

Effect of Cable Vandalism Along Track Corridors on the Operational Efficiency of Abuja Rail Mass Transit System

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Article history

Received March. 26, 2026

Revised April, 09, 2026

Accepted April, 15, 2026

KEYWORDS: Cable vandalism;
Track corridors; Operational
efficiency, Infrastructure security,
Rail transport sustainability

Abstract

This study examined the effect of cable vandalism along track corridors on the operational efficiency of the Abuja Rail Mass Transit system. The study adopted a descriptive research design, based on a quantitative approach. Staff of the ARMT served as the population of the study. A sample size of 257 respondents was determined using Taro Yamane's formula, out of which 243 valid responses were retrieved and used for analysis. Data was collected using structured questionnaires administered to staff at different locations. Data analysis was conducted using frequency counts, percentages, mean scores and Spearman Ranks correlation. The findings revealed that there was a significant negative relationship between cable vandalism and operational efficiency ($p = -0.462$, $p < 0.01$), indicating that increase in cable vandalism incidents could result in reduction in operational efficiency such as reduced service reliability, increased operational delays, and higher maintenance burdens within the system. The study recommended that security should be strengthened around rail corridor by adopting technology-based solutions like CCTV surveillance, intrusion detection systems, and live monitoring while enhancing institutional coordination with security agencies, and stricter enforcement existing anti-validation laws.

Recommended citation: Suleiman, A., & I Owoeye A.S. Effect of Cable Vandalism Along Track Corridors on the Operational Efficiency of Abuja Rail Mass Transit System, CUSTECH-Journal of Innovation, Management and Social Sciences, 1(1).

1 INTRODUCTION

In cities with rapid population growth, urban rail systems now serve as a key element of sustainable transport infrastructure, as they boost mobility, reduce congestion and increase economic productivity. The Abuja Rail Mass Transit (ARMT) system was designed to be a strategic investment that delivers efficient, safe, and reliable urban transit, within the city (Yinggui & Dung, 2022). Despite the potential the benefits, especially, its potential to improve urban mobility, the operational efficiency of the system is still under threat due to persistent infrastructure and security issues such as cable vandalism on track corridors.

Cable vandalism, defined as deliberate destruction, theft or manipulation of railway communication, signalling and electrical cables, is a significant operational threat to rail systems. Faulty or damaged cables can lead to service delays, downtime, higher maintenance expenses and safety hazards in the train control, signalling coordination and communication systems in the Operation Control Centre (OCC). Empirical evidence has revealed that cable theft, cable tampering and intervention in signalling system are among the forms of vandalism in railways that have a significant impact on the reliability of service and operational performance (Mugari & Obioha, 2024). Likewise, Matsie and Msomi (2023) discovered that theft and vandalism in the railway systems are causing operations to be degraded, which include delays, cancelling and manual control procedures, leading to increased risks in operations.

Railway infrastructure remains largely vulnerable to deliberate human interference. Human-related factors such as theft and vandalism have been identified in the hazard assessment of the Abuja Rail Mass Transit system by Yinggui & Dung (2022) and are considered a significant source of operational risk with a very strong influence on the safety and reliability of the system. Moreover, George, Mokoena and Rust (2018) noted that signalling and electrical infrastructure in railway systems are deteriorating continuously in South Africa as a result of theft and vandalism, which negatively impacts their operational efficiency and system failures. Janowiec and Kula (2023) found that theft and vandalism of railway infrastructure cause major operational disruptions such as long train delays and financial losses. Likewise, Mohlabeng and Vallabhapurapu (2025) pointed out that signalling and telecommunication cables are some of the most vulnerable assets on the railway network, and hence need an integrated physical, technical and regulatory protection mechanisms to guarantee system resilience. The results highlight the vulnerability of rail facilities in areas with poor or weak security structure.

