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ICT MANAGEMENT AND ENVIRONMENTAL SUSTAINABILITY PERFORMANCE IN PUBLIC UNIVERSITIES

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ABSTRACT

The growing demand for sustainable development has positioned public universities as key actors in promoting environmentally responsible practices. In this context, Information and Communication Technology (ICT) management plays a strategic role in improving environmental sustainability performance. This study aims to analyze the effect of ICT management on environmental sustainability performance in public universities. A quantitative approach was adopted using a non-experimental, cross-sectional, explanatory design. The study sample consisted of administrative and academic staff from a public university, selected through non-probabilistic convenience sampling. Data were collected using validated questionnaires that measured ICT management and environmental sustainability performance dimensions. Ordinal logistic regression was applied to test the research hypotheses. The results indicate that ICT management has a statistically significant effect on environmental sustainability performance, explaining a high proportion of variance in sustainable institutional practices. These findings demonstrate that effective ICT planning, digitalization, and technological infrastructure management contribute significantly to energy efficiency, paper reduction, and environmentally responsible decision-making in public universities.

KEYWORDS: ICT Management, Environmental Sustainability, Public Universities, Sustainable Performance.

1. INTRODUCTION

Environmental sustainability has become a central concern for higher education institutions due to increasing environmental degradation, climate change, and the global commitment to sustainable development. Public universities, as generators of knowledge and social transformation, are expected to lead by example through the adoption of sustainable management practices that reduce environmental impact and promote responsible resource use.

In this context, Information and Communication Technologies (ICTs) have evolved from being merely operational tools to becoming strategic assets that support institutional sustainability. Effective ICT management enables universities to optimize administrative and academic processes, reduce paper consumption, improve energy efficiency, and foster environmentally responsible behaviors among staff and students. The integration of ICTs into institutional management aligns with sustainability frameworks by supporting digital transformation and eco-efficient practices.

Several studies have highlighted the positive role of ICTs in organizational performance, particularly in terms of efficiency and innovation. However, limited empirical evidence exists regarding the relationship between ICT management and environmental sustainability performance in public universities, especially in developing countries. Most previous research has focused on the impact of ICTs on academic learning or organizational effectiveness, leaving a research gap concerning their contribution to environmental sustainability outcomes.

Furthermore, ICT management encompasses strategic planning, technological infrastructure, information systems integration, and human capacity development. When these components are effectively managed, they can significantly contribute to reducing carbon footprints, minimizing waste, and improving environmental monitoring and reporting systems within universities.

Therefore, this study seeks to address this gap by examining the effect of ICT management on environmental sustainability performance in a public university. The research is guided by the following general hypothesis: *ICT management has a significant effect on environmental sustainability performance in public universities.* By providing empirical evidence, this study aims to contribute to the academic literature and support decision-makers in higher education institutions in developing sustainable ICT strategies.

2. METHODOLOGY

This study adopted a **quantitative approach**, as it sought to measure and analyze the effect of ICT management on environmental sustainability performance through numerical data and statistical analysis. A **non-experimental, cross-sectional, explanatory design** was employed, given that the variables were not manipulated and data were collected at a single point in time to identify causal relationships between the study variables.

2.1. Population And Sample

The study population consisted of academic and administrative staff members of a public university. These participants were selected due to their direct involvement in institutional processes related to ICT usage, administrative decision-making, and sustainability practices. A sample was obtained using **non-probabilistic convenience sampling**, considering accessibility and voluntary participation. This sampling method is appropriate for explanatory studies in organizational contexts where the objective is to analyze relationships between variables rather than generalize results to a broader population.

2.2. Variables And Dimensions

The independent variable, ICT Management, was operationalized through the following dimensions:

- **Strategic ICT Planning**, referring to the alignment of ICT initiatives with institutional sustainability goals;
- **Technological Infrastructure**, including hardware, software, and digital platforms supporting sustainable operations;
- **Information Systems Management**, focused on data integration, digitalization of processes, and system efficiency.

The dependent variable, Environmental Sustainability Performance, was measured through dimensions such as:

- **Resource Efficiency**, including energy and paper consumption reduction;
- **Environmental Practices**, related to waste management and eco-friendly institutional policies;
- **Environmental Awareness and Monitoring**, addressing the use of ICTs for sustainability reporting and decision support.

