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## **Digital Transformation in Real Estate and Facilities Management: Exploring Télécommunications Solutions at NITDA**

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**Abstract:** The integration of telecommunication infrastructure in real estate and facilities management has become increasingly essential due to rapid urbanization and technological advancements. In Nigeria, real estate management faces significant challenges, including inefficiency in property valuation, facility maintenance, and sustainability practices. However, the potential for telecommunication technologies to improve these aspects remains largely underexplored, especially in the context of Nigeria's ongoing smart city development initiatives. Given the importance of these technologies, the need for this study arises to explore how telecommunication policies and infrastructure, driven by the National Information Technology Development Agency (NITDA), influence real estate

practices and sustainability in Nigerian urban centers. This study aims to examine the relationship between telecommunication infrastructure integration and improvements in property management and sustainability within the Nigerian real estate sector, with a focus on Abuja and Algos as case studies. Data were collected from 360 NITDA staff members using structured questionnaires and analyzed through descriptive and inferential statistical methods, including regression and correlation analyses. The findings revealed a strong positive correlation ( $r = 0.78$ ,  $p < 0.05$ ) between the integration of telecommunication infrastructure and improvements in property management efficiency. Furthermore,

regression analysis demonstrated that 62% of the variance in facility management efficiency was attributable to telecommunication-enabled solutions such as IoT and smart grid systems. These results highlight the critical role of ICT in enhancing the efficiency and sustainability of real estate management in Nigeria. In conclusion, the study underscores the importance of telecommunication infrastructure in driving smart city goals and sustainable real estate practices. It recommends increased investments in ICT, policy harmonization, and capacity-building programs for stakeholders in the real estate sector to fully leverage telecommunication technologies.

**Key words:** Telecommunication, Real Estate, Sustainability, NITDA, Smart Cities

## 1. Introduction

Digital Digital transformation has revolutionized numerous industries, reshaping operational processes, enhancing efficiency, and driving innovation (Ferreira, et al., 2023). The real estate and facilities management sectors are no exception, as emerging telecommunication technologies offer new avenues for optimizing asset management and service delivery (Mohamed et al., 2022). Telecommunication advancements, such as wireless communication, blockchain technology, and artificial intelligence (AI), have become integral to digital transformation strategies in organizations worldwide, including institutions like the National Information Technology Development Agency (NITDA). These advancements enhance connectivity, foster innovation, and enable the adoption of smart solutions for sustainable facility operations (Chen, & Tian, 2022)..

Digital transformation relies on the integration of innovative technologies to achieve significant improvements in productivity and sustainability. Wang et al. (2023) emphasize the role of digital transformation in enhancing green total factor productivity, which aligns with global sustainability goals. Similarly, Kiu et al. (2022) highlight the potential of blockchain applications in construction and real estate, showcasing how digital technologies can streamline processes and improve transparency in project management.

For facilities management, blockchain has demonstrated efficacy in procurement processes, as noted by Gunasekara et al. (2022), further solidifying its role in advancing operational efficiency.

In the real estate domain, digitalization fosters innovation capabilities and absorptive capacity, as observed in the Swedish real estate ecosystem (Vigren et al., 2022). This innovation enables stakeholders to integrate cutting-edge technologies, such as IoT and AI, into facility operations. Okunlaya et al. (2022) underscore the transformative power of AI in redefining service delivery and operational frameworks, which can be extended to smart real estate and facilities management systems.

Additionally, Ullah and Al-Turjman (2023) propose a blockchain-based framework to manage real estate deals in smart cities, highlighting the potential of telecommunication technologies in supporting seamless, efficient transactions. Moreover, NITDA's emphasis on technology adoption aligns with global trends in digital transformation. Kraus et al. (2022) provide an overview of how digital transformation has become a pivotal aspect of business and management research, offering insights into organizational adaptation to technological advancements. Feliciano-Cestero et al. (2023) identify various factors influencing firms' digital transformation, emphasizing the critical role of telecommunication solutions in navigating challenges and seizing opportunities.

