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SMART MANAGEMENT IN A BRAZILLIAN UNIVERSITY: AN ASSESSMENT

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1 INTRODUCTION

The imperative to address challenges such as urban expansion, infrastructure deficiencies, environmental degradation, and quality of life has propelled the rise of smart cities. The integration of information and communication technologies (ICTs) is fundamental to creating efficient, sustainable, and inclusive urban environments. Smart management practices, emphasizing human capital development, resource optimization, and participatory governance, are essential components of successful smart cities.

The educational sector has also embraced technological advancements, leveraging the internet to enhance learning experiences through online resources, collaborative tools, and mobile learning platforms. This evolution has paved the way for the emergence of the smart campus concept, characterized by technology-driven communication, collaboration, and innovation.

While the potential benefits of smart campuses are substantial, challenges related to user experience, learning outcomes, sustainability, privacy, and equity must be carefully addressed. As the field continues to evolve, ongoing research is essential to identify emerging trends and inform the development of effective smart campus strategies. This study contributes to the growing body of knowledge on smart campuses by examining the smart management dimension from the perspective of university students. By investigating student perceptions and experiences, the research aims to inform the development and implementation of strategies to enhance the smart campus experience.

2 LITERATURE REWVIEW

As smart cities emerge, driven by the Internet of Things (IoT) and advances in Information and Communication Technology (ICT), they facilitate the connection of devices on any scale, enabling widespread interaction. However, transitioning from a traditional city to a smart city involves significant technical, sociocultural, and economic transformations (Gandy and Nemorin, 2019). The implementation of smart cities requires specialized skills across various fields of knowledge (Sadowski and Pasquale, 2015).

The primary objective of smart cities is to promote social advancement by significantly contributing to the achievement of the Sustainable Development Goals (SDGs). By employing refined standards such as clean technology, smart cities aim to enhance the quality of life for citizens in areas such as health, transportation, and energy (Sing et al., 2020). Understanding and addressing the needs of the population ensures that public systems are closely aligned with the knowledge and goals of smart cities (Batty et al., 2012).

Digital and electronic technologies have transformed urban environments into interconnected ecosystems, creating a complex network that aims to make cities more sustainable, safe, efficient, and inclusive (Deakin and Al Waer, 2011). Integrating the needs of the city with those of society is crucial to ensure the acceptability of these initiatives. Consequently, the implementation of efficient technologies not only improves the quality of life but also enhances infrastructure and fosters active participation from society (Deakin, 2013).

To successfully form smart cities, there must be an interaction between data technology and innovation across various sectors that drive urban dominance and sustainable development. Giffinger et al. (2020) proposed that six domains are responsible for the success of smart cities:

smart economy, smart people, smart governance, smart mobility, smart environment, and smart living.

In summary, the theories propose that adopting mechanisms to create smart cities aims to develop environments that are more dynamic, sustainable, connected, and adaptable to the constantly evolving needs of society. This transformation entails improvements across several sectors. However, for the successful development of smart cities, methods and processes need to be standardized and based on a dynamic and continuous process, ensuring that the needs of the community and other stakeholders are met with flexibility and collaboration.

2.1 SMART CAMPUS

The emergence of universities in the Western world can be traced back to European Christian monasteries around the 11th century. Initially, the academic structure consisted of arts, medicine, theology, and law, following a scholastic foundation (Vaujanx et al., 2011; Scholz, 2020). For centuries, the Christian church maintained control over universities, and scientific practices were characterized by rigorous debates from various perspectives (Vaujanx et al., 2011).

This approach continued until the French Revolution, a period marked by the emergence of professional schools (Vaujanx et al., 2011; Scholz, 2020). Subsequently, other countries began to introduce classical research teaching linked to humanistic education (Scholz, 2020; Kintzinger, 2017). The First and Second World Wars brought about significant changes in educational systems, leading to the development of new types of universities, the introduction of new courses, disciplines, research methods, paradigms, and student movements that transformed the societal role of universities (Scholz, 2020).

Authors such as Min-Allah and Alrashed (2020), Prandi et al. (2019), and Chiu et al. (2020) note that the concept of a smart campus is still in an exploratory phase, with low consensus regarding its definition, dimensions, or particularities. The concept of a smart campus is generally based on three distinct characteristics: personalized services, information services, and environmental platforms (Ahmed et al., 2020).

A smart campus is envisioned as an intelligent space for teaching, learning, and living (Mishalani et al., 2019). It is an environment founded on Internet technology, benefiting from software that supports teaching, research, management, and campus life. Additionally, it can be understood as a learning ecosystem that employs information technology to foster efficient and interconnected collaborative governance, benefiting the broader community (Silva-da-Nóbrega, Chim-Miki, Castilho-Palacio, 2022).