2.3. Data Collection Instrument

Data were collected using structured questionnaires designed according to the study variables and dimensions. The instruments were validated by expert judgment to ensure content

validity and reliability. Responses were measured using a Likert-type ordinal scale, allowing for the classification of perceptions into ordered categories ranging from low to high levels of ICT management and sustainability performance.

2.4. Data Analysis Procedures

For data processing and analysis, statistical software was used to perform descriptive and inferential analyses. Descriptive statistics were applied to summarize the levels of ICT management and environmental sustainability performance. Prior to hypothesis testing, normality tests were conducted, revealing non-normal data distribution. Consequently, **ordinal logistic regression** was applied as a non-parametric inferential technique to evaluate the effect of ICT management on environmental sustainability performance.

This methodological approach ensured statistical robustness and alignment with the research objectives, enabling a clear interpretation of the relationship between ICT management and sustainability outcomes in public universities.

3. RESULTS

This section presents the descriptive and inferential results obtained from the statistical analysis of the data collected from academic and administrative staff of a public university. The findings are organized according to the study variables and research objectives.

3.1. Descriptive Statistics

3.1.1. ICT Management Level

The descriptive analysis revealed that ICT management in the studied public university was predominantly at a **moderate level**. A significant proportion of respondents perceived that ICT planning and implementation were partially aligned with institutional objectives, particularly those related to sustainability initiatives.

Regarding the **strategic ICT planning dimension**, most participants indicated that while ICT strategies exist, they are not fully integrated into long-term environmental sustainability policies. This suggests that ICT initiatives are often developed independently rather than as part of a comprehensive sustainability framework.

In terms of **technological infrastructure**, respondents reported moderate availability and functionality of digital tools and platforms. Although basic infrastructure supports digital communication and administrative processes, limitations were observed in the adoption of advanced technologies

aimed at energy efficiency and environmental monitoring.

The **information systems management dimension** showed similar results, with a moderate level of effectiveness. Digitalization of administrative processes, such as electronic documentation and online services, has been partially implemented; however, paper-based procedures are still present in several institutional areas.

3.1.2. Environmental Sustainability Performance Level

The environmental sustainability performance of the university was also perceived as **moderate**. Participants acknowledged institutional efforts to reduce environmental impact, particularly through initiatives such as digital communication, reduced paper usage, and awareness campaigns.

The **resource efficiency dimension** indicated moderate progress in reducing paper consumption and optimizing energy use through ICT-supported processes. However, respondents noted the absence of systematic monitoring systems to measure environmental performance indicators.

The **environmental practices dimension** reflected partial implementation of sustainable policies, including waste reduction and environmentally responsible procurement. These practices were often described as isolated initiatives rather than integrated institutional strategies.

Finally, the **environmental awareness and monitoring dimension** showed that ICT tools are occasionally used to disseminate sustainability-related information, but their use for real-time monitoring, data analysis, and decision support remains limited.

3.2. Normality Test

Prior to conducting inferential analysis, normality tests were applied to both study variables. The Kolmogorov-Smirnov test results indicated significance values below 0.05 for ICT management and environmental sustainability performance, confirming that the data did not follow a normal distribution. Consequently, non-parametric statistical techniques were employed.

3.3. Inferential Statistics

General Objective: Effect of ICT Management on Environmental Sustainability Performance

Ordinal logistic regression analysis was conducted to test the general hypothesis of the study. The results showed a **statistically significant relationship** between ICT management and

environmental sustainability performance ($p < 0.05$). The model demonstrated a strong explanatory capacity, indicating that improvements in ICT management substantially increase the likelihood of higher sustainability performance levels.

The pseudo R-square values suggested that ICT management explains a considerable proportion of variance in environmental sustainability performance. This confirms the strategic importance of ICT management as a driver of sustainable institutional practices.

Specific Objective 1: Strategic ICT Planning and Environmental Sustainability Performance

The analysis revealed that **strategic ICT planning** has a significant effect on environmental sustainability performance. Institutions with better-aligned ICT strategies showed higher levels of sustainability outcomes, particularly in digital process optimization and environmental policy implementation.

Specific Objective 2: Technological Infrastructure and Environmental Sustainability Performance

Results indicated a significant positive effect of **technological infrastructure** on sustainability performance. Adequate and modern ICT infrastructure supports energy-efficient systems, digital communication, and environmentally responsible operations.