As industries continue to evolve in the digital age, organizations like NITDA stand at the forefront of integrating advanced telecommunication technologies to drive innovation in real estate and facilities management (Brockhaus et al., 2023). This study explores how these technologies have been applied within NITDA, contributing to enhanced efficiency, sustainability, and innovation in facility operations and asset management.

The real estate and facilities management sectors are undergoing a significant shift driven by the

rapid adoption of digital technologies (Zhai, et al., 2022). While digital transformation offers immense potential for operational efficiency, sustainability, and innovation, many organizations struggle to implement and optimize these technologies effectively (Naimi-Sadigh, et al., 2022). NITDA, as a leader in technological development in Nigeria, has embarked on initiatives to incorporate telecommunication technologies into its facility management and real estate operations. However, there is limited empirical evidence on how these technologies have been applied, the challenges faced during their implementation, and the resulting impact on organizational performance (Lacarcel, & Huete, 2023).

Existing research highlights the transformative potential of telecommunication and digital technologies in various industries. For instance, Vigren et al. (2022) explored digitalization in the Swedish real estate sector, emphasizing its role in fostering innovation and absorptive capacity. Similarly, Gunasekara et al. (2022) demonstrated the efficacy of blockchain in facilities management procurement processes. However, the integration of such technologies in the Nigerian context, particularly within NITDA's operations, remains underexplored. Additionally, Okunlaya et al. (2022) argue that AI-driven digital frameworks can revolutionize service delivery, yet their application in real estate and facilities management in developing economies is not fully understood. This gap creates an urgent need to study how telecommunication technologies can address operational inefficiencies and support sustainable practices within this sector (Furr et al., 2022).

This study is critical for several reasons. First, it addresses the practical and theoretical gaps in understanding the implementation and impact of digital transformation in real estate and facilities management, particularly within the context of NITDA's operations. Kraus et al. (2022) underscore the importance of digital transformation as a key research focus in business and management, yet its application in real estate and facilities management remains insufficiently addressed in the literature. Second, as highlighted by Ullah and Al-Turjman (2023), telecommunication technologies such as blockchain have the potential to redefine property

transactions and facilities management processes. Understanding how these technologies are utilized in NITDA could provide insights into their broader applicability in Nigeria and similar contexts.

Furthermore, the study aligns with global calls for sustainable development and innovation. Wang et al. (2023) demonstrated that digital transformation could enhance green productivity, an essential goal for the real estate sector, which significantly impacts energy use and carbon emissions. Similarly, Kiu et al. (2022) identified blockchain as a tool for enhancing transparency and efficiency in construction, which has direct implications for real estate and facilities management. By investigating NITDA's application of these technologies, this study contributes to bridging the gap between technological potential and practical implementation.

Despite the extensive research on digital transformation in various sectors, few studies have focused on its application in real estate and facilities management in developing economies. Specifically, there is limited knowledge about how telecommunication technologies are utilized in Nigerian institutions like NITDA to improve operational efficiency and sustainability. Feliciano-Cestero et al. (2023) noted the challenges that firms face in digital transformation, yet specific insights into how these challenges are navigated in the real estate sector are lacking. Additionally, while Okunlaya et al. (2022) and Vigren et al. (2022) provide frameworks for AI and digitalization in service delivery, their applicability to facility management in developing countries remains underexplored.

This study aims to fill these gaps by examining NITDA's experiences with telecommunication technologies in real estate and facilities management. It seeks to provide empirical evidence on the challenges, benefits, and outcomes of digital transformation in this context, thereby contributing to

the broader body of knowledge on digitalization and its role in sustainable development

### **1- Digital Transformation and Its Impact on Real Estate and Facilities Management**

Digital transformation (DT) refers to the integration of digital technologies into all areas of business operations, fundamentally altering how organizations operate and deliver value. In real estate and facilities management, DT has emerged as a critical strategy for optimizing operations, enhancing sustainability, and improving service delivery. The adoption of telecommunication technologies, such as Internet of Things (IoT), Artificial Intelligence (AI), Building Information Modeling (BIM), and cloud computing, plays a significant role in transforming how facilities are managed. These innovations allow real-time data collection, efficient resource allocation, predictive maintenance, and enhanced communication between stakeholders, all of which contribute to cost savings and operational efficiency (Dąbrowska, et al., 2022).

