision-making processes, ensuring they are conducted more quickly and accurately [75].

Innovation is another significant positive impact of implementing ITSM. Universities can leverage this technology to develop new solutions that enhance education and teaching quality. Thus, ITSM plays a crucial role in improving higher education performance. Recognizing the vast potential of this technology, universities must implement ITSM effectively to achieve greater progress in the future [76].

In moderating the relationship between campus community readiness, IoT implementation, and university performance, IT Service Management (ITSM) plays a pivotal role. By employing intelligent management practices and fostering innovation, ITSM helps universities address connectivity challenges and fully harness the potential of IoT to create an efficient and innovative campus environment [77].

However, challenges often arise in managing infrastructure, ensuring data security, and integrating complex systems. ITSM offers effective solutions to these issues. With its problem-solving approach, ITSM helps universities identify and overcome barriers in IoT implementation [78]. By ensuring effective management of both technology and business processes, universities can optimize their use of IoT to improve student learning experiences and overall operational efficiency [52].

Therefore, ITSM serves as a critical factor in moderating the relationship between campus community readiness, IoT implementation, and university performance. With its emphasis on innovation, intelligent management, and efficient problem-solving, ITSM becomes a strategic partner for universities in fostering a thriving and innovative campus environment.

CONCLUSION

In conclusion, the readiness of the campus community and the implementation of IoT significantly enhance the performance of higher education institutions by enabling the development of smart campuses. IoT technology optimizes operations, improves efficiency in facilities management, security systems, and student services, and supports data-driven decision-making. However, the full potential of IoT can only be realized when universities prioritize community readiness by equipping students, faculty, and staff with the necessary skills and knowledge to effectively utilize IoT. Additionally, ITSM plays a critical role in moderating the relationship between community readiness and IoT implementation by ensuring seamless connectivity, intelligent management, and innovative solutions. Through ITSM practices, universities can optimize resources, enhance operational efficiency, and create a conducive learning environment, thereby preparing students for future technological advancements while delivering an exceptional educational experience.

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