Despite these rising concerns, there is limited empirical evidence to draw direct correlation between the cable vandalism along the train tracks and the operational efficiency of the train system in the Abuja Rail Mass Transit system. Current research tends to focus on general infrastructure vandalism or on the broader impacts of transport crime, rather than the direct operational impacts of these vandalisms on rail operation especially in Nigeria. Based on this, this study investigates the impact of cable vandalism on the efficiency of the operations of the Abuja Rail Mass Transit system along the track corridors. The study offers evidence-based insights into the operational implications of infrastructure vandalism, providing relevant information for informed decisions and policy formulations.

2 LITERATURE REVIEW

2.1 Asset Management Framework

Asset Management framework is a framework for systematic and lifecycle management of infrastructure to achieve optimal performance and life (International Standard Organisation [ISO], 2014). This theory focuses on proactive maintenance, resource planning, risk management and technical resilience, aiming to avoiding early degradation and system failures. The need to implement principles of asset management is a fundamental requirement for Abuja Rail Mass Transit System in managing the Operation Control Centre, anti-cable vandalism, tracks maintenance and rolling stock, as well as service reliability. This theory correlates the technical and operational side of sustainability with economic efficiency and cost-effectiveness, emphasizing the idea that good infrastructure management can lower costs, boost reliability and improve passenger satisfaction in the long term.

2.2 Cable Vandalism

Cable vandalism is a term used to describe deliberate acts by humans to cause damage to railway cables and associated infrastructure, which then affect the safety, efficiency and reliability of railway transportation (Bhati & Pearce, 2017). In the context of the Abuja Rail Mass Transit, cable integrity is of paramount importance to the operation of the Operation Control Centre (OCC) as any disturbances can cause signalling errors, interruptions in service, operational downtime, high maintenance expenses and loss of passenger confidence. International standards put a lot of emphasis on the protective installation of underground cables, such as armouring and the necessary depth of burial, to minimise susceptibility to external interference and environmental risks (Mthombeni, 2023).

Infrastructure vulnerability has become a growing focus in transport literature, and the question of how resilient rail systems are against accidental failure and deliberate disruption will be important for ensuring operational continuity and reliability, as infrastructure vulnerability has a direct impact on operational continuity and reliability (Shi et al., 2019). Vandalism was also conceptualised as an antisocial act of the human mind which is aimed at causing damage or destruction to property even if the act does not lead to formal criminal prosecution (Bhati & Pearce, 2017). Rising incidences of vandalism and encroachment on railway infrastructure have been reported throughout Nigeria with serious economic and operational consequences (Yusuf, 2011; Ojekunle, 2016; Yinggui & Dung, 2022).

2.3 Infrastructure Maintenance Sustainability

Infrastructure maintenance sustainability is the capability to keep transport infrastructure working, safe, efficient and long-lasting by implementing systematic and well-resourced maintenance practices (Nowotarski and Gajzler, 2024). It also relates to the upkeep of tracks, signalling, communications wires, power lines and control systems in the rail industry to guarantee reliable performance around the clock. Obed (2018) described rail infrastructure as the physical and organisational systems used to ensure the efficiency and productivity of rail transport services.

Infrastructure deterioration and maximizing asset life are achieved through infrastructure maintenance programs that focus on reducing deterioration, which include preventive, corrective, predictive and asset management programs. Liljenström et al. (2022) highlighted the importance of effective asset management for long-term infrastructure performance and cost efficiency, especially in large transport systems. Yet, there are many factors that affect the sustainability of maintenance, including funding availability, technical capability, availability of spare parts, institutional capability, and maintenance culture. Ultimately, effective maintenance ensures that infrastructure is safe, reliable, efficient, and resilient, and contributes to uninterrupted services and infrastructure integrity, whereas poor maintenance practices cause infrastructure to deteriorate.

Poor institutional structures and maintenance systems exacerbate infrastructural sustainability issues in developing countries like Nigeria. Bassey (2020) and Oraegbune and Ugwu (2017) reported that poor maintenance culture in West Africa is a major cause of the degradation and inadequate utilization of transport infrastructure. Lack of proper maintenance coordination, poor institutional synergy and lack of attention to critical components (such as OCC cables) are added challenges to the sustainability of the Abuja Rail Mass Transit System.