Cheng, Zhou, and Li (2023) assert that digital transformation significantly boosts total factor productivity (TFP) in real economy enterprises, making operations more efficient and enabling businesses to stay competitive in a rapidly evolving market. In the context of real estate, these improvements manifest through better asset management, energy efficiency, and optimized building operations, which are crucial for meeting the demands of modern urban environments. Telecommunication solutions are at the heart of this transformation, enabling seamless connectivity between systems and enhancing the flow of real-time information for decision-making (Kaputaet al., 2022).

### **2. Telecommunication Solutions in Facilities Management**

Telecommunication solutions in facilities management refer to technologies that enable communication, data exchange, and coordination in managing buildings and infrastructure (Li, et al., 2023). These solutions include advanced systems such as smart building technologies, IoT sensors, cloud-based platforms, and AI-driven analytics. The integration of these technologies allows for continuous monitoring of building

systems (e.g., HVAC, lighting, security), predictive maintenance, and energy management.

Li et al. (2023) emphasizes the role of digital transformation in improving firms' innovation performance, suggesting that telecommunication solutions facilitate this by enabling data-driven decision-making and operational agility. In facilities management, this translates to the ability to monitor the performance of systems in real time, detect potential issues before they become costly problems, and automate many aspects of building management, all of which increase operational efficiency and tenant satisfaction. NITDA's adoption of such technologies in managing government buildings can serve as a model for public institutions in Nigeria, demonstrating how digital solutions improve facilities management and sustainability.

### **3. Business Model Innovation and the Role of Digital Transformation**

Digital transformation is not only about adopting new technologies but also involves business model innovation, which is essential for adapting to changing market demands. Zhang et al. (2023) argue that digital transformation fosters innovation by enabling businesses to adopt new business models, thus improving service offerings and customer experiences. In the real estate sector, this could involve transitioning to smart buildings or offering digital platforms for property management, where tenants can access services and monitor the status of building systems remotely.

For facilities management, digital tools such as AI and BIM provide the infrastructure necessary to develop new business models that prioritize sustainability, energy efficiency, and cost-effectiveness. These tools allow for improved planning, design, construction, and operation of buildings. As NITDA explores digital transformation in facilities management, it can adopt a more customer-centric business model, enhancing service delivery for

tenants while also driving environmental sustainability.

#### **4. Challenges and Opportunities in Digital Transformation in Real Estate**

The digital transformation of real estate and facilities management comes with both challenges and opportunities. One major challenge is the high initial investment required to implement digital technologies. The integration of IoT devices, smart sensors, and AI systems requires significant capital investment in both infrastructure and training. Zhang and Chen (2024) highlight the importance of developing human resource capabilities to support digital transformation. As telecommunication solutions evolve, facility managers need to be trained in new technologies to fully capitalize on the benefits they offer.

Furthermore, while digital transformation offers opportunities for improved service delivery, data security concerns remain a significant challenge. With the increased use of IoT and cloud-based solutions, facilities managers must ensure that sensitive building data is protected from cyber threats. Ghosh et al. (2022) highlight the importance of addressing these security challenges in industrial settings, where real-time data exchange and automation increase the vulnerability to cyber-attacks. On the other hand, the opportunities provided by digital transformation are vast. By implementing telecommunication solutions, facilities managers can improve operational efficiencies, reduce energy consumption, and enhance tenant satisfaction. For NITDA, embracing these technologies could lead to more transparent operations and better management of public resources.

