Aplikasi Administrasi: Media Analisa Masalah Administrasi
Volume 28, Number 02, 2025, pp. 102-113
P-ISSN: 1411-9536 E-ISSN: 2621-3958
Open Access: https://doi.org/10.30649/aamama.v28i2.329

Digital Governance in Logistics Management: Strengthening Good Governance in State-Owned Enterprises

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ARTICLE INFO

Article history:
Received 2025-11-12
Revised 2025-11-19
Accepted 2025-11-19
Available online 2025-12-30

Keywords:
Good Governance, Digital Governance, Logistics Management, State-Owned Enterprises, SAP

ABSTRACT

This study examines the effectiveness of implementing Good Governance principles within a digital-based logistics management system at Warehouse OPT Zone 4A of PT Pertamina Hulu Rokan as part of the broader digital governance transformation in Indonesia's State-Owned Enterprises (BUMN). Using a descriptive qualitative approach, data were collected through field observation, in-depth interviews with four key informants, and analysis of digital documents from the SAP (System Application and Product) system during June–August 2025. The findings indicate that SAP implementation has significantly improved operational efficiency and accountability, with 94% material receipt accuracy, 82% audit compliance, and only 2.7% delivery delays. The system enhances internal accountability through automated reporting and audit trails while improving coordination across divisions. However, external accountability and public transparency remain limited, as data openness has not yet been institutionalized. Key challenges include limited warehouse capacity, uneven human resource readiness, and dependency on digital infrastructure. Theoretically, this study contributes to the integration of Good Governance and digital governance concepts within State-Owned Enterprises. Practically, it provides strategic recommendations to strengthen data-driven logistics governance, expand open data policies, and enhance digital literacy to achieve greater transparency and accountability in public sector management.

1. INTRODUCTION

The rapid advancement of digital technology has profoundly transformed governance paradigms across both the public and private sectors. In the context of public administration, the implementation of digital systems is no longer merely a consequence of technological progress but has become a strategic necessity to enhance transparency, accountability, and administrative efficiency. The World Bank (2023) reports that countries adopting digital governance systems experience significant improvements in administrative efficiency and public service quality. In Indonesia, this transformation is reflected in various policies and initiatives of the Ministry of State-Owned Enterprises (Kementerian BUMN, 2024), which promotes digitalization as a key instrument to strengthen governance quality and operational integrity.

One crucial dimension of digital governance implementation in BUMN lies in logistics management, which plays a vital role in ensuring the smooth flow of goods, materials, and information that support production and service processes. Effective logistics management reflects not only operational efficiency but also the accountability of organizational resource utilization. However, in practice, logistics processes in BUMN often encounter complex challenges, such as data delays, limited system integration, and inadequate traceability of internal transactions. These challenges indicate that

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digitalization in logistics management requires not only technological infrastructure but also a governance framework that embeds the core principles of good governance transparency, accountability, participation, and efficiency.

Good Governance serves as a normative framework that emphasizes integrity, openness, and accountability in public sector management (UNDP, 1997; World Bank, 2019). Meanwhile, Digital Governance extends these principles into the digital domain through the use of information and communication technologies (ICTs) to improve decision-making, service delivery, and oversight mechanisms (Bannister & Connolly, 2014; Meijer, 2015). The integration of these two paradigms is crucial, as digital governance functions not only as a technological tool but also as an institutional mechanism that reinforces good governance practices through data-based and transparent systems of accountability.

Previous studies have shown that the synergy between digital governance and good governance significantly enhances efficiency, transparency, and public trust in government institutions (Dwivedi et al., 2021). Nevertheless, most research has predominantly focused on the application of digital governance in external public service contexts such as administrative services or e-government while its implementation within internal administrative areas, including logistics management, remains underexplored, particularly in the context of BUMN in Indonesia. This condition reveals an empirical and conceptual gap in understanding how digital governance can be operationalized to strengthen good governance practices within internal resource management systems.

One notable example of digitalization in logistics management can be observed in PT Pertamina Hulu Rokan (PHR), a major upstream subsidiary of Pertamina. PHR has implemented a digital logistics system based on System Application and Product (SAP) to manage procurement, warehousing, and asset tracking. Although this digital transformation represents significant progress, internal audit findings and operational evaluations indicate persistent challenges such as data delays, manual interventions within digital workflows, and limited cross-departmental integration. These issues suggest that the adoption of digital systems has not yet been fully accompanied by the institutionalization of good governance values, particularly in transparency and accountability within resource management.

