

Digital Attendance System Implementation, Employee Competence, and Work Discipline on Government Employee Performance

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ABSTRACT

Purpose: This study aims to examine the determinants of civil servant performance by evaluating the impact of the digital attendance system, employee competencies, and work discipline—both individually and collectively—at the Dompus Regency Finance and Asset Management Agency (BPKAD).

Research Method: Using a quantitative causal design, primary data were collected through a questionnaire distributed to the entire population of 77 employees (saturation sampling). The data were then analyzed using the Structural Equation Modeling-Partial Least Squares (SEM-PLS) approach.

Results and Discussion: Digital attendance systems and work discipline have been shown to have a positive and significant impact on performance. Conversely, employee competence has been shown to have no significant impact. Collectively, this model explains 52.2% of the variation in performance. These findings confirm that the power of technological oversight and rule compliance can compensate for weaknesses in individual technical capacity.

Implications: In practical terms, agency leaders are advised to prioritize E-HRM investments to ensure reliable infrastructure for monitoring and enforcing disciplinary regulations. Future research is recommended to expand the sample scope to include other Regional Government Work Units (SKPDs).

Originality: This study integrates the Information System Success Model and the 21st-century digital competency framework into a single holistic Socio-Technical System analytical model for the public financial management sector.

Keywords: digital attendance system; employee competency; work discipline; government; employee performance.

1. Introduction

Technological advancements in the Society 5.0 era require public bureaucracies to transform into agile organizations focused on tangible results. This transformation aligns with the accelerated implementation of the Electronic-Based Government System (SPBE), mandated by Presidential Regulation No. 95 of 2018, which aims to create transparent and accountable governance through digitalization, particularly in the context of Electronic Human Resource Management (E-HRM). In the context of modern public management, technology is no longer merely an administrative tool but a strategic determinant of civil service performance. However, the effectiveness of this digital



transformation cannot stand alone; it heavily relies on the harmonious integration of the quality of the systems built, the capacity of the human resources operating them, and the work culture within government agencies.

The demand for high performance from local government officials requires robust competency standards. Based on the 21st-Century Digital Skills framework (Laar *et al.*, 2017), civil service performance is driven by a combination of digital technical competencies (operational mastery of technological tools) and essential socio-emotional skills, such as integrity and adaptability. In the era of digitalization, adaptive competencies are crucial for civil servants to operate technological tools optimally. This aligns with the Task-Technology Fit Theory (Goodhue & Thompson, 2014) and the Information Systems Success Model (DeLone & McLean, 2003), which assume that technology will only have a positive impact on performance if the system is relevant to the user's tasks and supported by individual capabilities. Without adequate competencies, even the most sophisticated systems risk triggering technostress and failing to achieve service objectives. In addition to competence, a fundamental element determining the performance of local government officials is discipline, as explicitly stipulated in (Regulation of the Ministry of State Apparatus and Regional Autonomy No. 94 of 2021). Discipline is the foundation of operational compliance, particularly for strategic agencies such as the Regional Financial and Asset Management Agency (BPKAD) of Dompu Regency, which demands high precision to achieve Good Financial Governance. To date, the greatest challenge in enforcing discipline has been the manual monitoring system, which has inherent weaknesses, including the risk of attendance manipulation or proxy attendance, as well as a recapitulation process prone to human error. The complexity of civil servant mobility—ranging from office-based administrative duties to field assignments—demands an objective, integrated control instrument to ensure that work discipline correlates directly with productivity.

