

Digital Surveillance or Performance Support? Technological Supervision and Staff Punctuality in Nigerian Universities

Nwankwo, Ernest Chukwuebuka & Onodugo, Vincent Aghaegbulam

University of Nigeria, Enugu Campus

Abstract

This study examines whether technological supervision in universities functions primarily as a form of digital surveillance or as a mechanism for enhancing staff performance, with particular emphasis on the mediating role of enforcement credibility and the moderating role of institutional context. Leveraging Behavioural Control Theory and Performance Management Theory, the study develops the Context-Contingent Technological Supervision Framework (CCTSF) to explain how digital monitoring systems influence staff punctuality through a conditional process mechanism. A quantitative survey design was adopted, using data from 346 academic and non-academic staff across selected public and private universities in South-East Nigeria. Data were analysed using Hayes' PROCESS Macro (Model 7) with bootstrapping (5,000 resamples). The findings indicate that technological supervision is positively correlated with enforcement credibility, which in turn significantly forecasts staff punctuality. The indirect effect was statistically significant ($\beta = 0.186$, 95% CI [0.115, 0.267]), indicating partial mediation. Further analysis reveals that institutional context significantly moderates this relationship, with a stronger indirect effect observed in private universities ($\beta = 0.241$) compared to public universities ($\beta = 0.132$). The index of moderated mediation ($\beta = 0.109$, 95% CI [0.051, 0.178]) confirms that the mediation pathway differs significantly across institutional settings. The study suggests that technological supervision functions as a context-dependent governance mechanism whose effectiveness is influenced more by enforcement credibility than by visibility alone.

1. Introduction

The growing use of digital technologies has transformed workplace supervision across many organizations. Traditional approaches to monitoring employee attendance and behaviour are increasingly being replaced by biometric systems, electronic attendance platforms, and automated tracking tools that provide real-time records and enhance accountability (Ball, 2010; Moore et al., 2018). These developments reflect a broader shift toward data-driven management, where

performance evaluation is increasingly based on measurable and verifiable information (Lupton, 2016; Ajunwa et al., 2017).

Universities have traditionally operated differently. Academic institutions have long relied on professional autonomy, collegiality, and trust-based supervision rather than continuous monitoring (Deem et al., 2007; Winter, 2009). However, increasing demands for accountability and performance measurement have encouraged universities to adopt more formal management practices, including the use of digital technologies to monitor staff attendance and punctuality (Bolden et al., 2009; Clarke & Knights, 2015). Biometric and electronic attendance systems are now common in many Nigerian universities as institutions seek to address concerns about lateness and absenteeism while improving administrative efficiency (Mone & London, 2018).

The expansion of digital monitoring has generated considerable debate. Critics view these technologies as surveillance mechanisms that strengthen managerial control and potentially undermine trust and professional autonomy (Ball, 2010; Zuboff, 2019). Supporters, however, argue that they improve transparency, accountability, and consistency in enforcing organizational rules (Bhave, 2014; Stanton & Weiss, 2000). Despite this debate, limited research has examined how the effectiveness of technological supervision varies across institutional contexts.

This study addresses this gap by investigating the relationship between technological supervision and staff punctuality in Nigerian universities, with particular attention to differences between public and private institutions. It argues that the effectiveness of digital supervision depends not only on the technology itself but also on the organizational environment in which it operates.

2. Literature Review and Theoretical Framework

2.1 Technological Supervision, Digital Control, and Performance Support

The increasing use of digital technologies has transformed workplace supervision. Organisations now rely on biometric systems, electronic attendance platforms, digital dashboards, and automated monitoring tools to track employee behaviour and attendance more efficiently (Kellogg et al., 2020; Leonardi, 2021). These technologies improve visibility, reduce dependence on manual records, and strengthen organisational oversight.

This shift is particularly significant in universities, which have traditionally relied on professional autonomy, collegiality, and trust rather than strict administrative monitoring. However, growing demands for accountability, efficiency, and measurable performance have encouraged higher education institutions to adopt more managerial approaches to supervision (Deem & Brehony, 2005).

Scholars remain divided on the implications of these technologies. One perspective views technological supervision as an extension of managerial surveillance that increases employee visibility and organisational control (Ball, 2021; Moore, 2020). Critics argue that continuous monitoring may reduce professional autonomy, increase pressure, and encourage employees to focus on easily measurable activities at the expense of broader professional responsibilities (Ball, 2010; Moore et al., 2018; Zuboff, 2019).