The gap between technological implementation and the realization of governance values raises an important question: to what extent have digital governance mechanisms been effectively institutionalized within logistics systems, and how do they contribute to strengthening good governance principles in BUMN? Previous research in Indonesia has tended to focus on digital transformation from managerial or technological perspectives (Pratama & Susanto, 2022; Kurniawan, 2023), while the governance implications of digitalization in logistics processes remain largely overlooked. Therefore, this study aims to fill that gap by employing an empirical approach that examines the interrelation between digital governance and good governance within the logistics management system of PT Pertamina Hulu Rokan.

Theoretically, this research contributes to the field of public administration and governance studies by proposing an integrative conceptual framework that links digital governance mechanisms with good governance outcomes in the context of BUMN. It extends previous studies by positioning digitalization not merely as a technological innovation but as an institutional reform strategy aimed at reinforcing transparency and

accountability within complex bureaucratic systems. Practically, the findings are expected to provide strategic recommendations for BUMN and policymakers to optimize the implementation of digital governance in logistics systems, thereby improving operational efficiency and performance accountability.

In conclusion, this study emphasizes that digital governance is not simply a form of technological modernization but a transformative governance paradigm that redefines how transparency, accountability, and efficiency are institutionalized within public organizations. By focusing on the case of PT Pertamina Hulu Rokan, this research seeks to provide empirical evidence that digital transformation in logistics management can serve as a crucial foundation for strengthening good governance practices in Indonesia's state-owned enterprises.

2. METHODS

This study employs a convergent parallel mixed methods design, integrating qualitative and quantitative approaches to generate a comprehensive analysis of digital governance in logistics management. In this design, both qualitative and quantitative data were collected concurrently, analyzed separately, and then integrated during the interpretation phase to compare convergence, complementarity, and divergence of findings. The unit of analysis in this research is the warehouse's digital administrative process related to the receipt, verification, and documentation of operational goods at PT Pertamina Hulu Rokan.

The qualitative component was designed to capture institutional dynamics, administrative behavior, governance practices, and user experiences. Data were obtained through document analysis, direct observation, and semi-structured interviews. Document analysis covered Standard Operating Procedures (SOPs), warehouse activity logs, audit reports, and digitally generated records to understand formal procedures and internal control mechanisms. Observations were conducted to examine the actual workflow, coordination patterns among divisions, and the practical functioning of digital systems during goods receipt. Semi-structured interviews were conducted with eight purposively selected informants, including one Assistant Warehouse Manager, two goods-receiving administrators, two distribution administrators, one warehouse analyst, and two logistics technicians. These individuals were selected based on their experience and operational responsibilities related to internal control and digital documentation processes.

The quantitative component relied on system-generated data extracted directly from the digital logistics information system. Quantitative indicators included error rates, verification timestamps, transaction durations, and frequency distributions of administrative activities. Error-rate calculations followed the formula: total administrative errors divided by total processed transactions multiplied by 100%. These metrics were used to assess the efficiency, accuracy, and reliability of digital governance implementation within the warehouse environment.

Qualitative data were analyzed using thematic analysis following the interactive model of Miles, Huberman, and Saldana (2014), consisting of data reduction, data display, and conclusion drawing or verification. Data reduction involved organizing interview transcripts, observation notes, and documents into thematic categories aligned with the research focus. Data display was conducted through narrative matrices and thematic charts to facilitate pattern recognition and interpretation. Quantitative data were analyzed using descriptive statistical techniques, focusing on proportions, comparative performance indicators, and frequency distribution patterns extracted from system logs.

Integration of qualitative and quantitative results was carried out using a triangulation strategy, encompassing method triangulation (interviews, observations, documents), data source triangulation (staff reports vs digital system logs), and analytic triangulation by comparing thematic findings with quantitative performance metrics such as error rates. This triangulated integration ensured that findings were credible, internally consistent, and reflective of both operational realities and governance considerations.

The research was conducted at the OPT Zone 4A Warehouse of PT Pertamina Hulu Rokan in Prabumulih, South Sumatra, from June to August 2025. This site was selected due to its strategic role within the company's supply chain and its dependence on digital governance systems for verifying, recording, and distributing operational materials. The combination of mixed method data and triangulated analysis provides a comprehensive understanding of how digital governance and management audit practices influence operational efficiency and internal control effectiveness within warehouse logistics.

3. RESULTS AND DISCUSSIONS

Results

The results of this study show that the implementation of Good Governance principles within the logistics management system at Warehouse OPT Zone 4A of PT Pertamina Hulu Rokan (PHR) has demonstrated substantial progress, particularly in accuracy, administrative reliability, and documentation transparency. However, several governance dimensions especially cross-unit coordination and workflow responsiveness still require improvement. Data triangulation involving SAP digital records, internal audit reports, field observations, and interviews with key operational personnel strengthens the validity of these findings.