Similar to smart cities, a smart campus integrates technologies such as the Internet of Things (IoT), cloud computing, and Geographic Information System (GIS) technology to promote scientific research growth based on the fusion of physical and digital infrastructure (Liang et al., 2011). The smart campus model represents the convergence of the campus's physical and cyberspaces, incorporating IoT sensors and applications to build an inclusive resource capable of enhancing university management (Min-Allah and Alrashed, 2020). Consequently, many universities have begun adopting smart technologies on their campuses.

From a management perspective, the interaction between students, employees, and campus resources forms the basis of a managerially intelligent campus (Chiu et al., 2020). Utilizing a deep network for service improvement, consumption reduction, problem signaling, locomotion, and sharing facilitates the establishment of responsive and improved methods (Bosch et al., 2019).

The future university must strive to leverage technology to promote a smart campus that enhances habitability and quality of life (Coccoli et al., 2017; Durán-Sanchez et al., 2018). Technology acts as the driving force behind the digitalization of processes in colleges and universities (Luo, 2018; Celdran et al., 2019). With the rapid emergence of new technologies, the digitization of processes has accelerated, enabling more focused management, concrete data utilization, and an intelligent strategic planning vision (Rico-Bautista et al., 2020; Fernández-Caramés and Fraga-Lamas, 2019). In summary, transforming universities into smart campuses requires a collaborative effort from all stakeholders and the integration of technology and sustainability.

2.2 SMART MANAGEMENT

Management, traditionally defined by the functions of planning, organizing, commanding, coordinating, and controlling, is a multifaceted discipline essential for the sustainability of all economic sectors within a company. It effectively guides operations by aligning resources, people, and even complex systems, such as cities (Oliveira, 2018; Soares, 2022). According to Pinto et al. (2019), the appropriate management model for smart cities involves citizen participation through open integration and community decision-making.

The management of smart cities aims to understand, stimulate, interact, share, and observe through the proper integration of smart technologies and processes, thus making cities more sustainable and resilient to meet the needs of their inhabitants (Pinto et al., 2019). Consequently, management and governance are crucial components in defining smart cities (Nascimento et al., 2019). By implementing initiatives that encourage citizens to become "active users" (active citizens), public and private actors share political, regulatory, and service provision responsibilities, representing a collective of stakeholders (Gil et al., 2019).

Smart governance management relies on active societal and political participation, ensuring that this integration controls the decision-making process (Kirimtat et al., 2020). Social, political, economic, and technological aspects form the core of intelligent governance, providing a better understanding of urban environments (Figueirôa-Ferreira and Fernandes, 2021). However, challenges such as lack of public and political support, limited resources, and conflicts of interest can impact the decision-making process and organizational structure when addressing problems (Kitchin and Moore-Cherry, 2020). Therefore, aiming for tangible outcomes like public value, clean energy, well-being, and smart livability promotes a more socialized urban life (Jiang et al., 2019).

Systematization posits that smart management is an indicative parameter with a set of indicators involving complex projects and financial resources. Consequently, governance includes the development of public administration, contributing to the transparency of its subsystems' functioning and maintenance (Baracho, 2020). When linking smart management to a smart campus, it can be defined as a comprehensive method that promotes participation, transparency, continuous growth, and the conscious use of resources to develop an environment conducive to academic success, sustainable development, and renewal (Silva-da-Nóbrega, Chim-Miki, Castilho-Palacio, 2022).

2.3 CORPORATE GOVERNANCE

In the 1930s, Berle and Means (1932) initiated the debate regarding the separation between control and ownership of organizations, positing that this division could drive conflicts of interest within organizations (Álvares, Giacometti, and Gusso, 2008). The concept of corporate governance began to gain traction in Brazil in the mid-1990s, introduced into the national discourse in 1995 by the Brazilian Institute of Corporate Governance (IBCG). It wasn't until 1998, however, that conflicts between controllers and minority shareholders brought significant attention to the topic (Silveira, 2010).

Corporate governance, as a concept, involves the execution of power, leadership, and management, associated with good governance practices endorsed by the World Bank since 1992 (World Bank, 1992). This governance model emphasizes managing capital efficiently to align and optimize organizational results, thereby providing a sense of security for both owners and administrators through various governance structures (Brasil, 2014).

Governance can be defined as the state's ability to effectively provide public policies, based on the conception of contemporary entities' formation (Wildberger and Gileá, 2020). It fosters cooperation through statutes and regulations that promote mutual collaboration between economic, social, and political sectors (Xavier, Totti, and Raddatz, 2021). From a legal perspective, governance pertains to state interventions and management, encompassing law and sovereignty, and is facilitated through the creation of institutional links between government, state, and society (Alves, 2022).

Corporate governance aims to enhance decision-making by considering stakeholders' perspectives. Monitoring techniques in management focus on benefiting the organization, shareholders, and stakeholders, thereby increasing the company's attractiveness for capital investments, mediating conflicts of interest, and ensuring maximum economic responsibility, social progress, and well-being (Weber and Santos, 2020).