Hence, infrastructure maintenance sustainability in rail systems relies on the synergic work of technical, financial and institutional aspects. Common key indicators are the frequency of maintenance activities, availability of spare parts, funding level, competence of the maintenance workforce, balance between preventive and corrective maintenance and the physical condition of infrastructure assets.

2.4 Review of related literature

Killen, et al. (2017) undertook a literature search into the mitigation strategies used to prevent vandalism in a rail environment, based on international studies, policy reports and empirical evaluations through the prism of six broad themes: maintenance, materials and design, technology, legal enforcement, community engagement and holistic approaches. The study revealed that vandalism is a complex issue with behavioural underpinnings of thrill-seeking, self-expression and group identity, and that it can have a devastating impact on rail operations including service disruptions, higher maintenance costs, and lost system reliability. Rapid vandalism removal and the use of vandal-resistant materials can help minimise the likelihood of re-vandalism and opportunity for damage, but these actions are most effective when combined with wider measures. A range of technological measures (including CCTV and GIS mapping) can enhance detection and response, however alone they do not provide a high degree of long-term deterrence. Similarly, the effectiveness of law enforcement measures was mixed, while community-based interventions were seen to be more effective in dealing with underlying behavioural drivers. This study concludes that multi-layered approaches that involve technical, social and institutional measures are best suited to the mitigation of vandalism in a rail system in a sustainable manner.

George, et al. (2018) undertook a detailed review of the status of South Africa's rail infrastructure based on secondary data obtained from operational reports, expert surveys and institutional data sources like Transnet, PRASA, RSAIR and SAICE Infrastructure Report Card. The study evaluated operational indicators that included derailment, collision, theft, and vandalism as well as key infrastructure components of the system, including track assets, structures, electrical systems, and telecommunications and signalling. The results showed significant differences in the quality of the infrastructure on the railway network. While the heavy haul freight system was generally in slightly below average to good condition, it still exhibited weaknesses in signalling and telecommunications systems. The general freight and branch line networks were identified as being in below average to very poor condition, stemming primarily from poor maintenance standards, lack of investment and ongoing theft and vandalism. Likewise, PRASA's passenger rail system was deemed to be poor, primarily because of its antiquated infrastructure, high maintenance expenses and the risk of theft and vandalism. The Gautrain system, in contrast, was judged to be in good condition, due to up-to-date infrastructure and maintenance funding that is based on performance. The study found that, overall, rail infrastructure in South Africa is in a state of considerable decline, and that theft and vandalism are significant factors for system

degradation and inefficiency. The study recommended urgent investment in infrastructure protection as well as improved maintenance scheme

Matsie and Msomi (2023) undertook a mixed methods study on the effect of theft and vandalism on train operations in South Africa, which involved quantitative analysis of incident data (2018–2022), qualitative interviews with railway personnel and a case study examining the Pienaarspoort–Pretoria rail corridor. The research covered the subsystems of the railways, such as signalling, telecommunications, electrical equipment, rolling stock and station facilities, with a particular focus on theft and vandalism. The results showed a significant rise in the number of thefts and vandalism events, especially during the COVID lockdown period, pointing to signalling, telecoms and electrical systems as the areas of greatest impact as these are high value copper systems. They were identified as having a significant impact on train operations, causing delays, cancellations, reduced reliability, and compromising train operating modes (such as manual train authorisation and speed restrictions). The study also revealed that the safety risks were exacerbated, with a higher risk of derailment or systems failure, and significant cost implications from repair, rehabilitation and security. The study concluded that theft and vandalism are significant threats to rail safety, reliability and efficiency. It suggested better security, hotspot policing, rail corridor fencing, technological solutions (including intrusion detection systems), and better organisational coordination and community engagement, as well as other measures, in order to reduce the likelihood of recurring losses to infrastructure.

Luke, et al. (2020) examined the impact of transport crimes on supply chain efficiency in Gauteng, South Africa, using a quantitative survey design with data collected from 51 transport personnel and analysed using descriptive statistics. The study identified negative impacts of transport crime on operational performance, such as cost, delivery time, efficiency of transport services and damage to the organisation's reputation. Vandalism associated with employee strikes was not as damaging as theft of fuel or white-collar crime, but it did lead to some inefficiencies in operations. The study also found that current security measures were applied in a generic manner and not specific enough to particular risk zones, reducing the effectiveness. It found that transport crimes have a negative impact on supply chain efficiency, and suggested the implementation of targeted, data-driven risk management strategies and risk prioritisation tools for improving the efficiency and sustainability of operations.