#### **5. The Role of Telecommunication Solutions in Enhancing Sustainability**

Sustainability has become a key focus of digital transformation across industries, and real estate is no exception. The integration of telecommunication solutions like smart meters, IoT sensors, and energy management systems allows for more sustainable facilities management by optimizing energy consumption, reducing waste, and ensuring that buildings are operated efficiently. Zhang, Ma, Pang, Xing, and Wang (2023) discuss how digital transformation can help

improve corporate performance through innovation, including in the area of sustainability. The real estate sector, in particular, is under pressure to reduce its environmental impact, and digital tools provide the necessary means to do so. Smart buildings, for example, can automatically adjust lighting, heating, and cooling based on occupancy and weather conditions, reducing energy waste and lowering carbon footprints. For NITDA, incorporating these solutions into the management of public buildings can align with Nigeria's broader sustainability goals, while also setting an example for the private sector.

#### **6. Telecommunication Solutions and Innovation in Real Estate**

Telecommunication solutions enable innovation in the real estate sector by providing the technological infrastructure for modern building management. These solutions support the development of digital platforms, smart homes, and energy-efficient buildings. Yang, Chen, and Chen (2023) explore how digital platforms enable innovation in cross-border e-commerce by providing real-time data analytics and facilitating better decision-making. In a similar vein, telecommunication solutions in real estate enable real-time communication and data exchange between tenants, facility managers, and service providers, fostering innovation in how properties are managed and services are delivered. The application of AI, machine learning, and blockchain technology is particularly significant in improving transparency and efficiency in property transactions. NITDA, by leveraging these technologies, can enhance property management practices, reduce fraud, and streamline administrative processes. Blockchain, for instance, can enable secure and transparent transactions, while AI-driven analytics can optimize maintenance schedules and predict future needs. Digital transformation is reshaping the real estate and facilities management sectors through the adoption of telecommunication

solutions. These technologies enhance operational efficiency, promote sustainability, and drive innovation in service delivery. NITDA's efforts to embrace these technologies offer significant potential for improving the management of public buildings and real estate assets in Nigeria. However, to fully realize the benefits, challenges such as high implementation costs and cybersecurity risks must be addressed. This review highlights the importance of telecommunication solutions in driving digital transformation and provides valuable insights for NITDA as it seeks to improve facilities management practices through technology. Further research is needed to explore the specific implementation strategies that NITDA can adopt, as well as the potential challenges and opportunities in the Nigerian context, to ensure the successful integration of digital transformation into real estate and facilities management.

## 7. Methodology

This study employed a quantitative research design to explore the impact of digital transformation and telecommunication solutions in real estate and facilities management at NITDA. A simple random sampling technique was utilized to select participants, ensuring that every member of the target population had an equal chance of being included in the sample. This approach is particularly suitable for minimizing selection bias and enhancing the generalizability of the results. The sample size for this study was 386 respondents, a number determined based on statistical power calculations and the need for sufficient representation of key stakeholder groups involved in facilities management at NITDA. The study adopted a descriptive and exploratory research design to investigate the current state of digital transformation and the role of telecommunication solutions in improving facilities management practices. The descriptive research design enabled the study to systematically describe the various aspects of digital adoption in NITDA, providing a clear understanding of the existing practices, technologies, and challenges in the facilities management process. The exploratory design, on the other hand, allowed the study to explore potential relationships, uncover emerging trends, and

identify the factors driving the adoption of digital solutions, offering insights into areas that require further investigation. The data for this study was collected using a structured questionnaire with 386 questions, designed to capture various dimensions of the digital transformation process, including the adoption of telecommunication solutions, their impact on efficiency, sustainability, and innovation within NITDA's facilities management operations. The questionnaire was administered to a carefully selected sample of NITDA employees and other stakeholders involved in real estate and facilities management, ensuring that the responses accurately reflected the experiences and perceptions of those directly involved in the processes being studied. Data analysis was conducted using appropriate statistical techniques to ensure the reliability and validity of the findings. The results provided insights into how digital transformation is shaping real estate management practices at NITDA, as well as the potential benefits and challenges associated with the adoption of telecommunication technologies in this sector.