Specific Objective 3: Information Systems Management and Environmental Sustainability Performance

The findings demonstrated that effective **information systems management** significantly influences environmental sustainability performance. The use of integrated digital systems enhances data availability, reduces paper-based procedures, and supports sustainability monitoring and reporting.

4. DISCUSSION

The purpose of this study was to analyze the effect of ICT management on environmental sustainability performance in public universities. The findings provide strong empirical evidence that effective ICT management significantly contributes to improved environmental sustainability outcomes. These results reinforce the growing recognition of ICTs not only as operational tools but also as strategic enablers of sustainable institutional transformation.

The general results indicate that ICT management explains a substantial proportion of variance in environmental sustainability performance. This suggests that universities that strategically plan, implement, and manage their ICT resources are more

likely to adopt environmentally responsible practices. This finding aligns with previous studies that highlight the role of ICTs in enhancing organizational efficiency and reducing environmental impact through digitalization and resource optimization.

One of the most relevant findings of this research is the strong influence of **strategic ICT planning** on sustainability performance. When ICT initiatives are aligned with institutional sustainability objectives, universities demonstrate higher levels of environmental efficiency, particularly in reducing paper consumption and improving administrative processes. This supports the argument that sustainability should be embedded within ICT governance structures rather than treated as an isolated initiative. Similar conclusions have been reported in organizational sustainability literature, where strategic alignment has been identified as a critical success factor for sustainable performance.

Regarding **technological infrastructure**, the results reveal that adequate ICT infrastructure significantly enhances environmental sustainability performance. Modern digital platforms and energy-efficient systems facilitate the transition from traditional, resource-intensive processes to digital workflows. This transition not only reduces environmental impact but also improves institutional transparency and operational effectiveness. These findings are consistent with prior research emphasizing that technological infrastructure is a prerequisite for sustainable digital transformation in higher education institutions.

The **information systems management dimension** also demonstrated a significant effect on environmental sustainability performance. Integrated information systems enable universities to monitor resource consumption, manage environmental data, and support evidence-based decision-making. However, the findings suggest that while basic digitalization efforts are in place, many public universities have yet to fully exploit ICT capabilities for advanced sustainability monitoring and reporting. This highlights an important area for institutional improvement.

Another important aspect revealed by this study is the moderate level of both ICT management and sustainability performance. While progress has been made, the findings indicate that sustainability initiatives in public universities are often fragmented and lack long-term strategic coordination. This reinforces the need for comprehensive ICT governance frameworks that explicitly incorporate environmental sustainability objectives.

From a theoretical perspective, the results contribute to the literature by extending ICT management research into the domain of environmental sustainability within higher education. Unlike previous studies that primarily focus on ICTs in teaching and learning contexts, this research emphasizes their managerial and strategic implications. The findings support the view that ICT management acts as a mediating mechanism between institutional strategy and sustainability outcomes.

Practically, the findings suggest that university administrators should prioritize ICT investments that directly support sustainability goals. This includes expanding digital administrative systems, implementing energy-efficient technologies, and developing ICT-based environmental monitoring tools. Moreover, capacity-building initiatives aimed at improving digital competencies among staff are essential for maximizing the sustainability benefits of ICTs.

Overall, this study confirms that ICT management is a key driver of environmental sustainability performance in public universities. By strengthening ICT governance and aligning technological initiatives with sustainability objectives, universities can significantly enhance their contribution to sustainable development.

5. CONCLUSIONS

The findings of this study provide robust empirical evidence regarding the significant role of ICT management in enhancing environmental sustainability performance in public universities. Based on the statistical analysis and discussion of results, several key conclusions can be drawn.

First, it is concluded that ICT management has a **statistically significant and positive effect** on environmental sustainability performance. Public universities that demonstrate higher levels of ICT planning, infrastructure development, and information systems management are more likely to implement sustainable practices effectively. This confirms the general hypothesis of the study and highlights ICT management as a strategic mechanism for achieving institutional sustainability objectives.

Second, the study concludes that **strategic ICT planning** is a critical determinant of sustainability performance. Universities that align ICT strategies with environmental goals achieve better outcomes in terms of digitalization, resource optimization, and reduction of environmentally harmful practices. This finding underscores the importance of integrating sustainability considerations into ICT governance

and institutional planning processes.