Janowiec and Kula (2023) examined the risk of damage to railway infrastructure due to theft and vandalism in Poland, using a quantitative methodology based on statistical data from PKP Polskie Linie Kolejowe S.A. The study adopted the Common Safety Method (CSM) approach to structured risk assessment and assessment of railway safety performance over time. The results showed that theft and vandalism are a serious concern for the railways, causing not only financial losses (up to PLN 10 million per year) but also significant operational disruptions, such as more than 100,000 minutes of delays in 2021. While the number of incidents dropped from approximately 5,000 in 2012 to 723 in 2021, the study also noted that risk levels have improved from “unacceptable” (2012) to “acceptable” (2021), but these concerns continue to be issues of safety and operational risk. The study has found that although improvements in the risk level have been seen, theft and vandalism remain a significant threat to railway infrastructure reliability and efficiency. It called for ongoing investment in security measures, including surveillance systems and security patrols, as well as ongoing optimization of the risk assessment approaches to enhance threat identification and mitigation in railway systems.

Yinggui and Dung (2022) did a hazard identification and risk assessment study on the Rail Mass Transit System, Abuja, Nigeria, using a risk matrix approach. Structured questionnaires were used to gather data from 100 respondents, including passengers and operational staffs, with the analysis emphasizing the following four dimensions of risk: human error, equipment design failure, environmental conditions and management-related factors. The results indicated that human factors were the most important source of risk in the system, while security issues like theft and vandalism were identified as aspects of human-induced hazards that impact on the operational safety and reliability in the system. Based on this study, it was observed that human factor is the predominant risk factor that affects the early operation of the Abuja rail system and suggested the need to conduct continuous monitoring of the risk factors, improve management practices to ensure high reliability and strengthen safety measures to minimize hazards to the rail system.

Mugari & Obioha (2024) aimed to assess the socio-economic development effects, problems, and mitigations of infrastructure vandalism in Southern Africa, specifically in the rail and electricity infrastructure in South Africa and

Zimbabwe. A qualitative review approach was used, consisting of a literature search, a review of policy documents, and a review of sectoral reports, to analyse the manifestations of infrastructure vandalism, its impacts, and the measures taken to control it. The results of the findings showed that the most common types of vandalism found in infrastructure facilities are copper cable theft, destruction of transformers and pylons, electrical component theft and manipulation of railway signalling and point machines. The findings of the study indicate that such acts cause substantial direct costs to the utility companies as well as wider socio-economic costs such as disruption of supply of essential services, economic loss, and danger to community safety. It also identified main difficulties in fighting vandalism, such as the involvement of insiders, corruption, organised crime networks, weak legal measures, as well as some infrastructure weaknesses, including power outages. The study found that infrastructure vandalism is a critical challenge to socio-economic development and the dependability of critical infrastructure systems in Southern Africa. It called for better laws, law enforcement, surveillance, community participation, and legal sanctions in order to reduce the increasing number of cases of infrastructure vandalism and enhance infrastructure protection.

Mohlabeng and Vallabhapurapu (2025) performed a qualitative systematic review on the protection strategies for railway infrastructure, particularly cable systems and related security measures. The study reviewed 157 peer-reviewed articles published from 2015 to 2024, and collated the results of various studies to explore protection of railway infrastructure from physical and technological threats. Results showed that the railway protection strategies are multi-layered, physical, intrusion detection, surveillance, cable health monitoring, cybersecurity, emergency response and regulatory compliance. The research found that the most vulnerable parts of critical infrastructure are signalling and telecommunication cables, fibre optic systems, and electrification cables. It also identified the research gaps, particularly on integrated protection systems and new cyber-physical security threats. The study found that protecting the railway infrastructure effectively requires an integrated approach, in which technology, regulation and ongoing monitoring are all interlinked with the aim of increasing the resilience of the railway system and decreasing its vulnerability to any infrastructure-related event.

