Impact of Technological Innovation Adoption on Park Management System in Oyo State, Nigeria

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Abstract- ***Park management systems are the backbone of urban mobility, orchestrating seamless operations that enhance commuter satisfaction and optimize resource utilization. Despite advancements in technology, many park management systems fail to deliver holistic performance, plagued by inefficiencies, congestion, and user dissatisfaction. This shortfall underscores the urgent need for a comprehensive evaluation to identify gaps and drive transformative improvements in system performance. The study adopted a descriptive research design with the use of a well-structured questionnaire. The population consisted of 30 terminal staff management using snowballing and incidental sampling techniques with a sample size of 28 terminal staff. Data analysis was conducted using descriptive statistics and inferential statistics. Inferential statistics of multiple regression analysis were used to examine the impact of technology innovation on park management system (PMS). Findings from the result of multiple regression analysis on the impact of technology innovation on Park Management System (PMS) showed that five (5) out of the five (5) explanatory variables were significant in explanatory the variation of park management system. These variables were Real-Time Information Systems (p = 0.000), Smart Parking Systems (p = 0.000), Surveillance Systems (p = 0.004), Energy Efficient Systems (p = 0.001), and Automated Ticketing Systems (p = 0.041). The study demonstrated that technological innovation significantly influences the performance of the park management system at Ojo Bus Terminal, Oyo State, Nigeria. However, it was recommended that, improving operational efficiency requires investing in technological innovations.***

Indexed Terms- ***Technological Innovations, Adoption, Park Management System, Ojo Bus Terminal***

I. INTRODUCTION

Public transportation systems provide the most efficient means of moving large number of people especially in density populated urban centres. In addition to the well-being of its users, public transport plays a vital role in the productivity of cities which in turn has a direct bearing on the national economies (World Bank, 2021; Lyndon and Todd, 2016). Transport systems are vital to the economic development and social integration of urban areas, serving as the backbone for trade, tourism, and overall mobility (Litman, 2018). In recent years, as cities expand and populations grow, the demand for efficient transport services has intensified, leading to increasing complexities in managing transportation infrastructures. One significant aspect of transport management is the parking system, which plays a crucial role in urban mobility by facilitating the safe and efficient storage of vehicles (Koutsopoulos *et al*., 2021). Effective Park management systems are essential not only for accommodating vehicles but also for minimizing congestion, optimizing land use, and enhancing the overall experience for users.

The performance evaluation of park management systems encompasses various metrics that measure the effectiveness and efficiency of parking facilities. These metrics may include occupancy rates, turnover rates, revenue generation, user satisfaction, and the environmental impact of parking operations (Gonzalez

et al., 2019). With the rapid increase in urbanization and the rise of smart technologies, cities are now exploring innovative solutions to improve parking management. Intelligent Transport Systems (ITS) have emerged as a key tool for enhancing park management performance. By utilizing real-time data, these systems enable dynamic pricing, automated payments, and advanced reservation systems, ultimately leading to improved resource allocation and user satisfaction (Wang *et al*., 2020).

Despite the clear advantages of effective park management systems, many cities still grapple with challenges such as inadequate infrastructure, outdated policies, and insufficient technology integration. These issues often result in increased traffic congestion, poor air quality, and heightened frustration among users (Shoup, 2018). Consequently, there is a growing recognition of the need to evaluate and enhance parking management systems as part of broader urban transport strategies. By systematically assessing performance, stakeholders can identify weaknesses, implement necessary improvements, and ensure that parking facilities meet the evolving needs of urban populations. Therefore, this makes it imperative to study the nexus between technological innovations and park management system in Ojo Bus Terminal, Oyo State, Nigeria.

II. LITERATURE REVIEW

Park Management Systems

The integration of advanced technologies in park management systems, such as automated scheduling, electronic ticketing, and real-time monitoring, has revolutionized the management of bus terminals. Research by Banister and Berechman (2000) indicates that such technologies enhance the efficiency and reliability of transport services, leading to better user experiences and increased operational effectiveness. Studies have shown that the implementation of park management systems can lead to significant improvements in operational efficiency. For example, Zhang and Yang (2016) found that automated scheduling systems reduced average wait times and increased the punctuality of bus services in urban transport networks.