In response to these disciplinary control challenges, government agencies have begun transitioning to adopt a Digital Attendance System based on the Global Positioning System (GPS) and biometrics. Conceptually, this system is designed to monitor civil servants' attendance in real time with precise location accuracy. However, implementation in the field, particularly among civil servants at the Dompu Regency BPKAD, reveals significant challenges. Initial observations indicate technical challenges, including internet connection instability during high server load, difficulties for staff in adapting to the application interface, and concerns about data security. These phenomena demonstrate that the availability of a digital attendance system does not automatically guarantee improved discipline and performance unless it is accompanied by adequate infrastructure readiness and users' digital competency maturity. These on-the-ground implementation dynamics have sparked academic discourse and reflected a research gap. Several studies, such as those by Adih *et al.*, (2024), Mulyani *et al.*, (2024), and Ramayasa *et al.*, (2025), confirm that implementing electronic attendance systems has a positive and significant impact on discipline and performance due to their high transparency. In line with this, Elisnawati *et al.*, (2023) highlight that robust digital competencies are a crucial catalyst for optimizing the use of technological systems to simultaneously boost employee discipline and performance. Conversely, Rosyidi *et al.*, (2021) found contradictory results: attendance technology did not have a significant impact on performance without comprehensive strengthening of digital competencies. Furthermore, the study by Setyadi *et al.*, (2019) confirmed that changes in technological systems can induce technostress, which in turn reduces employee performance. It is this inconsistency in empirical findings that makes further exploration critically necessary.

Given the urgency of practical issues and existing theoretical gaps, this study offers novelty by integrating the Information Systems approach (DeLone & McLean) and 21st-Century Digital Skills (Laar *et al.*, 2017). In practice, the Regional Financial and Asset Management Agency (BPKAD) requires evidence-based evaluation to ensure that technology investments are not merely administrative formalities but genuinely improve productivity. Therefore, this study aims to analyze and empirically demonstrate the determinants of local government officials' performance through the roles of digital attendance systems, competencies, and discipline, with a focus on the BPKAD of Dompu Regency. The results of this study are expected to make strategic contributions to the development of adaptive, high-performing human resource management policies.

The remainder of this paper is organized as follows. Section 2 provides a literature review and hypothesis development. Section 3 presents the research method and design. Section 4 provides the results and discussion. Section 5 is Concluding Remarks and Recommendations.

2. Literature Review and Hypothesis Development

The transformation of human resource management in the Society 5.0 era requires a theoretical integration of the Information Systems Success Model, the Task-Technology Fit Theory, and Competency Theory to translate technology into tangible productivity gains. A literature review reveals a research gap, even though some studies demonstrate that electronic attendance systems consistently improve discipline and performance (Adih *et al.*, 2024; Mulyani *et al.*, 2024; Ramayasa *et al.*, 2025), other studies have found that such innovations may fail to have an impact or even trigger technostress without the reinforcement of digital competencies and task fit (Rosyidi *et al.*, 2021; Setyadi *et al.*, 2019). The empirical inconsistencies of this technocentric perspective underscore the urgency of research, in which the implementation of the Digital Attendance System cannot be evaluated in isolation but must be examined holistically alongside employees' competency readiness and the establishment of a culture of work discipline within the Dompu Regency BPKAD.

2.1 Digital Attendance System and Employee Performance

The Digital Attendance System is designed not merely as a tool for recording attendance but as an integrated monitoring instrument. Based on the Information System Success Model (DeLone & McLean, 2003), a system with ease of access, server reliability, and high accuracy of biometric/GPS data will facilitate administrative efficiency among civil servants. Previous research by Adih *et al.*, (2024) and Mulyani *et al.*, (2024) indicates that the reliability of attendance applications eliminates time inefficiencies and prevents attendance manipulation, allowing employees to focus more on completing their core tasks.

H1: *The implementation of the Digital Attendance System has a positive and significant effect on Employee Performance.*

2.2 Employee Competencies and Employee Performance

In the era of digital transformation, civil servant competencies extend beyond understanding conventional administrative duties to encompass digital literacy and adaptability. Based on the 21st-Century Digital Skills framework (Laar *et al.*, 2017), employees are not only required to master hard

skills—or purely technical abilities, such as operational proficiency in using the Digital Attendance System—but also cognitive and socio-emotional soft skills, such as integrity, emotional control, adaptability, and the motivation to excel under the pressure of a heavy workload. (Elisawati *et al.*, 2023) demonstrate that competent skills act as a catalyst, transforming technology from an administrative burden into an efficient tool that supports productivity.