Third, the results indicate that **technological infrastructure** plays a fundamental role in supporting environmental sustainability. Adequate and modern ICT infrastructure enables the implementation of digital workflows, energy-efficient systems, and environmentally responsible administrative processes. However, the study also reveals that many public universities remain at a moderate level of infrastructure development, limiting the full potential of ICT-driven sustainability initiatives.

Fourth, the study confirms that **information systems management** significantly influences environmental sustainability performance. The effective use of integrated digital systems facilitates environmental monitoring, data-driven decision-making, and transparent reporting. Nonetheless, the findings suggest that these systems are often underutilized, pointing to the need for improved system integration and staff training.

Finally, it is concluded that although public universities have made progress in adopting ICT-based sustainability practices, these efforts remain fragmented and insufficiently institutionalized. To achieve long-term sustainability, universities must move beyond isolated initiatives and adopt comprehensive ICT management frameworks that explicitly support environmental sustainability goals.

6. THEORETICAL IMPLICATIONS

From a theoretical perspective, this study contributes to the existing body of knowledge by extending ICT management research into the field of environmental sustainability within higher education institutions. While previous studies have predominantly examined the role of ICTs in academic learning, teaching innovation, or administrative efficiency, this research highlights their strategic importance in achieving environmental sustainability objectives.

The findings support theoretical frameworks that view ICT management as a multidimensional construct encompassing strategic planning, infrastructure, and information systems governance. By empirically demonstrating the effect of these dimensions on environmental sustainability performance, the study reinforces the argument that ICT management functions as an enabling mechanism for sustainable organizational transformation.

Furthermore, this research contributes to sustainability management theory by positioning

ICT management as an internal capability that enhances institutional environmental performance. The results suggest that sustainability outcomes are not solely driven by environmental policies but also by the effective management of technological resources. This perspective provides a more integrated understanding of how digital transformation and sustainability strategies intersect in public universities.

Additionally, the use of ordinal logistic regression in analyzing sustainability performance contributes methodologically by offering a robust approach for examining causal relationships in non-normal data contexts. This methodological contribution is particularly relevant for future studies in organizational and sustainability research within higher education settings.

7. PRACTICAL IMPLICATIONS

From a practical standpoint, the findings offer valuable insights for university administrators, policymakers, and ICT managers. The results indicate that improving ICT management practices can significantly enhance environmental sustainability performance without requiring excessive financial investment.

University decision-makers should prioritize the integration of sustainability objectives into ICT strategic planning processes. This includes developing ICT policies that explicitly address environmental goals, such as reducing paper usage, optimizing energy consumption, and supporting digital administrative services.

Moreover, investments in technological infrastructure should focus on sustainability-oriented technologies, including cloud-based systems, energy-efficient hardware, and digital platforms that reduce reliance on physical resources. Strengthening information systems management can further support environmental monitoring, reporting, and data-driven sustainability initiatives.

Capacity-building initiatives are also essential. Training academic and administrative staff in digital competencies and sustainability practices can maximize the effectiveness of ICT tools and foster a culture of environmental responsibility within

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universities.

8. LIMITATIONS AND FUTURE RESEARCH

Despite the relevance and robustness of the findings, this study presents certain limitations that should be acknowledged. First, the research employed a **cross-sectional design**, which limits the ability to establish causal relationships over time. Although ordinal logistic regression provided strong evidence of association, longitudinal studies would allow for a deeper understanding of how ICT management practices influence sustainability performance in the long term.

Second, the use of **non-probabilistic convenience sampling** restricts the generalizability of the results. The findings reflect the perceptions of academic and administrative staff from a single public university, which may not fully represent the diversity of institutional contexts across different regions or countries. Future studies should consider larger and more diverse samples, including multiple universities, to enhance external validity.

Third, the study relied on **self-reported data**, which may be subject to response bias or social desirability effects. Although validated instruments were used, incorporating objective sustainability indicators—such as energy consumption data or carbon footprint measurements—could strengthen future research.

Regarding future research directions, scholars are encouraged to explore **comparative studies** between public and private universities to identify differences in ICT-driven sustainability performance. Additionally, qualitative or mixed-method approaches could provide deeper insights into institutional decision-making processes and organizational culture related to ICT management and sustainability.

Future research could also examine the **mediating or moderating roles** of variables such as organizational culture, leadership commitment, or digital competencies. Exploring these factors would contribute to a more comprehensive understanding of how ICT management supports sustainable development in higher education institutions.

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