The digital transformation has significantly impacted the structure, processes, and procedures within Public Administration (Covas, 2021). Public Administration encompasses the management processes of state governance, including policy formulation, project implementation, regulation, supervision, and resource management, all aimed at promoting well-being and the effective functioning of citizens and democratic institutions (Hungarian, 2020).

This model seeks to integrate digital technologies within the public sphere and governance sector, fostering a constitutive and cooperative perspective. However, challenges such as information transparency, participation channels, and openness of elements need to be addressed to achieve effective Digital Public Governance. Without these factors, traditional hierarchical models cannot fully transition to digital governance (Tavares and Bittencourt, 2022).

3 METHODOLOGY

The present study aims to analyze the smart management dimension of a Brazilian university, specifically evaluating it as a smart campus from the perspective of its students. This research employs a quantitative, descriptive-exploratory approach, utilizing criteria designed to provide an overview and support the evolution of a smart campus while addressing the obstacles it faces. The importance of diverse conceptions among stakeholders is acknowledged, with the goal of characterizing a group to infer trends and behavioral patterns within a given context.

The target audience selected for this study consists of students from the Federal University of Campina Grande (UFCG), located in the Northeast of Brazil. UFCG hosts approximately 20,000 students across 124 undergraduate programs (bachelor's, master's, and doctoral), with a faculty of 1,500 professors and a staff of 1,400 employees. As a public university, UFCG is recognized nationally for its initiatives to develop a smart campus at its main headquarters and operates across seven campuses (UFCG, 2023).

The first stage of this research involves a comprehensive literature review (Baracho, Min-Allah and Alrashed, Kirimtat et al., 2020) to define the main criteria for the Smart Campus and Smart Management framework. Consequently, the structure encompasses eight primary subdimensions and 27 variables related to Smart Campus, Smart Management, and Governance. Prior to the survey's application, face validity and content validation were conducted with undergraduate and postgraduate students and faculty members to enhance the reliability and clarity of the questions, resulting in a refined set of 27 variables (Table 1).

Table 1: Indicators in smart management

Indicators	Variable	Authors
My campus has a management focused at the use in resources sustainable?	Sustainable resources	
At your perspective, The UFCG uses technologies smart for optimize O use in resources natural or reduce waste?	Natural resources	SILVA-DA-NOBREGA, 2022
At your perspective, The UFCG he has adopted The integration in smart management practices aligned with sustainability objectives?	Sustainability practices	
At your vision, The UFCG disclose your installment in bills annually?	Installment in account	
At your opinion, The UFCG promotes The transparency in the operations and processes of management practices?	Transparency	BARACHO, 2020
At your perspective, the UFCG implements strategies/actions that promote one environment in information shared openly?	Culture of transparency	BARACHO, 2020
At your perspective, The UFCG implements strategies/actions that promote an environment of openly shared information?	Managemen t of processes	SILVA- DA-NOBREGA ET AL, 2022
At your opinion, The UFCG it has one platform online process management?	System management	MIN-ALLAH AND ALRASHED, 2020
In your view, the UFCG implements in form effective the use of management systems?	Technical capabilities	MIN-ALLAH AND ALRASHED, 2020
In your opinion, UFCG provides technical training among stakeholders for what are prepared for to use to the technologies in form effective?	Data security	MIN-ALLAH AND ALRASHED, 2020
From your perspective, does UFCG guarantee data privacy and information security when using these technologies?	Budget	SILVA-DA-NOBREGA ET AL, 2022
At your opinion, The UFCG performs one planning strategic budget participative?	Outlet in decision	VALKAMA AND SALMINEN, 2019
For the your vision, The UFCG uses approaches based in data and analysis for the decision-making process of the advice?	Culture of innovation	GIL ET AL, 2019
For the your point in View, The UFCG encourages one culture in active encouragement to creativity, thinking original and collaboration between different areas?	Participation	
At your perspective, The UFCG makes it easier The participation of stakeholders us Law Suit in outlet in decision from the organization?	Culture of appreciation	KIRIMTAT ET AL, 2020
At your opinion, The UFCG contributes for The construction in one culture that values The active participation among students?	Integration	
At your perspective, The UFCG ensures what all you levels hierarchical if feel included It is valued in participatory processes ?	Optimization of processes	CHIU ET AL, 2020
In your view, does UFCG use dynamic management to optimize and automate processes?	Monitoring	RICO-BAUTISTA ET AL, 2020
At your opinion, The UFCG monitor you Law Suit in long term?	Efficiency	CHIU ET AL, 2020
At From its perspective, UFCG uses approaches to evaluate the efficiency of existing processes?	Standardization	RICO-BAUTISTA ET AL, 2020
At your vision, the UFCG standardizes you Law Suit What contributes to the efficiency and quality of work?	Smart Management	SOARES, 2022