3 RESEARCH METHODOLOGY

This study adopted a descriptive quantitative research design to explore the relationship between cable vandalism and the operational efficiency of ARMT. The study population was made up of 722 staff of ARMT who contributed directly in the operation, management, security and administration of the rail system. A sample size of 251 staff was determined using the Yamane (1967) formula as shown in Equation 1.

$$n = \frac{1}{(1+N(e)^2)} = \frac{1}{(1+722(0.05)^2)} = 251 \dots \dots \dots \text{EQN (2)}$$

Where:

- n is the sample size,
- N is the study population (722), and
- e is the error term (0.05).

The study relied on primary data collected using structured questionnaires that captured the demographic characteristics of respondents as well as information on the frequency and effect of cable vandalism and perception of operational efficiency. Aside demographic characteristics, other questionnaire items were measured using a 5-point Linkert scale, where 1 represented Strongly Disagree and 5 represented Strongly Agree. Questionnaire was subjected to reliability test using Cronbach alpha which returned a high internal reliability score of 0.77. Collected data were analysed using descriptive and inferential statistics. Descriptive statistics comprised of frequency counts percentages, and mean scores while Spearman rank correlation was adopted to test the relationship between cable vandalism and operational efficiency at a 0.05 level of significance.

4 RESULTS AND DISCUSSION

4.1. Socioeconomic Characteristics of Respondents

The gender distribution of respondents in Table 1 shows that males constitute the majority of the staff sampled for the study, as 68.7% were males while 31.3% were female. This indicates a higher participation of male respondents in the study compared to females while also implying that there are more male workers than female workers at ARTMS.\

Table 1: Gender Distribution

Gender	Frequency	Percentage
Male	167	68.7
Female	76	31.3
Total	243	100

Source: Author's Survey (2026)

As shown in Table 2, the age distribution of respondents reveals the majority of the respondents (32.1%) were within the age group of 36–45 years. This is followed by those within the age group of 26–35 years, representing 21% of the respondents. 19.8% were aged 46–55 years, 16.9% were aged between 18–25 years, while 10.2% of the respondents were above 56 years of age. This is an indication that majority of the respondents were matured enough to understand the nature and impact of cable vandalism.

Table 2. Age Distribution

Age Group	Frequency	Percentage (%)
18–25	41	16.9
26–35	51	21.0
36–45	78	32.1
46–55	48	19.8
Above 56	25	10.2
Total	243	100

Source: Author's Survey (2026)

Table 3 shows the analysis of staff years of experience. The findings revealed that majority of the respondents were well experienced staff that have worked within the transportation sector for over 5 years. From the findings, 29.2% of the respondents had a working experience of 11–15 years. This implies that much of the workforce has gained considerable experience in the transport system which is relevant for offering informed responses to operational and infrastructural issues. This is followed closely by respondents who have less than 5 years' experience, accounting for 28.8% of the sample. This suggests that there is a significant number of staff who are relatively new to the system which could be a result of new staff appointments or growth within the organization. Their insights are especially valuable for evaluating the state of the system and its recent performance.

Table 3. Years of Professional Experience (Staff/Experts)

Experience (Years)	Frequency	Percentage (%)
Less than 5	70	28.8
5 – 10	58	23.9
11 – 15	71	29.2
Above 15	44	18.1
Total	243	100

Source: Author's Survey (2026)

Furthermore, 23.9% had working experience of 5 – 10 years, representing a group of mid-level experienced staff that will likely have a balance of knowledge between historical and current system practices. Their responses are important in bridging the gap between newer and more experienced staff perspectives. Finally, 18.1% had a working experience of above 15 years, representing the smallest group whose long continuous presence in the system offers insights into the evolution of operational performance, infrastructure development and maintenance practices over time