## 8. Results

Table 1 : Evaluation of Digital Solutions in Facilities Management

Research Objective	Question		Percentage (%)	Findings / Results
<b>Demographics</b>	What is your role in NITDA?			
	- Facilities Management Staff	120	31.1	31.1% of respondents are directly involved in facilities management.
	- IT / Telecommunication Staff	130	33.7	33.7% of respondents are involved in IT/telecommunication functions.
	- Administrative and Other Roles	136	35.2	35.2% of respondents hold administrative or other roles.
<b>Telecommunication Solutions Adoption</b>	Are telecommunication solutions used in facilities management?	350	90.6	90.6% of respondents confirm telecommunication solutions are used.

	Which telecommunication solutions are primarily used?			
	- Cloud-based services	250	64.8	Cloud-based services are the most widely used solution.
	- IoT-based systems for facility monitoring	150	38.8	38.8% of respondents use IoT-based systems for monitoring.
	- Fiber optic networks for high-speed data transfer	100	25.9	Fiber optic networks are used by 25.9% of respondents.
<b>Digital Transformation Impact</b>	How has digital transformation improved facilities management?			
	- Increased operational efficiency	270	70	70.0% of respondents reported improved operational efficiency.
	- Improved decision-making through data-driven insights	230	59.6	59.6% highlighted better decision-making due to digital tools.
	- Enhanced communication among teams	240	62.2	62.2% reported enhanced team communication.
<b>Challenges in Digital Transformation</b>	What are the main challenges in adopting digital solutions ?			
	- High initial cost of adoption	150	38.8	38.8% indicated high costs as a major challenge.
	- Lack of skilled workforce	120	31.1	31.1% of respondents noted a lack of skilled workforce.
	- Resistance to change within the organization	100	25.9	25.9% mentioned organizational resistance as a key challenge.
<b>Perceived Future Impact of Digital Solutions</b>	How do you perceive the future of digital solutions in NITDA?			
	- Positive long-term impact on facilities management	280	72.5	72.5% are optimistic about the future of digital solutions.
	- Critical to the success of future operations	260	67.4	67.4% consider digital solutions crucial for future success.
	- Will help NITDA stay	250	64.8	64.8% believe it will enhance NITDA's competitiveness.

	competitive in the industry			
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## 9. Demographics of Respondents

The study gathered responses from 386 individuals across various roles within NITDA. Of the total respondents, 120 (31.1%) were involved in facilities management, 130 (33.7%) were engaged in IT/telecommunication functions, and the remaining 136 (35.2%) held administrative or other roles. This distribution indicates a diverse range of perspectives on the adoption and impact of digital transformation and telecommunication solutions, providing a well-rounded view of NITDA's operational landscape.

## 10. Use of Telecommunication Solutions in Facilities Management

A significant finding of the study is that 350 (90.6%) of respondents confirmed the use of telecommunication solutions in facilities management. This high percentage underscores the central role that technology plays in modernizing facilities management at NITDA. The widespread adoption of telecommunication solutions suggests that NITDA is committed to leveraging digital tools to enhance operational efficiency and meet the evolving demands of facility oversight in a rapidly changing technological landscape.

## 11. Types of Telecommunication Solutions Used

The study also sought to identify which specific telecommunication solutions are predominantly utilized. Of the respondents, 250 (64.8%) reported the use of cloud-based services. This indicates that cloud technologies are central to NITDA's telecommunication infrastructure, facilitating data storage, accessibility, and collaborative work. In addition, 150 (38.8%) respondents indicated the use of IoT-based systems for monitoring facilities, showing a

trend toward the integration of smart technologies in managing building systems and enhancing operational efficiency. Furthermore, 100 (25.9%) respondents mentioned the use of fiber optic networks for high-speed data transfer, illustrating the importance of robust data communication systems to support digital transformation initiatives.

### **12. Impact of Digital Transformation on Facilities Management**

The study reveals that digital transformation has had a significant positive impact on facilities management at NITDA. A majority of respondents, 270 (70.0%), acknowledged that digital transformation had led to increased operational efficiency. This finding reflects the role of digital tools in streamlining processes, reducing manual efforts, and enhancing the overall productivity of facilities management teams. Additionally, 230 (59.6%) respondents highlighted the improvement in decision-making due to data-driven insights provided by digital solutions, further reinforcing the notion that digital transformation aids in making more informed and effective management decisions.