H2: *Employee Competence has a positive and significant effect on Employee Performance.*

2.3 Work Discipline and Employee Performance

Work discipline, manifested through adherence to operating hours and standard operating procedures (SOPs), is a fundamental variable in bureaucratic governance, particularly within the BPKAD environment, which demands high precision and strict deadlines. Previous studies (Ramayasa *et al.*, 2025; Mulyani *et al.*, 2024; Adih *et al.*, 2024) consistently demonstrate that higher levels of discipline are positively correlated with improved performance by reducing error rates, enhancing output quality, and minimizing counterproductive behavior.

H3: *Work discipline has a positive and significant effect on employee performance.*

2.4 The Influence of the Implementation of a Digital Attendance System, Competence, and Work Discipline on Employee Performance

Simultaneously, technology and human resource behavior are mutually integrated within a modern organizational system (Socio-Technical System). The existence of an advanced and effective Digital Attendance System (SPD) will not yield optimal results if operated by employees who lack adequate competencies (KOM). Furthermore, even if the system is reliable and the employees are technically competent, the agency's performance will not reach its maximum potential without a high level of work discipline (DK), such as adherence to rules, working hours, and operational standards. Conversely, the productivity of competent and highly disciplined employees will also be hindered if the attendance system and supporting technology frequently experience disruptions. Therefore, a harmonious synergy among the reliability of technological systems, the competence of human resources, and a disciplined work culture is essential to achieve maximum performance among BPKAD employees in Dompu Regency.

H4: *The implementation of a digital attendance system, employee competence, and work discipline collectively influence employee performance.*

3. Research Method

This quantitative causal-associative study aims to examine the determinants of civil servant performance within the Dompu Regency BPKAD (Sugiyono, 2019). Given the limited population size, this study employed saturation sampling of all 77 employees to minimize bias and optimize the generalizability of the results, in line with recommendations for sample feasibility in populations under 100 (Arikunto, 2013). Primary data collection was conducted by distributing a closed-ended questionnaire with a 1–5 Likert scale. To ensure the validity of the findings, the quantitative data were cross-validated through field observations of employee attendance behavior and a documentary review of the institution's personnel records.

Data analysis was performed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) with SmartPLS software, given its ability to model complex structural relationships without assuming a normal data distribution (Hair *et al.*, 2014). The outer model evaluation stages were conducted to ensure convergent validity (factor loadings > 0.70; AVE > 0.50) and construct reliability (Cronbach’s Alpha > 0.60; Composite Reliability > 0.70). Specifically for discriminant validity, in addition to the criteria (Fornell & Larcker, 1981), this study used the Heterotrait-Monotrait Ratio (HTMT) with a threshold of < 0.90 as recommended by Henseler and Sarstedt (2013). After the instrument was validated, the evaluation continued with the inner model to test the coefficient of determination (R²), predictive relevance (Q²), and effect size (f²). The final hypothesis test was conducted using the bootstrapping procedure, with acceptance criteria set at a t-statistic > 1.96 and a p-value < 0.05.

Table 1. Variables and Measurements

Variable	Operational Definition	Indicator	Source
Work Discipline (DK)	The level of compliance by public officials with norms, institutional regulations, and operational standards to ensure good governance.	Compliance with working hours Compliance with uniforms and agency regulations Completion of tasks in accordance with the SOP The effectiveness of working hours for core tasks Responsibility for managing assets/documents	(Hasibuan, 2016)
Employee Performance (Y)	The quality and quantity of work are achieved efficiently and independently by civil servants.	Achievement of volume targets/SKP Quality of work Timeliness (deadline) The effectiveness of resource utilization Independence & initiative without supervision	(Robbins & Judge, 2019)
Employee Competencies (KOM)	The capabilities of public servants consist of a combination of knowledge, technical skills, and work attitude in the digital age.	Understanding regulations and responsibilities Technical proficiency in the application Integrity & honesty in attendance Discipline and emotional control under pressure Motivation to excel	(Laar <i>et al.</i> , 2017)
Digital Attendance System (SPD)	The success of the implementation of the attendance record information system, as measured by the quality of the system, the information, and the services.	Convenience and flexibility of access System reliability and speed Accuracy of attendance data Ease of information formatting Administrator response time Administrator competence & empathy Long-term satisfaction	(DeLone & McLean, 2003)