In your opinion, does UFCG integrate Smart Management into budget processes?	Analysis in data	HUNGARIAN, 2020
From your perspective, does UFCG apply data analysis to improve the accuracy of budget forecasts?	Budget decision	WEBER AND SANTOS, 2020
In your opinion, does UFCG use criteria to decide on budget reallocations during the execution period?	Strategy	WEBER AND SANTOS, 2020
For the your vision, The UFCG adopt strategies for to lead with unexpected changes during the budget cycle?	Personal development	
From your point of view , UFCG influence the professional development of your employees?	Empowerment	TAVARES AND BITTENCOURT, 2022
At your opinion, The UFCG promotes O empowerment It is the delegation in responsibilities in between you leaders It is your teams?	Culture of agility	
At your vision, The UFCG ensures what you leaders are aligned with the vision, innovation It is culture in agility?	Culture of agility	

Source: Authors (2024).

The second stage of the research focused on data collection using an online questionnaire distributed through the Google Forms platform. This survey research model aimed to gain insights into stakeholders' perceptions of the smart campus concept, supported by the predefined criteria (Chiu et al., 2020; Weber and Santos, 2020).

To reach the target audience, the questionnaire was disseminated among students at the Federal University of Campina Grande (UFCG) via social media platforms such as Instagram and WhatsApp, in-person administration, and email. This approach was designed to maximize the versatility and reach of the research. The sample size was determined to achieve a 95% confidence level with a 5% margin of error, requiring 378 respondents. This sample size was deemed sufficient to ensure that the research results were reliable and could be used effectively for decision-making.

To assess the attributes and support decision-making, the Importance-Performance Analysis (IPA) technique (Martilla and James, 1977) was employed. IPA identifies strengths and weaknesses in order to develop specific recommendations for improvement, addressing gaps and bottlenecks to foster positive changes. This flexible approach allows for the exploration of human experiences, providing valuable insights that contribute to knowledge advancement and practical application (Sever, 2015).

The data were analyzed using IBM SPSS Statistics 26 software to summarize, describe, and generate the IPA matrix. The IPA matrix consists of four quadrants:

Quadrant 1: High performance but low impact—elements in this quadrant are performing well but have minimal impact, indicating areas where improvements can further enhance effectiveness.

Quadrant 2: High performance and high impact—items in this quadrant contribute significantly to success and are performing well, thus should be maintained or further supported.

Quadrant 3: Low performance and low impact—elements here are neither performing well nor significantly impacting outcomes, suggesting low priority for immediate intervention.

Quadrant 4: High performance but low impact—elements in this quadrant are performing well but have little impact, suggesting that resources may need reallocation or discontinuation of services (Martilla and James, 1977).

The IPA matrix was selected for its ability to visually represent priority areas for resource allocation, facilitating alignment between organizational goals and stakeholder needs. The matrix below illustrates the evaluation criteria and scores within each quadrant (Figure 1).

Figure 1. Matrix IPA

Source: Authors based on Martilla and James (1977)

To achieve this, specific questions relevant to the research objective were formulated, with respondents asked to rate their opinions, attitudes, or experiences using a five-point Likert scale, as detailed in Appendix 1. This scale ranged from 1 to 5, where lower values (1 and 2) indicated lower levels of importance or performance, a neutral value (3) represented a neutral stance, and higher values (4 and 5) reflected greater relevance or performance for each indicator. This approach allowed for a nuanced capture of respondent feedback, providing a comprehensive understanding of the importance and performance associated with each criterion.

4 RESULTS AND DISCUSSIONS

A total of 415 responses were collected, of which 384 were deemed valid. The invalid responses included 11 from individuals who were not UFCG students and 25 with inaccurate data. The sample predominantly consisted of 64.9% female respondents, with 93.6% of them aged between 18 and 30 years. Most participants were enrolled in undergraduate courses (77.2%) and were based on the main campus in Campina Grande (92.1%). These characteristics are summarized in Table 2.

Table 2: Data demographic

Feature	Category	Frequency	%
Gender	Feminine	262	64.9
	Masculine	142	35.1
	Below from 18 years	0	0
	In between 18 It is 30 years	378	93.6
Age range	In between 31 It is 40 years	20	5
	In between 41 It is 50 years	3	0.7
	In between 51 It is 60 years	two	0.5
	Above from 61 years	0	0
Kind of course	Student graduation	380	99
	Student in postgraduate	4	1
	Meadow Big	372	92.1
	Cajazeiras	7	1.7