Based on SAP transaction logs from June to August 2025, the material receiving accuracy rate reached 94%, indicating a strong alignment between purchase orders and delivered materials. This figure suggests that the digital verification process has effectively minimized discrepancies. Furthermore, audit compliance stood at 82%, reflecting a generally consistent adherence to fixed procedures, though some gaps remain in the uniform application of Standard Operating Procedures (SOPs) across units. The manual administrative error rate was only 2.7%, demonstrating the effectiveness of automated documentation, multi-layered verification, and real-time data validation in reducing human error.

These quantitative results are reinforced by qualitative insights. Interviewed staff noted that automation reduces redundant steps and shortens the documentation cycle, yet they also emphasized that coordination between receiving and distribution units still relies partially on manual communication when operational loads increase. This indicates that while the digital system enhances accuracy, it is less effective in mitigating workflow bottlenecks driven by organizational structure and role segmentation.

1. Effectiveness of the Logistics Process

SAP functions not only as a digital transaction tool but also as an integrated data governance mechanism that strengthens internal control and supports transparent logistics procedures. The high accuracy rate (94%) and low manual error rate (2.7%) collectively demonstrate that SAP has successfully reduced discretionary errors and enhanced procedural reliability. These findings align with Digital Era Governance

perspectives, which argue that automation reduces the discretionary space for human error and strengthens traceability through structured audit trails.

The study also found that SAP implementation significantly improved operational efficiency. Using transaction processing time as a performance parameter, the efficiency level was calculated as:

$$Efficiency = \frac{100 - 8.5}{10} \times 100\% = 15\%$$

This efficiency improvement confirms that digital workflows reduce cycle time, increase responsiveness, and support data-driven decision-making. The result is consistent with Hammer & Stanton's (1999) operational excellence framework, which emphasizes the importance of process simplification and digital integration in improving productivity and service speed.

However, the qualitative data indicate that the effectiveness of SAP is partially constrained by organizational and structural factors. Operational staff noted differing interpretations of SOPs across units, limited cross-functional information sharing, and occasional delays in authorization when supervisors are handling simultaneous tasks. These challenges suggest that technological improvements alone do not guarantee optimal governance performance; organizational alignment, capacity building, and cross-unit integration remain critical.

Governance Implications

The findings strongly reinforce the theoretical connection between digital governance mechanisms and strengthened administrative control. Digital verification, layered approval workflows, and traceable transaction histories contribute directly to the principles of transparency, accountability, and control as defined in the UNDP (1997) Good Governance framework. The low error rate (2.7%) serves as empirical evidence of improved procedural integrity, while the 82% audit compliance indicates a relatively strong but still incomplete alignment with governance norms. Nevertheless, the data also highlight areas requiring improvement. In particular:

1. Cross-functional coordination remains fragmented, especially during peak operational periods.
2. SOP interpretation varies among units, reducing consistency in governance implementation.
3. Responsiveness is dependent on individual roles, indicating latent gaps in workflow automation.

Thus, while SAP advances governance quality, organizational and human factors remain decisive. This supports the argument that digital governance is most effective when combined with institutional strengthening, capability enhancement, and well-structured accountability mechanisms.

2. Operational Efficiency of SAP

The implementation of SAP at Warehouse OPT Zone 4A has significantly improved operational efficiency by accelerating information flow, enhancing accuracy, and reducing administrative redundancy. Features such as real-time tracking, automated reporting, and synchronized data sharing enable rapid and consistent information exchange across

units. Field observations confirm that transitioning from manual documentation to digital processing has shortened workflow cycles and strengthened internal controls.

Quantitative results support these observations. Administrative errors decreased to 2.7%, transaction processing time improved by 15%, and material receiving accuracy reached 94%. These improvements indicate that SAP enhances data reliability, reduces documentation discrepancies, and minimizes communication delays that previously occurred due to fragmented information systems. This aligns with Lambert et al. (2008), who emphasize cross-functional information integration as a key determinant of supply chain effectiveness. From a Good Governance perspective, SAP reinforces the principles of effectiveness, efficiency, and accountability through transparent, traceable, and standardized processes.

Despite these gains, qualitative findings highlight several constraints. Differences in SOP interpretation, uneven digital literacy among staff, and limited cross-functional communication during peak workloads occasionally diminish the full potential of digital integration. These issues suggest that technological improvements alone are insufficient without organizational alignment and continuous staff capacity-building.