Source: Previous Research (2026)

4. Results and Discussion

4.1 Analysis Results

The Regional Financial and Asset Management Agency (BPKAD) of Dompu Regency is a strategic local government agency that requires a high level of operational accuracy and compliance to achieve good financial governance. As part of its adaptation to bureaucratic digitization, this institution has

implemented a GPS- and biometrics-based digital attendance system to monitor the attendance of its 77 employees. However, the dynamics of the system’s implementation in the field are still marked by technical network issues and user adaptation challenges, making the BPKAD of Dompu Regency a highly relevant case study for evaluating the integration of information technology, civil servant competencies, and discipline in relation to their performance.

Tabel 2. Construct Reliability and Validity

Variable	Code	Outer Loadings	Cronbach's Alpha (>0,60)	Composite Reliability (>0,70)	AVE (>0,50)	Remarks
Work Discipline (DK)	DK1	0.769	0.862	0.900	0.644	Valid & Reliabel
	DK2	0.812				
	DK3	0.824				
	DK4	0.792				
	DK5	0.814				
Employee Performance (KP)	KP1	0.861	0.909	0.932	0.733	Valid & Reliabel
	KP2	0.848				
	KP3	0.881				
	KP4	0.841				
	KP5	0.848				
Employee Competencies (KOM)	KOM1	0.829	0.897	0.924	0.708	Valid & Reliabel
	KOM2	0.837				
	KOM3	0.818				
	KOM4	0.878				
	KOM5	0.843				
Digital Attendance System (SPD)	SPD1	0.870	0.923	0.938	0.685	Valid & Reliabel
	SPD2	0.856				
	SPD3	0.858				
	SPD4	0.790				
	SPD5	0.780				
	SPD6	0.844				
	SPD7	0.790				

Source: SemPLS (2026)

Based on Table 2, all research instruments were found to be valid and reliable. This is indicated by the fulfillment of the thresholds for convergent validity (outer loading > 0.70; AVE > 0.50) and internal consistency (Cronbach's Alpha > 0.60; Composite Reliability > 0.70) (Hair *et al.*, 2014). Based on Table 3, discriminant validity is satisfied because the root-mean-square error of estimation (RMSE) for each variable exceeds its interconstruct correlation. This demonstrates that each research variable is empirically distinct (Fornell & Larcker, 1981; Hair *et al.*, 2014).

Based on Table 4, all Heterotrait-Monotrait Ratios (HTMT) are below 0.90. This confirms that there is no measurement overlap, ensuring that each variable is empirically unique and distinct (Cohen, 1988; Henseler & Sarstedt, 2013; Hair *et al.*, 2014). Based on Table 5, the model is classified as moderate, explaining 52.2% of the variation in Employee Performance (R² = 0.522). Furthermore, this model has demonstrated good predictive validity, as evidenced by a Q² value of 0.362 (> 0), thereby meeting the standard criteria for evaluating the inner model (Henseler & Sarstedt, 2013; Hair *et al.*, 2014). Based on Table 6, the effect size (f²) results indicate that the Attendance System (0.128) and Work Discipline (0.073) have small effects on Employee Performance. In contrast, Employee Competence (0.003) has



virtually no effect. This classification refers to effect size evaluation standards (Cohen, 1988; Hair *et al.*, 2014), which set threshold values of 0.02 (small), 0.15 (medium), and 0.35 (large).