	Cuité	10	2.5
Campus	Ducks	6	1.5
	Pombal	6	1.5
	Souza	3	0.7
	Sumé	0	0

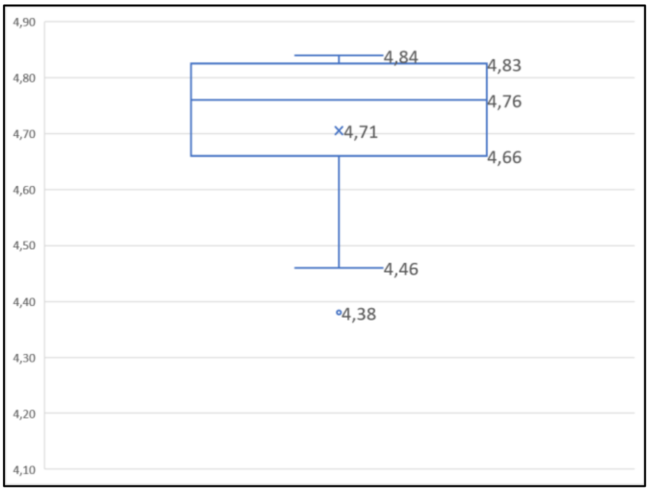
Source: Authors (2024)

4.1 Analysis statistic

Statistical analyses offer a nuanced understanding of the data collected from the survey, primarily focusing on describing distributions and identifying central characteristics. These analyses also facilitate the exploration of relationships between variables, thereby guiding various data analysis processes and making the information more comprehensible. The boxplot technique is employed to visualize data dispersion intuitively. This method summarizes the data using five key values: minimum, maximum, median, and quartiles.

In the importance boxplot (Figure 2), statistical data reflect respondents' perceptions of the importance of different attributes for assessing smart management within a smart campus. Most data points are clustered between 4.46 and 4.84, indicating a high level of importance attributed to these attributes. Although there are some data points outside the lower end of the plot, such as scores around 4.38, the overall level of importance remains consistently high. The interquartile range, spanning 50% of the data, is 0.17, suggesting a high degree of agreement among students regarding the significance of the analyzed attributes. This demonstrates a strong consistency in students' perceptions of the attributes under review.

Figure 2: Boxplot Importance

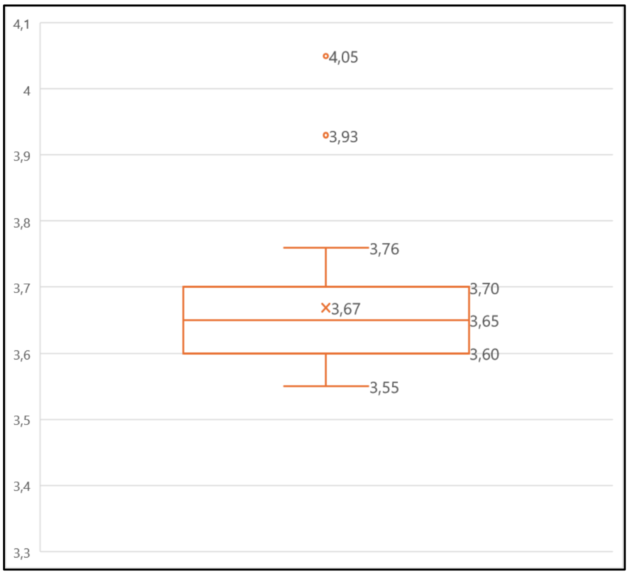


Source: Authors (2024).

The performance boxplot (Figure 3) provides a summary of how respondents rated the university campus's performance, revealing that the overall assessment is less favorable. The data show an average performance level that is generally perceived as unsatisfactory. Notably, around 50% of the interquartile range is relatively narrow, varying between 3.60 and 3.70, resulting in a small difference of 0.10 points. This indicates a relatively consistent view among respondents, but the overall performance rating remains modest.

The boxplot also reveals that the upper whisker is more extended than the lower whisker, suggesting a somewhat more positive perception in the upper quartile. The shorter size of the boxplot indicates that there is greater agreement among respondents, with less variation in perceptions of performance. However, there are some outliers beyond the upper quartile limits, representing higher performance values that deviate from the trend observed in the 75% range between the first and third quartiles.

Figure 3: Boxplot in Performance



Source: Authors (2024)

Examining the difference between the importance and performance boxplots (Figure 4) reveals a notable discrepancy. The importance boxplot indicates that the attributes evaluated by respondents are deemed crucial for assessing smart management within a smart campus context. In contrast, the performance boxplot illustrates a moderate level of execution for these indicators, as evidenced by its lower positioning on the graph. This disparity highlights the gaps between the high importance placed on these indicators and the university's actual performance in meeting them. The analysis underscores a need for improvements in the university's execution of these critical attributes to align with their perceived importance.