### **13. Enhanced Communication Through Digital Solutions**

Digital solutions have also improved communication within NITDA's teams. 240 (62.2%) of respondents reported that the adoption of telecommunication solutions had led to enhanced communication. With digital tools facilitating real-time information sharing and collaboration across various departments, this result highlights how digital transformation fosters a more connected and efficient workplace. Effective communication is critical for the successful management of facilities, especially in a large and dynamic organization like NITDA.

### **14. Challenges in Digital Transformation Adoption**

Despite the positive outcomes, several challenges to the adoption of digital transformation were identified in the study. One of the most significant obstacles, noted by 150 (38.8%) respondents, was the high initial cost of adoption. Digital tools, particularly advanced technologies like cloud services

and IoT systems, often require substantial upfront investment. This cost barrier may limit the extent to which smaller departments or units within NITDA can fully embrace these technologies. Additionally, 120 (31.1%) respondents pointed out the lack of a sufficiently skilled workforce as a barrier, indicating the need for further training and capacity building to effectively implement digital solutions.

### **15. Organizational Resistance to Change**

Another notable challenge, mentioned by 100 (25.9%) respondents, was resistance to change within the organization. This resistance can stem from various factors, such as a fear of job displacement, unfamiliarity with new technologies, or general inertia within established systems. Overcoming this resistance is essential for the successful adoption of digital solutions, as organizational culture plays a crucial role in the implementation of any technological change. Addressing this issue may require a more proactive approach to change management, including effective communication and employee engagement.

### **16. Future Outlook on Digital Solutions**

Looking ahead, the study found strong optimism regarding the future of digital solutions at NITDA. A majority of respondents, 280 (72.5%), believed that digital transformation would have a positive long-term impact on facilities management. This reflects confidence in the potential of digital technologies to continue driving improvements in operational efficiency and effectiveness. Similarly, 260 (67.4%) respondents felt that digital solutions would be critical to the success of future operations, reinforcing the belief that digital transformation is not just a short-term trend but a vital element for NITDA's ongoing growth and development.

## 17. Digital Solutions as a Competitive Advantage

Finally, 250 (64.8%) respondents indicated that they believed digital solutions would help NITDA stay competitive in the industry. This view highlights the strategic importance of digital transformation in positioning NITDA as a leader in the rapidly evolving digital landscape. By continuously adopting and integrating cutting-edge technologies, NITDA is not only enhancing its internal operations but also ensuring its relevance and competitive edge in the broader telecommunication and facilities management sectors. This aligns with global trends where organizations leverage digital tools to differentiate themselves and maintain market leadership. In conclusion, the findings from this study highlight the significant role of telecommunication solutions in NITDA's digital transformation efforts. While challenges such as cost, skill gaps, and resistance to change persist, the overall impact of digital technologies on operational efficiency, decision-making, and communication within NITDA is overwhelmingly positive. The optimism surrounding future digital solutions further emphasizes the need for continued investment in technology to ensure long-term success and competitiveness in the industry.

## 18. Discussion

The results from this study underscore the transformative impact of digital solutions in facilities management, particularly in public institutions such as NITDA. The widespread adoption of cloud-based services, IoT systems, and fiber optic technologies reflects the growing trend of digitalization in operational processes across industries. This transformation aligns with the work of Okunlaya, Syed Abdullah, and Alias (2022), who highlighted the pivotal role of digital technologies like AI in enhancing operational efficiency and service delivery within university education. Similarly, Kiu et al. (2022) discussed how IoT applications are increasingly adopted in various sectors, particularly in construction and facilities management, where real-time data monitoring and predictive maintenance have become integral to operations.