In contrast, another perspective sees technological supervision as a tool for improving transparency, accountability, and procedural fairness (Aguinis & Burgi-Tian, 2021; Meijerink & Bondarouk, 2021). By creating accurate attendance records and reducing opportunities for manipulation, digital systems can provide a more objective basis for enforcing organisational rules.

The mixed evidence suggests that technological supervision does not generate uniform outcomes. While some studies report improvements in punctuality and compliance, others identify increased anxiety, declining trust, and employee resistance. These contrasting findings indicate that organisational context plays a critical role in determining how digital monitoring affects behaviour.

2.2 Theoretical Framework

This study draws on Behavioural Control Theory and Performance Management Theory to explain the relationship between technological supervision and staff punctuality.

Behavioural Control Theory argues that employees are more likely to comply with organisational expectations when behaviour is observable, measurable, and linked to consequences (Ouchi, 1979; Snell, 1992). Digital monitoring systems enhance behavioural visibility by generating accurate and traceable records of employee attendance, making deviations easier to detect.

Performance Management Theory complements this perspective by emphasizing clarity, standardization, and accountability as mechanisms for improving performance (Aguinis & Burgi-

Tian, 2021). From this viewpoint, technological supervision not only monitors behaviour but also reduces ambiguity in expectations and promotes consistent enforcement of organisational rules.

However, both theories implicitly assume that visibility automatically translates into compliance. Empirical evidence suggests otherwise. Similar monitoring technologies often produce different outcomes across organisations, indicating that visibility alone is insufficient to explain behavioural change.

To address this limitation, the study introduces enforcement credibility as the mechanism linking technological supervision to punctuality. Technological systems increase visibility, but compliance depends on whether employees believe that monitored behaviours are consistently followed by meaningful consequences. Where enforcement is credible, monitoring is more likely to influence behaviour; where enforcement is weak or inconsistent, visibility may have little practical effect.

The study conceptualizes technological supervision and staff punctuality through employees' perceptions and experiences of monitoring systems. Although perceptual measures cannot directly capture objective attendance behaviour, they are appropriate because enforcement credibility itself is fundamentally perceptual. Its influence depends on how employees interpret monitoring systems rather than on their mere technical presence.

Enforcement credibility is not measured directly but is inferred through institutional context, particularly differences between public and private universities in governance structures, administrative discipline, and enforcement consistency. While this approach provides indirect evidence of the proposed mechanism, future research should develop dedicated measures of enforcement credibility and incorporate objective attendance data.

By integrating enforcement credibility into Behavioural Control Theory and Performance Management Theory, this study shifts attention from the presence of monitoring technologies to the conditions under which they become behaviourally effective.

2.3 Academic Work, Managerialism, and Digital Governance

The adoption of technological supervision in universities reflects broader changes in higher education governance. Over recent decades, universities have increasingly embraced managerial

principles emphasizing efficiency, accountability, measurable performance, and administrative control (Deem & Brehony, 2005; Shore & Wright, 2018).

Within this environment, digital technologies have become central components of contemporary accountability systems. Electronic attendance platforms, digital dashboards, and automated monitoring tools provide documented evidence of employee behaviour and institutional performance (Power, 2021). Consequently, universities are moving away from traditional collegial models of self-regulation toward more formal systems of monitoring and evaluation.

Nevertheless, the implications of this transition remain contested. Supporters argue that digital supervision improves transparency and coordination, whereas critics contend that it strengthens managerial control and erodes professional autonomy (Möhlmann & Zalmanson, 2023). These tensions are particularly evident in higher education, where academic work has historically been guided by trust and professional discretion.

2.4 Empirical Review

Research generally shows that technological supervision influences employee behaviour by increasing visibility, accountability, and attendance accuracy. Electronic monitoring systems reduce ambiguity in attendance records and make compliance easier to assess (Ball, 2010; Cascio & Montealegre, 2016; Stanton, 2000).

Studies on electronic performance monitoring indicate that digital supervision can improve punctuality and compliance, particularly where traditional oversight mechanisms are weak (Ball, 2021). However, these effects are strongest when monitoring systems are supported by consistent enforcement and clear administrative procedures (Aguinis & Burgi-Tian, 2021).

Research on digital monitoring also highlights potential drawbacks. While increased visibility can encourage compliance, it may simultaneously reduce autonomy, increase stress, and lower job satisfaction (Moore, 2020). Employee reactions are often shaped by perceptions of fairness, transparency, and purpose. Monitoring systems viewed as legitimate and objective tend to generate greater acceptance than those perceived as intrusive or punitive (Ravid et al., 2020).