The role of park management systems in enhancing safety and security is well-documented. Real-time surveillance and monitoring systems have been effective in reducing crime rates and improving passenger safety. According to research by Liu *et al*., (2017), the deployment of comprehensive security measures within transport hubs has led to a noticeable decrease in incidents and an increase in passenger confidence. Electronic ticketing systems integrated into park management systems have streamlined revenue collection processes. Studies by Chen and Liu (2018) demonstrate that digital payment systems reduce revenue leakages and improve financial accountability. Improving passenger experience through technology is a common theme in transport studies. Real-time information systems, digital display boards, and mobile apps providing schedule updates contribute to a better travel experience. Research by Fan and Huang (2019) shows that passengers value timely information and convenience, which are facilitated by modern park management systems.

Technological Innovations Adoption

The adoption of technology and innovative solutions has revolutionized motor park management systems at bus terminals. Bus terminals are critical nodes in urban transportation networks, serving as hubs for passenger

boarding, alighting, and transit. Efficient management of these terminals is essential for ensuring smooth operations and a positive passenger experience. In recent years, technological innovations have played a pivotal role in transforming motor park management systems, offering solutions that enhance operational efficiency, safety, and service quality. One of the most significant advancements in motor park management is the introduction of digital ticketing and reservation systems. These systems allow passengers to book tickets online, reducing the need for physical queues at terminals (Zhang *et al*., 2020). Mobile applications further enhance convenience by providing features such as booking, real-time tracking, and customer support. Automated scheduling and dispatch systems leverage advanced algorithms to optimize bus schedules based on passenger demand and traffic conditions (Chen, 2019). Real-time data enables efficient allocation of buses, minimizing wait times and improving service frequency. Global Positioning System (GPS) technology has enabled real-time tracking of buses, allowing passengers to monitor bus locations and estimated arrival times through mobile apps and digital signage at terminals (Li and Zhao, 2018). This real-time information significantly enhances the passenger experience by reducing uncertainty and wait times.

Fleet management systems utilize telematics to collect data on vehicle performance, fuel consumption, and driver behavior (Wang *et al*., 2021). These systems provide maintenance alerts and predictive analytics to prevent breakdowns and extend vehicle lifespan, thereby improving operational efficiency and safety. Interactive kiosks at bus terminals offer passengers access to ticket purchases, route information, and customer service (Smith and Jones, 2017). Mobile notifications keep passengers informed about delays, cancellations, and other critical information, enhancing their overall travel experience. Contactless payment methods, such as Near Field Communication (NFC) and Quick Response (QR) codes, streamline the ticket purchase and boarding process (Brown, 2022). Integrated fare systems facilitate seamless transitions between different modes of public transportation, providing a unified payment experience for passengers. Surveillance systems, including Closed-Circuit Television (CCTV) cameras, enhance security at bus terminals and on buses (Ahmed and Hassan, 2020). Emergency communication systems enable quick coordination with emergency services and real-time incident reporting, improving overall safety for passengers and staff. The adoption of electric buses and energy-efficient terminal designs contributes to environmental sustainability by reducing emissions and improving air quality (Green *et al*., 2023). Renewable energy sources and eco-friendly practices are increasingly being integrated into bus terminal operations. Artificial intelligence (AI) and data analytics are transforming motor park management by providing insights into passenger flow patterns and optimizing terminal layouts and services (Kim *et al*., 2020). Predictive maintenance algorithms analyze vehicle data to forecast maintenance needs, reducing downtime and costs. Chatbots and virtual assistants offer 24/7 customer support for booking, inquiries, and complaints (Williams, 2019). Digital feedback platforms allow passengers to provide input on their experiences, which is then analyzed to improve service quality.

III. METHODOLOGY

The study adopted a descriptive research design with the use of a well-structured questionnaire. The

population consisted of 30 terminal staff management using snowballing and incidental sampling techniques with a sample size of 28 terminal staff. Data analysis was conducted using descriptive statistics and inferential statistics. Inferential statistics of multiple regression analysis was used to examine the impact of technological innovations adoption on PMS at Ojo Bus Terminal.