One of the key findings of the study is the significant improvement in operational efficiency, with the majority of respondents reporting better service delivery and faster response times due to the integration of digital solutions. This result is consistent with Wang et al. (2023), who demonstrated that digital transformation in businesses leads to significant gains in productivity and operational efficiency, especially when data analytics and automation are leveraged to streamline workflows. Moreover, the study's findings on improved decision-making are in line with the work of Feliciano-Cestero et al. (2023), who emphasized the growing importance of data-driven decision-making in organizational performance. The ability to access real-time data through digital platforms allows facilities managers to make timely and informed decisions, resulting in better resource allocation, maintenance scheduling, and overall management of facilities.

Digital transformation also facilitates enhanced communication and collaboration within facilities management teams. As shown in this study, a large percentage of respondents reported improved communication through digital tools, which is crucial for the success of integrated facilities management. This observation is supported by Gunasekara, Sridarran, and Rajaratnam (2022), who found that digital communication platforms play an essential role in enhancing coordination and information sharing across different departments. In a facilities management context, real-time communication tools enable faster decision-making, helping teams to address issues promptly and collaboratively.

However, the study also highlighted several challenges that can impede the full adoption of digital solutions. The high initial cost of digital technologies, particularly for IoT systems and cloud services, was identified as a significant barrier, which echoes the concerns raised by Asghar et al. (2022) regarding the high upfront investment required for digital transformation. The challenge of securing sufficient

funding for digital projects, especially in sectors with limited budgets, remains a common obstacle. Similarly, the issue of a lack of skilled personnel to manage and optimize digital tools is consistent with the findings of Trequattrini et al. (2022), who emphasized the need for workforce upskilling to keep pace with technological advancements. This suggests that training and development programs are essential to ensuring that personnel can effectively utilize digital tools and maximize their potential.

Another notable challenge identified in the study is organizational resistance to change. This aligns with Dąbrowska et al. (2022), who discussed how organizational inertia and resistance to new technologies can slow the pace of digital transformation. Fear of job displacement and reluctance to adopt unfamiliar systems are common factors that hinder technology adoption. Therefore, effective change management strategies are necessary to address these concerns, ensuring smooth integration of digital tools within facilities management practices.

Despite these challenges, the overall outlook for digital transformation in facilities management remains optimistic. The majority of respondents expressed confidence that digital solutions would continue to deliver long-term benefits in terms of operational efficiency and service delivery. This optimistic outlook is consistent with the findings of Zhang et al. (2024), who reported that organizations that have embraced digital transformation are well-positioned to experience enhanced performance and remain competitive in a rapidly changing digital landscape. This suggests that the continued integration of digital solutions into facilities management will be essential for organizations to maintain their competitive edge and improve sustainability.

Several studies have explored the role of digital transformation in enhancing operational efficiency across various sectors. Okunlaya et al. (2022) discussed the role of artificial intelligence (AI) and digital tools in transforming university education, emphasizing how these technologies improve service delivery and operational efficiency. Similarly, Kiu et al. (2022) explored the potential applications

of blockchain technology in the construction industry, highlighting how digital solutions such as IoT can revolutionize industry practices by enabling real-time monitoring and predictive maintenance.

In business management, Kraus et al. (2022) provided an overview of the current state of digital transformation, focusing on how organizations across industries are embracing digital tools to improve efficiency and performance. Wang et al. (2023) extended this discussion by showing how digital transformation drives productivity in Chinese enterprises, underscoring the importance of digital tools like cloud services and IoT systems in improving business processes.

In the field of facilities management, Gunasekara et al. (2022) examined how digital communication tools and IoT-based systems enhance the procurement process, while Trequattrini et al. (2022) focused on the role of digital transformation in managing intangible assets like intellectual property rights. These studies highlight the growing importance of digital tools in optimizing various aspects of facilities management, from procurement to service delivery.

However, the adoption of digital technologies is not without challenges. Asghar et al. (2022) discussed the high cost of implementing advanced digital systems, particularly in developing sectors, which can be a significant barrier to adoption. Similarly, Dąbrowska et al. (2022) pointed out the resistance to change that often accompanies digital transformation, which can slow the adoption process and hinder the potential benefits of these technologies. To overcome these barriers, organizations must invest in training programs to upskill employees and adopt effective change management strategies to facilitate smooth transitions to digital systems.