Studies focusing on biometric attendance systems in higher education report improvements in attendance accuracy and reduced opportunities for manipulation (Jeske & Santuzzi, 2015).

However, technological effectiveness remains highly dependent on implementation quality and enforcement consistency. Where institutional rules are applied uniformly, biometric systems are more likely to improve punctuality; where enforcement is inconsistent, their impact tends to weaken (Tyler, 2006).

Comparative research further suggests that organisational context matters. Private institutions generally exhibit stronger enforcement mechanisms, more centralized decision-making, and clearer accountability structures, enabling technological supervision to produce more consistent behavioural outcomes (Aguinis & Burgi-Tian, 2021). Public institutions, by contrast, often operate within more complex bureaucratic environments where enforcement may be less predictable (Scott, 2014).

Research on workplace surveillance similarly reveals mixed outcomes. Digital monitoring can enhance accountability and compliance but may also undermine trust and increase psychological strain if employees perceive it as excessive or unfair (Ball, 2021; Moore, 2020). Overall, surveillance functions as a double-edged mechanism whose effects depend heavily on implementation and context.

2.5 Synthesis and Research Gap

Three major gaps emerge from the literature.

First, most studies on technological supervision originate from corporate or Western settings, leaving limited evidence from Sub-Saharan African universities. Second, existing research often portrays digital monitoring either as a surveillance mechanism or as a performance-enhancing tool without adequately explaining how these roles coexist. Third, insufficient attention has been given to how differences between public and private universities shape the effectiveness of technological supervision.

Although scholars increasingly acknowledge the importance of institutional context, it is often treated as a background variable rather than an active explanatory factor. Consequently, there remains limited understanding of why similar monitoring systems produce different behavioural outcomes across organisations.

This gap is particularly important in Nigeria, where public and private universities differ substantially in governance structures, administrative discipline, and enforcement practices. These differences are likely to influence whether technological supervision functions primarily as surveillance or as a mechanism for improving accountability and punctuality.

2.6 Context-Contingent Technological Supervision Framework (CCTSF)

To address these gaps, this study develops the Context-Contingent Technological Supervision Framework (CCTSF). The framework extends Behavioural Control Theory and Performance Management Theory by proposing a context-sensitive explanation of how technological supervision influences staff punctuality.

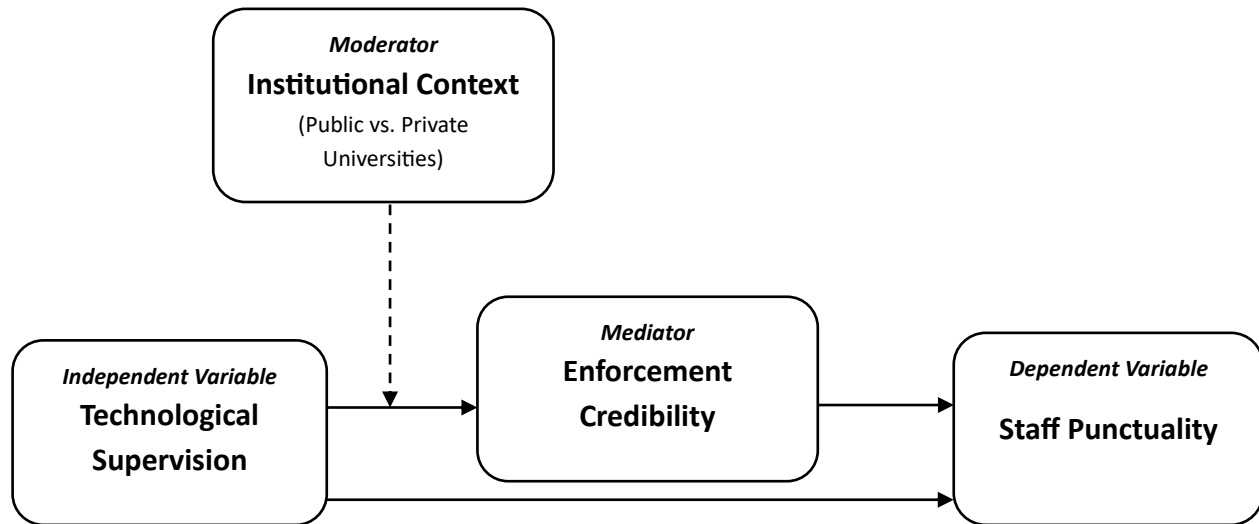
At the centre of the framework is enforcement credibility, which serves as the mechanism linking technological supervision to behavioural outcomes. Digital systems increase behavioural visibility, but visibility alone does not guarantee compliance. Behavioural change occurs when employees perceive monitoring systems as credible and believe that observed behaviours are consistently associated with meaningful consequences.