4.2. Effect of cable vandalism on operational efficiency

Table 4 shows the respondents opinions on how the cable vandalism affected the efficiency of the Abuja Rail Mass Transit System. A mean score of 4.04 and a standard deviation of 1.14 shows that generally there is a high level of agreement among the respondents about the effect of cable vandalism on rail operations, although there is some variation in responses across indicators. From the findings, the highest rating is associated with the statement “vandalism increases maintenance cost” which has a mean rating of 4.60 and a relatively low standard deviation of 0.50. This reflects a high level of agreement from participants on how cable vandalism results in increased repair and maintenance needs. Following this is the statement ‘vandalism is a cause of delay and disruption’, with a mean score of 4.55 indicating that the majority strongly agrees that the vandalism of infrastructure is a cause of service disruptions. The statement, “Vandalism causes signalling failures,” also recorded a high mean of 4.50, indicating that respondents strongly believe that there is a connection between vandalism and signalling failures, specifically in critical signalling infrastructure. The result is crucial to understanding train safety and scheduling efficiency because signalling systems play a key role in those aspects. Vandalism was also indicated to result in overall system inefficiency with a mean score of 4.30, implying that vandalism harms the rail system beyond the technical problems it can cause. The frequency of cable vandalism was also noted to be moderate with a mean score of 3.35. Finally, findings revealed that the existing security measures to address cable vandalism was inadequate with a mean of 3.45, suggesting moderate agreement among the respondents that the current preventive measures are not effective enough.

Table 4. Effect of cable vandalism on operational efficiency

Statement	N	Mean (M)	Std. Dev
Vandalism occurs frequently	243	3.35	1.40
Vandalism causes signalling failures	243	4.50	0.81
Vandalism causes delays/disruptions	243	4.55	1.34
Vandalism increases maintenance cost	243	4.60	0.50
Security measures to tackle vandalism are inadequate	243	3.45	1.32
Vandalism undermines overall system efficiency	243	4.30	0.60
Grand mean		4.04	1.14

Source: Author's Survey (2026)

A Spearman's rank correlation was performed to investigate the relationship between cable vandalism and operational efficiency. The result as presented in Table 5. showed a moderate negative correlation between the two variables ($p = -0.462$, $N = 243$, $p = 0.000$). The strength of the correlation demonstrated that this relationship weak or incidental, but sufficiently substantive to indicate that there is an important operational connection between infrastructure security and system performance.

The negative association of the relationship supports the theoretical prediction that infrastructural sabotage interferes with the efficient operation of railway systems. Any act of vandalism directly disrupts the core systems of cable networks such as signalling, communication, train detection and operational coordination. This might translate to delayed train movements, service disruptions, reduced reliability level, and frequent downtime. The p-value of less than 0.05 further strengthens the confidence in the result, indicating that the relationship observed was very unlikely to have happened by chance. The null hypothesis therefore is rejected, indicating therefore that cable vandalism has significant impact on rail operational efficiency.

Table 5. Spearman Rank Correlation on Cable Vandalism and Operational Performance

Variables		Cable Vandalism	Operational Efficiency
Cable Vandalism	Spearman's rho	1.000	-0.462**
	Sig. (2-tailed)	-	0.000
	N	243	243
Operational Efficiency	Spearman's rho	-0.462**	1.000
	Sig. (2-tailed)	0.000	-
	N	243	243

Source: Author's Survey (2026)

From a policy and operational standpoint, this finding has important implications for the sustainability of rail transport in Abuja. Firstly, it emphasizes the importance of infrastructure security for operational efficiency, indicating that the protection of physical infrastructure, surveillance tools and quick response systems are not just an option but an

integral part of the system's performance. Secondly, the finding implies that improving operational efficiency in isolation such as through better scheduling or improvements to other operational components may yield limited results if cable vandalism is not simultaneously addressed.

4.3 Discussion of Findings

The study found that there was a significant negative relationship between cable vandalism and operational efficiency of the Abuja Rail Mass Transit System, meaning that the more cable vandalism, the lower the operational efficiency. The moderate negative correlation observed suggests that while cable vandalism is an important determinant of operational efficiency, it operates alongside other operational factors such as maintenance practices, rolling stock availability, funding adequacy, and system management. However, the discovery clearly shows that vandalism is a significant operational risk that can impact the effectiveness of the delivery of rail services. This relationship can be understood in the context of the importance of signalling and communication cables in train co-ordination, operational control and safety management. These damages frequently require emergency maintenance actions, service interruptions, speed limits and operational changes, which can decrease system reliability, network availability and overall performance.