Tabel 3. Validitas Diskriminan - Kriteria Fornell-Larcker

Variable	Work Discipline	Employee Performance	Employee Competencies	Digital Attendance System
Work Discipline	0.802			
Employee Performance	0.664	0.856		
Employee Competencies	0.772	0.602	0.841	
Digital Attendance System	0.737	0.680	0.728	0.828

Source: SemPLS (2026)

Tabel 4. Discriminant Validity (HTMT)

Variable	Work Discipline	Employee Performance	Employee Competencies	Digital Attendance System
Work Discipline				
Employee Performance	0.744			
Employee Competencies	0.886	0.666		
Digital Attendance System	0.822	0.735	0.797	

Source: SemPLS (2026)

Table 5. Coefficient of Determination (R²) and Predictive Power (Q²)

Variable	R Square	Q ²	Info
Employee Performance	0.522	0.362	Moderate

Source: SemPLS (2026)

Table 6. Effect Size (f²)

Variable	f ² Value	Securities Category
Digital Attendance System → Employee Performance	0.128	small
Employee Competencies → Employee Performance	0.003	-
Work Discipline → Employee Performance	0.073	small

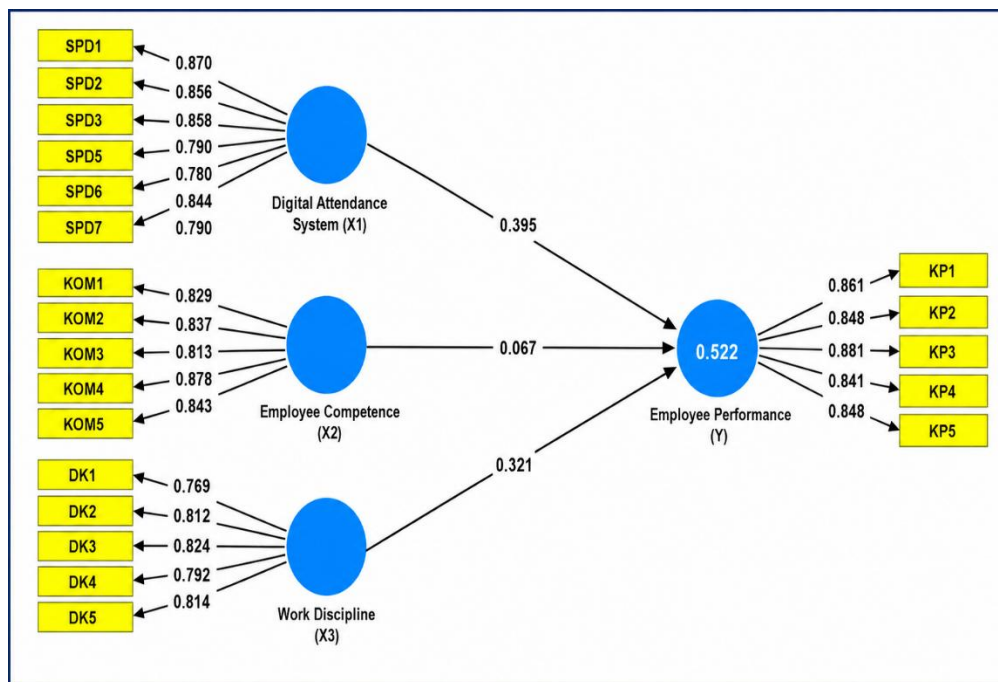
Source: SemPLS (2026)

Table 7. Hypothesis Test Results (Path Coefficients)

Hip.	Path of Influence	Original Sample (O)	T-Statistics	P-Values	Decision
H1	Digital Attendance System → Employee Performance	0.395	2.860	0.004	Accepted
H2	Employee Competencies → Employee Performance	0.067	0.542	0.588	Rejected
H3	Work Discipline → Employee Performance	0.321	2.381	0.018	Accepted

Source: SemPLS (2026)

Based on Table 7, the results of the hypothesis testing using the bootstrapping procedure demonstrate that the Digital Attendance System (H1) and Work Discipline (H3) have a positive and significant effect on Employee Performance, as they meet the criteria of T-Statistics > 1.96 and P-Values < 0.05. Conversely, Hypothesis 2 (H2) is rejected because Employee Competence was found to have no significant influence on Employee Performance, as indicated by a T-statistic below the threshold (0.542 < 1.96) and a P-value above the significance level (0.588 > 0.05) (Hair *et al.*, 2014).