The framework further proposes that institutional context moderates this process. Institutional context, operationalized as public versus private university ownership, reflects differences in governance structures, administrative discipline, and enforcement consistency. In environments characterized by stronger enforcement and clearer accountability structures, technological supervision is more likely to generate credible signals that encourage punctuality. Conversely, weaker enforcement environments reduce the behavioural influence of monitoring systems.

Accordingly, the framework predicts that the indirect effect of technological supervision on staff punctuality through enforcement credibility will be stronger in private universities than in public institutions.

The CCTSF therefore shifts attention from the mere existence of monitoring technologies to the institutional conditions that determine whether digital supervision becomes behaviourally effective. Rather than viewing technological supervision as inherently beneficial or inherently intrusive, the framework conceptualizes it as a context-dependent process whose outcomes emerge from the interaction between digital visibility and institutional enforcement credibility.

Conceptual Model: Context-Contingent Technological Supervision Framework (CCTSF)



The conceptual model illustrates the proposed indirect relationship between technological supervision and staff punctuality through enforcement credibility, as well as the moderating role of institutional context (public versus private universities) on the effectiveness of technological supervision.

3. Hypotheses Development

This study draws on Behavioural Control Theory, Performance Management Theory, and the Context-Contingent Technological Supervision Framework (CCTSF) to explain how technological supervision influences staff punctuality. Rather than assuming a direct effect, the framework proposes that the relationship operates through enforcement credibility and varies across institutional contexts.

Technological supervision involves the use of digital monitoring tools such as biometric attendance systems, electronic clock-in platforms, and automated tracking technologies. Behavioural Control Theory suggests that these systems increase the visibility and traceability of employee behaviour, making non-compliance easier to detect (Ouchi, 1979; Snell, 1992). Performance Management Theory further argues that monitoring systems are most effective when they communicate clear expectations and are linked to consistent consequences (Aguinis & Burgi-Tian, 2021). Consequently, technological supervision is expected to strengthen employees' perceptions that attendance rules are meaningfully enforced.

H1: Technological supervision has a significant positive effect on enforcement credibility in Nigerian universities.

Enforcement credibility refers to employees' belief that monitored behaviours are consistently followed by predictable organisational consequences. When enforcement is perceived as credible, employees are more likely to comply with institutional expectations, including punctuality.

H2: Enforcement credibility has a significant positive effect on staff punctuality in Nigerian universities.

Building on these relationships, technological supervision is expected to influence punctuality indirectly by strengthening enforcement credibility. In other words, digital monitoring improves behavioural outcomes when it generates credible accountability signals.

H3: Enforcement credibility mediates the relationship between technological supervision and staff punctuality in Nigerian universities.

The effectiveness of technological supervision may also depend on institutional context. Private universities typically exhibit more centralized governance and stronger enforcement consistency than public universities. As a result, monitoring systems are likely to generate stronger credibility signals in private institutions.

H4: Institutional context significantly moderates the relationship between technological supervision and enforcement credibility, such that the relationship is stronger in private universities than in public universities.

Taken together, the framework suggests that the indirect effect of technological supervision on staff punctuality through enforcement credibility will vary across institutional settings.

H5: The indirect effect of technological supervision on staff punctuality through enforcement credibility is stronger in private universities than in public universities.

4. Methodology

This study employed a quantitative survey design to examine the relationship between technological supervision and staff punctuality in Nigerian universities. The design was

appropriate for investigating behavioural patterns and testing relationships among variables within different institutional contexts (Creswell & Creswell, 2023; Saunders et al., 2019).

4.1 Population, Sample, and Sampling Procedure

The study population comprised 11,500 academic and non-academic staff from selected public and private universities in South-East Nigeria where digital attendance monitoring systems were operational. The region was chosen due to its high concentration of tertiary institutions and increasing adoption of technological supervision practices.