IV. RESULT AND DISCUSSION

The results from the multiple regression analysis demonstrated that technological innovation adoption had a significant impact on the park management system at the Ojo Bus Terminal, Oyo State, Nigeria. The model summary in Table One (1) revealed a strong relationship between the predictors and the park management system, with an R value of 0.891. The R square value of 0.794 indicated that approximately 79.4% of the variance in the park management system was explained by the selected technological innovations adoption which include Energy Efficient Systems, Smart Parking System, Surveillance Systems, Real-Time Information System, and Automated Ticketing System. The ANOVA results Table One (1) established that the regression model was statistically significant, with an F-value of 16.986 and a significance level of 0.000, which was below the threshold of 0.05. This finding further supported the conclusion that the predictors had a significant impact on the park management system. The coefficients table in Table Two (2) highlighted that some technological innovations adopted were statistically significant in their impact on the park management system. Specifically, the Real-Time Information System (p = 0.000), Smart Parking System (p = 0.000), Surveillance Systems (p = 0.004), and Energy Efficient Systems (p = 0.001) all had significant positive effects on the system. Additionally, the Automated Ticketing System (p = 0.041) also contributed significantly, although it had a slightly higher p-value compared to the other factors. Based on these findings, the null hypothesis (H_{01}), which suggested that technological innovation had no significant impact on the park management system, was rejected. The analysis confirmed that technological innovation significantly positively influenced the park management system at the Ojo Bus Terminal.

Table 1: Model Summary and ANOVA[a]

Multiple R	.891[a]
R Square (R^2)	.794
Adjusted R Square (R^2)	.748
Standard Error	.309

Analysis of Variance Table

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	8.091	5	1.618	16.986	.000[b]
	Residual	2.096	22	.095		
	Total	10.187	27			

Source: Data Analysis (2024)

Table 2: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	Std. Error	Beta		
1	(Constant)	-.450	.286		-1.573	.130
	Automated Ticketing System	.150	.069	.249	2.172	.041

Real Time Information System	.279	.063	.503	4.414	.000
Smart Parking System	.249	.060	.474	4.144	.000
Surveillance Systems	.211	.066	.346	3.210	.004
Energy Efficient Systems	.261	.064	.433	4.045	.001

a. Dependent Variable: Park Management System

Source: Data Analysis (2024)

The findings from multiple regression analysis of this study underscore the pivotal role of technological innovations adoption in enhancing the efficiency and functionality of park management systems at the Ojo Bus Terminal, Oyo State, Nigeria. The multiple regression analysis revealed that the selected technological innovations adoption collectively accounted for a substantial 79.4% of the variance in the park management system ($R^2 = 0.794$). This aligns with research by Wang *et al*. (2023), who emphasized that smart technologies, such as automated ticketing and real-time information systems, significantly improve the operational effectiveness of transport hubs by optimizing resource utilization and enhancing user satisfaction. The ANOVA results further validated the significance of the regression model, demonstrating a robust F-value of 16.986 at a significance level below 0.05. This corroborates findings by Smith and Brown (2022), who argued that statistical significance in such models often reflects the transformative potential of smart infrastructure investments in public transport and urban mobility. The coefficients table provided deeper insights into the contributions of individual predictors. These results are consistent with the findings of Lee *et al*. (2022), who highlighted the critical importance of real-time data and smart parking solutions in reducing congestion and improving commuter satisfaction in urban settings. Similarly, the positive influence of Surveillance Systems and Energy Efficient Systems aligns with findings from Johnson *et al*. (2023), who noted their role in enhancing security and sustainability in transportation hubs. The Automated Ticketing System, while also significant ($p = 0.041$), exhibited a slightly higher p-value compared to other predictors. This suggests that while automated ticketing contributes positively, its impact may depend on complementary systems, as suggested by Miller and Davis (2023), who posited that the integration of automated systems with user-friendly interfaces is key to maximizing their benefits.

CONCLUSION AND RECOMMENDATION

Based on the findings, the study therefore concluded that, technological innovations adoption had significant impact on park management system at Ojo Bus Terminal, Oyo State, Nigeria. However, it was

recommended that; Park management authorities should prioritize the adoption of Real-Time Information Systems, Smart Parking Systems, Surveillance Systems, Energy Efficient Systems, and Automated Ticketing Systems to optimize operational efficiency, enhance user satisfaction, and reduce congestion.

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