Source: SemPLS (2026)

Figure 1. Path Analysis

4.2 Discussion

4.2.1 The Effect of Digital Attendance Systems on Employee Performance (Hypothesis 1)

The results of the statistical analysis demonstrate that the implementation of the Digital Attendance System has a positive and significant effect on employee performance; Hypothesis 1 is accepted. This is evidenced by a path coefficient of 0.395, with a T-statistic of 2.860 (>1.96) and a P-value of 0.004 (<0.05). These findings provide empirical support for the Information Systems Success Model (DeLone & McLean, 2003). In the context of the Dompu Regency BPKAD, the GPS- and biometric-based attendance system functions not only as an administrative tool but also as a reliable monitoring instrument. The system’s ability to track locations in real-time has proven effective in reducing time inefficiencies and closing loopholes for attendance manipulation. When these loopholes are closed, civil servants are automatically encouraged to allocate their work time more optimally to complete core tasks, ultimately boosting the achievement of volume and quality targets for work outcomes.

The success of this system is highly rational and aligns with theoretical expectations that relevant technology will support bureaucratic operations. These research findings reinforce the conclusions of Adih *et al.*, (2024) and Mulyani *et al.*, (2024), confirming that the reliability of attendance applications eliminates administrative barriers, allowing employees to focus more on performance. Furthermore, these findings are also consistent with research on the implementation of digital attendance systems in government agencies (Kusmana, 2025), which confirms that biometric-based attendance technology is not susceptible to manipulation, thereby significantly reducing fraudulent practices such as “proxy attendance.” This digitalization system successfully enforces regularity and promotes greater individual accountability for work hours, which is a crucial foundation for local financial management agencies that demand precision and strict governance.

4.2.2 The Effect of Employee Competence on Employee Performance (Hypothesis 2)

Contrary to initial expectations, the analysis indicates that Employee Competence does not significantly affect Employee Performance; therefore, Hypothesis 2 is rejected. The data clearly indicate a very low path coefficient (0.067), supported by a T-Statistic of 0.542 (<1.96) and a P-Value of 0.588 (>0.05). Furthermore, the effect size (f-square) was 0.003, indicating that the competency variable has virtually no real effect on performance variation in this model. Theoretically, this finding presents an intriguing anomaly within the framework of 21st-century digital skills (Laar *et al.*, 2017). Although employees are required to possess digital literacy, the reality on the ground suggests that the highly structured task routines at the BPKAD, guided by rigid Standard Operating Procedures (SOPs), mean that high levels of adaptive or innovative competence do not necessarily translate into improved daily performance.

This anomaly can be comprehensively explained through the lens of the Task-Technology Fit Theory (Goodhue & Thompson, 2014). The mismatch occurs because the adopted attendance technology is designed to be very simple—merely pressing a button or facial scanning—thus requiring no complex digital competency prerequisites from its users. Furthermore, rejecting this hypothesis strongly supports the contradictory findings of Rosyidi *et al.*, (2021), which state that technological innovations fail to impact performance without task fit. It aligns with the study by Setyadi *et al.*, (2019) regarding the threat of technostress. Rapid technological transitions, combined with heavy financial management workloads, are highly likely to trigger technological burnout, in which employees feel burdened by the new system rather than assisted by it. Furthermore, the rejection of this hypothesis strongly supports the findings of Afifah *et al.*, (2024) in local government agencies, which empirically demonstrate that competence does not have a significant direct influence on employee performance. This underscores that in the public sector, high technical competence is often undermined by the rigidity of bureaucratic routines, meaning that high skills do not automatically translate into tangible performance without sufficient discretion in task execution.