Table 3. Data statistics of subdimensions

Ranking	IMPORTANCE				PERFORMANCE					GAP
	Variable	Average	Detour Standard	Alpha		Average	Detour Standard	Alpha	VAR	gap I- P
1	TE	4.76	0.045	0.715	TE	3.64	0.055	0.715	V1	1.09
2	CA	4.76	0.034	0.726	CA	3.64	0.04	0.726	V2	1.09
3	EP	4.76	0.045	0.727	EP	3.83	0.195	0.727	V3	0.92
4	PA	4.75	0.036	0.586	PA	3.63	0.081	0.586	V4	1.12
5	OR	4.73	0.051	0.702	OR	3.61	0.055	0.702	V5	1.13
6	GL	4.73	0.024	0.762	GL	3.60	0.028	0.762	V6	1.09
7	ST	4.73	0.030	0.767	ST	3.58	0.028	0.767	V7	1.15
8	TR	4.73	0.047	0.791	TR	3.69	0.056	0.791	V8	1.04
	AVERAGE	4.74	0.039	0.722	-	3.65	0.067	0.722	-	1.07

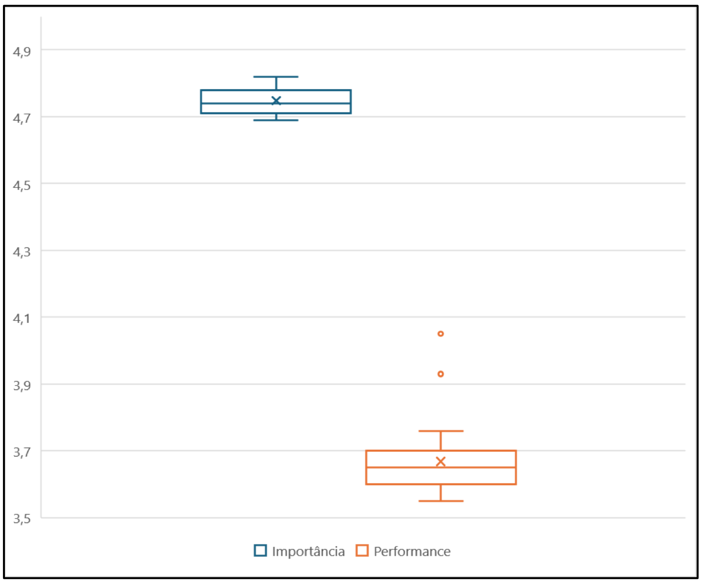
Source: Authors (2024).

The analysis reveals that the most important dimension in the smart campus framework is technology (TE), with a mean score of 4.76 and a standard deviation of 0.045. This suggests that technology plays a crucial role in automating processes, managing resources, and facilitating connections between campus system devices, thereby driving educational innovation. In contrast, transparency (TR) is the least important dimension, scoring an average of 4.73 with a standard deviation of 0.047. Nonetheless, it is still highly valued, indicating that students appreciate the engagement of the university community in fostering trust and the active presence of campus management.

Regarding performance, the dimension with the highest performance was efficient processes (EP), which achieved a mean score of 3.83 and a standard deviation of 0.195. This reflects UFCG's capability to respond swiftly to demands and issues, optimizing the use of time and resources. Conversely, the sustainability dimension (ST) had the lowest performance, with an average score of 3.58 and a standard deviation of 0.287. This suggests a lack of commitment to sustainable practices, leading to negative environmental impacts within the academic environment.

The data analysis also shows that all subdimensions exhibit gaps, indicating that improvements are needed to ensure integrated system communication and long-term strategic planning. The importance-performance (I-P) gap, which ranges from 0.93 to 1.15 on a scale of 1 to 5 points, highlights these discrepancies. Table 4 summarizes the mean, standard deviation, and I-P gap for each variable. It shows that the most important subdimensions are technology (TE, 4.82), participation and access (PA, 4.81), and governance and leadership (GL, 4.79). In contrast, sustainability (ST, 4.69) and operations and resources (OR, 4.69 and 4.70) are considered less important. Some variables have means above 4, with averages around 4.60 to 4.75 and a standard deviation of 0.02, indicating that these factors need further attention. These findings emphasize the need to address gaps and prioritize resources to enhance the functioning of the smart campus.

Figure 4: Difference boxplot importance x performance



Source: Authors (2024)

Initially, the mean and standard deviation for both importance and performance were calculated to facilitate the IPA (Importance-Performance Analysis). These values were used to assess the overall significance and effectiveness of various subdimensions. Table 3 presents these general indices by subdimension. To ensure the reliability of the data, alpha values (Cronbach's alpha) were calculated for the overall sample, each dimension, and each variable. All calculated alpha values exceeded 0.7, indicating a high level of reliability for the model used in this study. This suggests that the data is consistent and that the measurement model effectively captures the attributes being assessed.

The analysis reveals that the most important dimension for the smart campus at UFCG is Technology (TE), with a mean score of 4.76 and a standard deviation of 0.045. This suggests that technology significantly facilitates the automation of processes, resource management, and connectivity between campus system devices, which is crucial for educational innovation. Conversely, Transparency is the least important dimension, scoring an average of 4.73 with a standard deviation of 0.047. Despite its slightly lower ranking, it remains highly valued, reflecting students' appreciation for the university community's engagement in building trust and ensuring effective campus management.