Using Cochran's (1977) formula for large populations, a sample size of 372 respondents was determined. A stratified random sampling technique was employed, with universities categorized as public or private and respondents further stratified into academic and non-academic staff. Simple random sampling was then used within each stratum. Of the 372 questionnaires distributed, 346 were returned and valid for analysis, representing a response rate of 93.0%.

4.2 Research Instrument

Data were collected through a structured questionnaire developed from the literature on technological supervision, electronic performance monitoring, behavioural control, and performance management. The instrument comprised four sections: demographic information, technological supervision, enforcement credibility, and staff punctuality.

All items were measured on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Technological supervision was measured using indicators such as biometric attendance systems, electronic verification procedures, and consistency of monitoring practices. Enforcement credibility captured perceptions of enforcement consistency, administrative discipline, and consequence predictability, while staff punctuality focused on adherence to work schedules, attendance consistency, and reductions in lateness.

4.3 Validity and Reliability

Content validity was established through expert review by specialists in Educational Management and Human Resource Management. Construct validity was assessed using Exploratory Factor Analysis (EFA). The Kaiser-Meyer-Olkin (KMO) value of 0.901 and a significant Bartlett's Test of Sphericity ($\chi^2 = 3218.45$, $p < .001$) confirmed the suitability of the data for factor analysis.

Principal Component Analysis with Varimax rotation produced a clear three-factor structure, with factor loadings ranging from 0.705 to 0.844.

Reliability was assessed using Cronbach's alpha. The coefficients were 0.87 for technological supervision, 0.91 for enforcement credibility, and 0.84 for staff punctuality, with an overall reliability coefficient of 0.89. These values exceeded the recommended threshold of 0.70, indicating satisfactory internal consistency.

Table 1. Reliability Statistics

Variable	Number of Items	Cronbach's Alpha
Technological Supervision	8	0.87
Enforcement Credibility	10	0.91
Staff Punctuality	6	0.84
Overall Instrument	24	0.89

4.5 Data Analysis

Data were analysed using IBM SPSS Statistics and PROCESS Macro Version 4.2 (Hayes). Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize respondent characteristics and key study variables.

Prior to hypothesis testing, diagnostic tests confirmed that the assumptions of normality, linearity, homoscedasticity, and multicollinearity were satisfied. Skewness and kurtosis values fell within the acceptable range of ± 2.0 , while Variance Inflation Factor (VIF) values were below 5.0 and tolerance values exceeded 0.10.

Pearson correlation analysis was conducted to examine relationships among the study variables. The hypotheses were tested using PROCESS Macro Model 7, which is suitable for moderated mediation analysis. In the model, technological supervision served as the independent variable (X), enforcement credibility as the mediator (M), staff punctuality as the dependent variable (Y), and institutional context (public = 0; private = 1) as the moderator (W).

Indirect effects were estimated using 5,000 bootstrap resamples with bias-corrected confidence intervals. Moderated mediation was considered significant when the confidence interval for the index of moderated mediation excluded zero. All analyses were conducted at the 0.05 significance level. AI tools were used solely for language editing and manuscript refinement.

5. Results

5.1 Descriptive Statistics and Preliminary Analysis

Table 2 presents the descriptive statistics and correlations among the study variables. Significant positive relationships were observed among all constructs. Technological supervision was positively associated with enforcement credibility ($r = .61, p < .01$) and staff punctuality ($r = .57, p < .01$), while enforcement credibility was strongly related to staff punctuality ($r = .65, p < .01$). These findings provide initial support for the proposed relationships.

Table 2. Means, Standard Deviations, and Correlations

Variable	Mean	SD	1	2	3
1. Technological Supervision	3.89	0.71	1		
2. Enforcement Credibility	3.76	0.74	.61**	1	
3. Staff Punctuality	3.94	0.68	.57**	.65**	1

Note: $p < .01$.

Diagnostic tests confirmed that assumptions of normality, linearity, homoscedasticity, and multicollinearity were satisfied. Exploratory factor analysis also supported construct validity ($KMO = 0.901$; Bartlett's $\chi^2 = 3218.45, p < .001$), with factor loadings ranging from 0.705 to 0.844.

5.2 Direct and Moderating Effects

Hierarchical regression results are presented in Table 3. Technological supervision significantly predicted staff punctuality across all models, while enforcement credibility and institutional context also exerted significant positive effects. The interaction term between technological supervision and institutional context was significant ($\beta = 0.263, p < .001$), indicating moderation. The final model explained 52.7% of the variance in staff punctuality ($R^2 = .527$).