4.2.3 The Effect of Work Discipline on Employee Performance (Hypothesis 3)

The test of Hypothesis 3 (H3) yielded results supporting the empirical claim, showing that Work Discipline has a positive and significant effect on Employee Performance. Statistically, this is evidenced by an Original Sample value of 0.321, with a T-Statistic of 2.381 (>1.96) and a P-Value of 0.018 (<0.05). This finding reinforces the fundamental assumption of civil service management as outlined in (Permenpan RB No. 94 of 2021), which positions discipline as an absolute prerequisite for bureaucratic productivity. Within the work ecosystem of the Dompu Regency BPKAD, which manages local financial flows, adherence to operating hours and diligence in following SOPs are not merely normative obligations but the primary safeguards against critical errors (human error). Discipline acts as an internal control mechanism that directly leads to efficient resource utilization and the timely completion of core tasks.

The strong relevance of discipline to performance is logical and consistent with prior studies. These findings align with research (Mulyani *et al.*, 2024; Ramayasa *et al.*, 2025; Rubiyanti & Sasmita, 2026), which agrees that discipline curbs counterproductive behavior. Furthermore, the dynamics of modern bureaucratic governance suggest that integrating discipline with precise digital monitoring fosters a culture of predictive compliance. Studies in the field of Public Sector Human Resource Management, particularly within local government financial management agencies (Nani *et al.*, 2024;

Agus *et al.*, 2025) demonstrate that in agencies with specific work pressures and high accountability demands, discipline becomes the most dominant determinant variable that maintains the stability of collective performance, and is even capable of compensating for deficiencies or fluctuations in individual technical competencies across various administrative lines.

4.2.4 The Simultaneous Effect of Digital Attendance Systems, Competence, and Discipline on Performance (Hypothesis 4)

An inner model analysis indicates that the variables of the Digital Attendance System, Employee Competence, and Work Discipline collectively account for 52.2% of the variation in Employee Performance ($R^2 = 0.522$). This confirms that the Socio-Technical System framework is valid for evaluating the productivity of local government officials. The performance of BPKAD employees does not exist in a vacuum; it is the result of a complex interaction among the reliability of the technological infrastructure—namely, the Attendance System—the individual capacity of its users (although only partially significant), and organizational cultural norms—namely, Work Discipline. The moderate coefficient of determination indicates that the conceptual model integrating Information Systems and Human Resources approaches is highly relevant to capturing the reality of Electronic Human Resource Management (E-HRM) in the Society 5.0 era.

Interestingly, this simultaneous interaction explains why performance can still be maintained at a good level. Although Hypothesis 2 (Competence) was partially rejected, the integration of a rigid technological system (SPD) and the enforcement of strict disciplinary rules (DK) can orchestrate employee behavior in such a way that it continues to produce standardized outputs. This aligns with the overarching goal of the Electronic-Based Government System (SPBE). The coercive power of the technological system successfully compensates for the digital competency gap among civil servants. This finding addresses a research gap by offering a new perspective: that in the early phase of E-HRM adoption in local governments, structural compliance—namely, attendance and discipline systems—is far more important in boosting performance than the mere strengthening of soft-skill competencies, a conclusion supported by various recent findings regarding resistance to technology adoption in local bureaucracies.

5. Concluding Remarks and Recommendation

This study, which employed the SEM-PLS method on 77 employees of the Dompu Regency BPKAD, demonstrated that the digital attendance system and work discipline have a positive and significant impact on performance. Conversely, employee competence was found to have no significant direct influence. Collectively, these three factors account for 52.2% of the variation in employee performance.

This study found that within a structured bureaucratic routine, the strength of an unmanipulable technological system and the enforcement of discipline can compensate for deficiencies in individual competence. Therefore, leaders are advised to prioritize initial E-HRM investments in the reliability of monitoring infrastructure and disciplinary regulations, rather than focusing solely on technical training (soft skills).

The limitations of this study lie in the sample scope, which is confined to a single agency, and the fact that the independent variables explain only 52.2% of total performance. For future research, it is recommended to expand the sample to other local government agencies, include new variables such

as leadership, workload, or technostress, and employ mixed methods to explore qualitative narratives on technology adaptation.

Statement of Use of Generative AI

During the preparation of this work, the author used generative artificial intelligence tools to support the scientific writing process. Grammarly was used to check grammar, refine writing style, and improve clarity in scientific writing. All interpretations, analyses, and conclusions presented in this study are the sole responsibility of the author.

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