In terms of performance, the dimension with the highest performance is Efficiency and Processes (EP), with an average score of 3.832 and a standard deviation of 0.195. This indicates that UFCG effectively responds to demands and problems, optimizing the use of time and resources for unexpected events. On the other hand, the dimension with the lowest performance is Sustainability (ST), with an average score of 3.58 and a standard deviation of 0.0287. This highlights a notable deficiency in sustainable practices, impacting the overall quality of life and contributing to negative environmental effects within the campus environment.

All subdimensions reveal performance gaps, suggesting the need for improvements to ensure integrated system communication and a long-term strategic plan. The Importance-Performance (I-P) difference ranges from 0.9275 to 1.15 on a scale of 1 to 5 points, as detailed in Table 4. This gap analysis identifies areas where the smart campus is not meeting its full potential, offering opportunities for academic managers to enhance performance. A smaller gap indicates better alignment between the importance of attributes and the university’s performance.

Table 4. Data statistics of variables

Ranking	Variable	Average	Standard Deviation	Alpha	Variable	Average	Standard deviation	Alpha	VAR	Gap I- P
1	V1	4.78	0.0359	0.953	V1	3.7	0.1084	0.954	V1	1.08
2	V2	4.74	0.0353	0.953	V2	3.65	0.1083	0.954	V2	1.09
3	V3	4.69	0.0353	0.953	V3	3.59	0.7141	0.954	V3	1.1
4	V4	4.77	0.0336	0.953	V4	3.64	0.9855	0.954	V4	1.13
5	V5	4.71	0.0334	0.953	V5	3.68	1.1808	0.954	V5	1.03
6	V6	4.71	0.0327	0.953	V6	3.6	1.3335	0.954	V6	1.11
7	V7	4.82	0.0317	0.953	V7	4.05	1.4585	0.954	V7	0.77
8	V8	4.75	0.0287	0.953	V8	3.93	1.5511	0.954	V8	0.82
9	V9	4.71	0.0287	0.953	V9	3.61	1.6279	0.954	V9	1.1
10	V10	4.76	0.0278	0.953	V10	3.74	1.6969	0.954	V10	1.02
11	V11	4.80	0.0283	0.953	V11	3.73	1.7139	0.954	V11	1.07
12	V12	4.75	0.0268	0.953	V12	3.58	1.7310	0.954	V12	1.17
13	V13	4.73	0.0274	0.953	V13	3.6	1.7525	0.954	V13	1.13
14	V14	4.81	0.0247	0.953	V14	3.68	1.7735	0.954	V14	1.13
15	V15	4.74	0.0253	0.953	V15	3.58	1.7918	0.954	V15	1.16
16	V16	4.71	0.0247	0.953	V16	3.59	1.8131	0.954	V16	1.12
17	V17	4.78	0.0240	0.953	V17	3.65	1.8336	0.954	V17	1.13
18	V18	4.73	0.0244	0.953	V18	3.71	1.8504	0.954	V18	1.02
19	V19	4.78	0.0235	0.953	V19	3.66	1.8620	0.954	V19	1.12
20	V20	4.75	0.0242	0.953	V20	3.65	1.8726	0.954	V20	1.1
21	V21	4.78	0.0229	0.953	V21	3.58	1.8789	0.954	V21	1.2
22	V22	4.7	0.0230	0.953	V22	3.61	1.8832	0.954	V22	1.11
23	V23	4.69	0.0220	0.953	V23	3.61	1.8760	0.954	V23	1.1
24	V24	4.74	0.0230	0.953	V24	3.55	1.8541	0.954	V24	1.19
25	V25	4.79	0.0188	0.953	V25	3.76	1.8163	0.954	V25	1.03
26	V26	4.72	0.0186	0.953	V26	3.65	1.7120	0.954	V26	1.07

27	V27	4.73	0.0183	0.953	V27	3.68	1.5488	0.954	V27	1.02
	Average	**4.7474**	**0.0271**			**3.6688**	**1.5307**			**1,070**

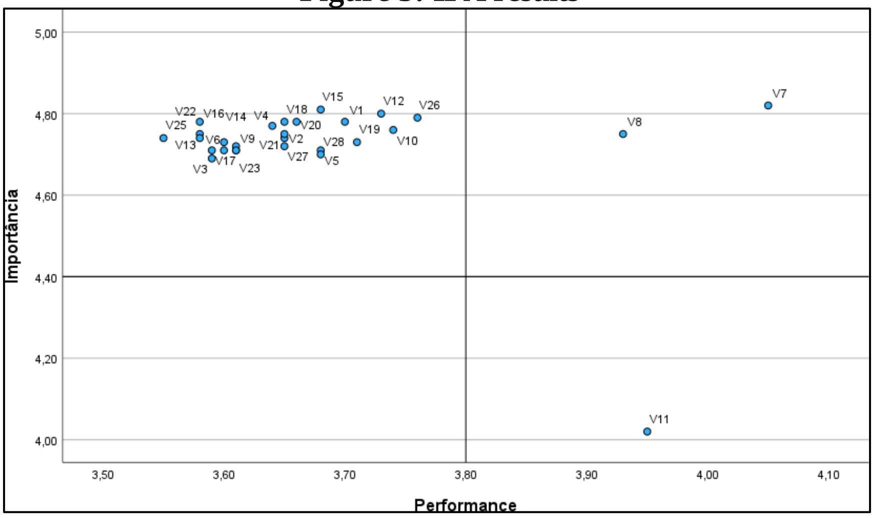
Source: Authors (2024)