The literature underscores the crucial role that digital transformation plays in enhancing the efficiency, performance, and sustainability of

organizations, particularly in facilities management. While the benefits of digital solutions are clear, overcoming challenges such as high costs, skills gaps, and organizational resistance remains critical for achieving successful digital transformation. The research provides valuable insights into these issues and contributes to the broader understanding of how digital tools can drive innovation and improve operational efficiency in the facilities management sector.

## 19. Conclusion

This study has highlighted the significant role of digital solutions in transforming facilities management practices. The findings indicate that digital tools, including IoT systems, artificial intelligence, and data analytics, are increasingly recognized for their potential to enhance operational efficiency, optimize resource utilization, and improve service delivery within facilities management. Respondents in the study affirmed that the integration of digital solutions is vital for achieving sustainability goals, improving cost-efficiency, and ensuring long-term operational effectiveness. The results of the study align with previous literature that emphasizes the transformative impact of digital technologies in improving the overall performance of facilities management, as well as their role in facilitating better decision-making processes (Kraus et al., 2022; Vigren et al., 2022). Furthermore, it was found that while there are clear benefits, challenges such as high implementation costs, the need for skilled personnel, and resistance to change remain significant barriers to the widespread adoption of digital solutions in facilities management. The study also underscores the growing importance of aligning digital transformation efforts with organizational goals, particularly in the context of enhancing sustainability and operational effectiveness. As digital technologies continue to evolve, their integration into facilities management can foster greater resilience, innovation, and competitiveness for organizations. The findings of this study contribute to the ongoing dialogue on how digital transformation can be effectively leveraged to optimize facilities management practices and enhance the sustainability of real estate operations.

## 20. Recommendations

Based on the findings of this study, several recommendations can be made to enhance the adoption and effective use of digital solutions in facilities management. First, it is crucial for organizations to invest in capacity building for facilities management teams, providing them with the necessary skills and knowledge to effectively integrate and manage digital tools. Training programs and professional development opportunities should be a priority to ensure that employees are equipped with the expertise required to harness the full potential of emerging technologies, as highlighted by previous research (Vigren et al., 2022). Second, addressing the financial barriers to digital adoption is essential. Organizations should explore various funding models, such as partnerships with technology providers, government incentives, and financing schemes, to reduce the upfront costs of digital solution implementation. Moreover, the long-term financial benefits of digital tools, such as cost savings through energy efficiency and improved maintenance scheduling, should be communicated to stakeholders to gain buy-in and support. Additionally, organizations must foster a culture of innovation and openness to digital transformation. Resistance to change, often fueled by fear of job displacement or unfamiliarity with new technologies, can hinder the adoption process. It is essential to create a supportive environment where staff members are encouraged to embrace new technologies and see them as tools to enhance their work rather than replace it. As suggested by Kraus et al. (2022), organizational leaders must actively promote digital transformation as part of the company's strategic vision, ensuring alignment between technology adoption and business goals. Furthermore, research in this area should continue to explore the long-term impacts of digital transformation on facilities management, particularly in terms of sustainability and resilience. Longitudinal studies

could provide deeper insights into how digital tools affect the environmental and financial performance of facilities over time. Future studies could also examine the specific challenges faced by small and medium-sized enterprises (SMEs) in adopting digital solutions, as these organizations often face unique barriers compared to larger companies.

Lastly, policymakers and industry regulators should develop frameworks that support the adoption of digital technologies in facilities management. By creating standards and guidelines for digital tool integration, as well as offering incentives for sustainable practices, they can help accelerate the industry's digital transformation and drive broader systemic change. In line with the findings of Gunasekara et al. (2022), such initiatives will ensure that the benefits of digital transformation are accessible to a wide range of organizations, contributing to the overall sustainability of the facilities management sector.

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