Table 3. Hierarchical Regression Results Predicting Staff Punctuality

Variables	Model 1	Model 2	Model 3
Constant	1.742***	1.603***	1.521***
Technological Supervision	0.421***	0.308***	0.276***
Enforcement Credibility	—	0.447***	0.401***
Institutional Context	—	0.214**	0.198**
TS × IC	—	—	0.263***
R ²	0.324	0.481	0.527
ΔR ²	—	0.157	0.046

5.3 Conditional Process Analysis

PROCESS Macro Model 7 was used to test the moderated mediation model. Technological supervision significantly predicted enforcement credibility ($\beta = 0.402$, $p < .001$), and the interaction between technological supervision and institutional context was significant ($\beta = 0.221$, $p < .001$). Enforcement credibility significantly predicted staff punctuality ($\beta = 0.463$, $p < .001$), while technological supervision retained a significant direct effect ($\beta = 0.214$, $p < .001$), indicating partial mediation.

Bootstrapping (5,000 resamples) revealed a significant indirect effect of technological supervision on staff punctuality through enforcement credibility ($\beta = 0.186$, 95% CI [0.115, 0.267]). The indirect effect was stronger in private universities ($\beta = 0.241$, 95% CI [0.160, 0.336]) than in public universities ($\beta = 0.132$, 95% CI [0.072, 0.194]). The index of moderated mediation was also significant ($\beta = 0.109$, 95% CI [0.051, 0.178]), confirming that the strength of the indirect effect varied across institutional contexts.

5.4 Hypotheses Testing

Overall, the findings support the Context-Contingent Technological Supervision Framework (CCTSF), demonstrating that technological supervision improves staff punctuality both directly

and indirectly through enforcement credibility, with stronger effects observed in private universities.

6. Discussion, Contributions, and Limitations

The findings support the Context-Contingent Technological Supervision Framework (CCTSF) by showing that technological supervision improves staff punctuality both directly and indirectly through enforcement credibility. The results suggest that digital monitoring systems influence behaviour not simply because they increase visibility, but because employees believe that monitored behaviours are linked to meaningful and consistently applied organisational consequences. In other words, monitoring becomes effective when employees perceive enforcement as credible.

This finding extends Behavioural Control Theory and Performance Management Theory by demonstrating that visibility alone is insufficient to produce compliance. Rather, the behavioural impact of technological supervision depends on whether employees believe that attendance records will be used consistently in organisational decision-making.

The stronger indirect effect observed in private universities further underscores the importance of institutional context. Differences in governance structures, administrative discipline, and enforcement consistency appear to shape how employees interpret and respond to monitoring systems. These findings help explain the mixed conclusions reported in previous studies, suggesting that technological supervision can function as both a surveillance mechanism and a performance-support tool depending on how it is implemented and enforced.

This study makes three key contributions. First, it identifies enforcement credibility as a critical mechanism linking technological supervision to staff punctuality. Second, it develops and empirically supports the Context-Contingent Technological Supervision Framework (CCTSF), highlighting the combined influence of technological visibility, enforcement credibility, and institutional context. Third, it contributes evidence from Nigerian universities, extending a literature that has been dominated by studies from Western corporate settings.

A limitation of the study is its reliance on employee perceptions rather than objective measures of enforcement behaviour and attendance records. Future research could incorporate objective performance indicators, longitudinal data, and multi-level designs to provide a more

comprehensive understanding of how technological supervision influences employee behaviour across different institutional environments.

7. Conclusion

This study examined whether technological supervision in Nigerian universities functions primarily as digital surveillance or as a mechanism for improving staff performance. The findings suggest that technological supervision positively influences staff punctuality, but its effectiveness is conditional rather than automatic.

Digital monitoring systems improve punctuality by increasing accountability and strengthening enforcement credibility. However, the magnitude of this effect depends on institutional context. The stronger effects observed in private universities indicate that governance structures, administrative discipline, and enforcement consistency play critical roles in determining whether technological supervision produces meaningful behavioural outcomes.

The findings therefore move beyond a simple surveillance-versus-support debate. Technological supervision is neither inherently controlling nor inherently supportive. Rather, it operates as a context-dependent governance mechanism whose effects emerge from the interaction between digital visibility and credible enforcement practices.

Overall, the study demonstrates that the success of technological supervision depends less on the technology itself than on the institutional environment in which it is embedded. Understanding this interaction is essential for advancing theory and improving the implementation of digital monitoring systems in higher education and other organisational settings.

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