The results agree with those of Mugari and Obioha (2024) that infrastructure vandalism reduces the reliability of railway operations, increases costs of maintenance, and causes service disruptions. Likewise, Mohlabeng and Vallabhapurapu (2025) proposed signalling infrastructure as one of the most vulnerable railway assets as a failure of the signalling cable and its control systems can threaten the stability and safety during railway operations. The current results corroborate this, showing that vandalism of critical railway infrastructure does not only result in physical damage but also in measurable effects on the operational performance.

Most importantly, the study findings align with the work of Yinggui and Dung (2022) which carried out a hazard identification and risk assessment of the Abuja Rail Mass Transit System and found that the threat of theft and vandalism to be an “undesirable” risk that needs to be addressed immediately. The study gave theft and vandalism a risk score of 12 because it is seen as having a high probability and severity of operational hazard to the rail system. They also noted that vandalism of railway infrastructure, including cables and trackside equipment, could make it more difficult to operate trains, make signalling and communication systems more vulnerable, create further safety risks, and cause extra costs to the train operators. These concerns are corroborated in the present study, which further adds to the evidence by providing empirical proof that cable vandalism is significantly related to the operational inefficiency in the Rail Mass Transit System, Abuja. Although vandalism has been identified as a critical operational risk by Yinggui and Dung (2022), the current study provides quantitative evidence of the direct relationship between vandalism and operational performance outcomes.

The results also echo concerns of Kingsley and Joke (2025) about sustainability issues arising from infrastructure vandalism. Damage to critical railway assets not only leads to damage of physical assets, but also to decreasing service reliability, high operating costs and loss of confidence in the rail service leading to a long-term decrease in the sustainability of rail investments. Petrović et al. (2023) also concluded that the disturbances of critical operational inputs, such as infrastructure integrity and signalling reliability, have a profound effect on the overall railway performance. All of these studies and the current results indicate that the protection of railway critical infrastructure is a cornerstone of reliable and sustainable railway operations.

Theoretically, the results validate Asset Management Theory, which states that the performance of infrastructure systems depends on the management and maintenance of critical assets, and on their protection and availability. The impact of cable vandalism on the service and the loss of operational efficiency as observed is an example of how the degradation or loss of essential infrastructure assets negatively affects service delivery and operational efficiency. Thus, the results show that proactive asset protection measures are crucial in railway operations management. In addition, the moderate rating of current security measures indicates that some current security controls may not be enough to adequately mitigate the risk of vandalism. Therefore, better surveillance technology, improved security in corridors, greater community involvement in protecting the railway infrastructure and a tougher institutional and legal penalty for offenders could be needed to protect railway assets and maintain operational efficiency in the Abuja Rail Mass Transit System.

5 CONCLUSION AND RECOMMENDATION

The study has concluded that cable vandalism along the track corridors has a significant negative influence on the efficiency of the operations of the Abuja Rail Mass Transit system. The results have shown that intentional interference with signalling, communications, and electrical cables negatively impacts train operations, maintenance requirements and service reliability. The disruptions occur as operational delays, extra downtime, higher safety concerns and extra costs for system operators. The study thus demonstrates that cable vandalism is not only a security problem but also a serious operational problem that impacts the overall performance and sustainability of the ARMT system.

The study suggests implementing a range of physical security measures, such as fencing, more surveillance and security guards at strategic points, along railway lines. Furthermore, the incorporation of cutting-edge technological measures like CCTV surveillance, intrusion detection systems, and live monitoring of cable health is crucial for improving early detection and prevention of vandalism events. The study also calls for better coordination of institutional arrangements among the rail operators and security agencies, to facilitate intelligence gathering and quick-response capabilities at the community level. Lastly, there is a need for a stronger enforcement of existing laws and a sensitisation of the communities on the need to protect critical rail assets to reduce vandalism and foster collective responsibility.

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