The results underscore that the most critical subdimensions for a smart campus are Technology (TE) (mean = 4.82), Participation and Accessibility (PA) (mean = 4.81), and Governance and Leadership (GL) (mean = 4.79). Conversely, Sustainability (ST) (mean = 4.69) and Operational Resources (OR) (means = 4.69 and 4.70) are considered less important. Nonetheless, some variables with means above 4 and averages between 4.60 and 4.75 indicate areas needing attention. These findings highlight the essential resources and priorities necessary for developing an effective smart campus environment.

4.2 IPA Analysis

Based on this, Figure 5 below presents the IPA matrix, which highlights the four quadrants used to compare the importance attributed to certain attributes with the performance perceived in these attributes. The first quadrant contains more than 50% of the attributes (25), indicating that these factors are extremely important for the development of a smart campus. This quadrant emphasizes the need for managers to implement smart solutions to enhance decision-making and improve the performance of these critical attributes.

Figure 5: IPA results



Source: Authors (2024)

Quadrant 1 contains variables from six different subdimensions: sustainability (3), transparency (3), participation (3), process efficiency (4), budget (4), and governance/leadership (3). This quadrant includes more than 50% of the attributes, indicating that these factors are crucial for the development of a smart campus. Managers need to focus on these attributes to improve their performance, as they are essential for creating an effective and well-managed smart campus.

Quadrant 2 features two variables from the technology subdimension, highlighting areas such as the use of management systems, information security, and the proper use of management platforms. These factors are considered important but currently have low performance on campus. This suggests that while these aspects are vital for future innovation and leadership, they require significant improvement. Quadrant 3 did not include any variables, indicating that there are no attributes that are both of low importance and low performance.

Quadrant 4 shows attributes with high performance but low importance. The only variable in this quadrant is the existence of an Administrative Council (CA), suggesting that while this variable performs well, it is not deemed crucial for the current smart campus objectives.

Figure 5 illustrates that, according to Quadrant 1, paths for improvement should focus on directing resources and efforts towards critical areas like Technology (V7 and V8), Administrative Council (V11), and maintaining commitment to aspects related to Sustainability (V1), Participation (V15), and Governance/Leadership (V26). The results indicate that Smart Management not only integrates operational efficiency and quality of life on campus but also supports environmental sustainability, technological innovation, and community engagement.

5 CONCLUSIONS

This research aimed to analyze the smart management dimension of a Brazilian university as a smart campus from the perspective of its students. Indicators were formulated based on literature and applied using a quantitative methodology, specifically Importance-Performance Analysis (IPA). The study assessed how students perceived the importance and applicability of various smart management variables, highlighting their relevance in helping university managers make informed decisions aligned with campus objectives (Silva-da-Nóbrega, Chim-Miki, Castilho-Palacio, 2022).

The research produced theoretical, methodological, and empirical insights. It demonstrated that smart management encompasses not only the implementation of advanced technologies but also the creation of a sustainable and high-quality living environment. This approach aims to address community needs and expectations while leveraging technological tools to achieve these goals. The study evaluated eight sub-dimensions: sustainability, technology, participation, process efficiency, transparency, governance/leadership, budget, and administrative council.

In the methodology, indicators were adapted using the IPA matrix to assess the educational institution and identify areas deemed most important by students, prioritizing improvements for future decision-making. The results for UFCG revealed key priorities for managers to consider, particularly in Technology, Administrative Council, and Process Efficiency.

The quantitative analysis summarized two main findings: (1) the smart management model and its indicators, and (2) UFCG's current performance in smart management. Students rated all analyzed variables as highly important (>4), but the university's performance was found to be average in relation to smart management practices. While technology-related items were highlighted as crucial, issues related to Participation and the Administrative Council should also be prioritized.

The study found that UFCG promotes academic innovation, utilizes emerging technologies, and enhances resource automation. However, there is a need for greater engagement of the academic community, including students, faculty, and staff, in decision-making related to the smart campus. Developing mechanisms for student involvement and piloting smart campus initiatives could be beneficial for future improvements.

The study's limitation lies in its unilateral perspective, as only UFCG students participated, which may not fully represent the views of other stakeholders. Future research should explore new variables, conduct stratified studies, and investigate university partnerships for smart city projects. Additionally, examining how universities can contribute to public policy formulation related to smart campuses would provide valuable insights.

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