Table 1. Performance Indicators of SAP Implementation in Supply Chain Operations

No	Indicator	Target	Actual	Variance (%)	Category
1	Material receiving accuracy	≥ 95%	94%	-1%	High
2	Transaction processing time	≤ 10 Minutes	8.5 Minutes	+15%	High
3	Manual administrative error rate	≤ 5%	2.7%	+2.3%	Very Low
4	Compliance with internal SOP	≥ 80%	82%	+2%	High

Operational Efficiency Implications

The findings indicate that improvements in processing time, accuracy, and administrative reliability achieved through SAP integration directly support the principles of efficiency and effectiveness within Good Governance. Real-time data updates, automated documentation, and synchronized workflows contribute to more accurate decision-making and reduce the risk of administrative discrepancies. The low error rate (2.7%) and increased processing efficiency (15%) demonstrate measurable gains in operational control and procedural consistency across the logistics workflow. Nevertheless, several challenges remain and require managerial attention:

1. Cross-functional coordination is not yet optimal, particularly during high-volume operational periods.
2. SOP interpretation differs between units, resulting in uneven application of procedures.
3. Digital literacy varies among staff, affecting system utilization and consistency in reporting.

Thus, while SAP significantly enhances operational efficiency, its long-term governance impact depends on strengthening cross-unit coordination, standardizing procedural understanding, and investing in staff capability-building. This underscores that digital tools yield maximum benefits only when supported by robust institutional alignment and continuous organizational development.

3. Accountability in Asset Management

The implementation of accountability mechanisms within the logistics and asset management processes at Warehouse OPT Zone 4A shows a strong alignment with internal governance standards. All logistics activities follow established Standard Operating Procedures (SOPs), while routine internal audits function as the primary management control mechanism to ensure compliance. Each material receipt is automatically recorded and uploaded into the SAP system, forming a verifiable digital audit trail. This digital traceability allows the internal control division to monitor activities in real time, minimizing opportunities for data manipulation, administrative inaccuracies, or undocumented transactions.

Evaluation results indicate that internal audit compliance reached 82%, suggesting that most units adhere to procedural requirements, although standardization across all units is not yet fully consistent. Meanwhile, reporting for goods distribution achieved 100% compliance, as SAP's automated documentation process eliminates manual intervention and significantly reduces the risk of reporting discrepancies. These results demonstrate the critical role of digitalization in strengthening administrative accountability, improving data consistency, and enhancing the reliability of internal reporting mechanisms.

However, despite the strong level of internal accountability, public accountability remains limited. Operational data although fully traceable internally are not yet accessible to external stakeholders, including oversight bodies or the public. This gap reflects the ongoing challenge faced by many State-Owned Enterprises (SOEs), where transparency tends to be internally sufficient but externally constrained. As Adam (2022) states, public information disclosure is a prerequisite for ensuring organizational integrity and strengthening public trust. Agindawati (2019) also asserts that accountability requires not only compliance with administrative procedures but also openness regarding the outcomes and social value of organizational actions. Therefore, expanding open data policies becomes essential to broaden accountability from an internal orientation toward a more holistic, public-centered governance model.

Table 2. Accountability Metrics Table

No	Activity	Accountability Mechanism	Compliance (%)	Remarks
1	Goods Receipt	SOP + SAP	94	Nearly optimal
2	Distribution	SAP + automatic notification	82	Requires external publication
3	Internal Audit	Regular audit + log file	82	Good internal compliance

Accountability Implications

The findings demonstrate that SAP strengthens internal accountability through automated reporting, digital audit trails, and consistent documentation standards. These mechanisms enhance data integrity and reduce the likelihood of administrative deviations, supporting the Good Governance principles of transparency, integrity, and control. However, several key areas require further attention:

1. Public accountability remains limited because operational data are not yet accessible to external stakeholders.
2. Variations in SOP interpretation reduce uniformity in accountability implementation.
3. Audit effectiveness is constrained by uneven digital literacy across units.

Thus, while SAP substantially strengthens internal accountability, broader accountability outcomes depend on improving SOP standardization, enhancing staff capacity, and adopting open data policies that extend transparency beyond the internal environment of PT Pertamina Hulu Rokan.

4. Transparency and Information Openness

Transparency in logistics operations at Warehouse OPT Zone 4A is significantly strengthened through the integration of SAP's digital recording and audit trail functionalities. Every transaction ranging from goods receipt, storage adjustments, distribution activities, to data modification is automatically logged within the system, producing a continuous and verifiable documentation chain. SAP's audit trail feature provides detailed tracking of user activity, including identity, time stamps, and the specific type of action performed. This minimizes opportunities for undocumented changes, enhances internal oversight, and ensures that all operational data remain intact and traceable.

These digital transparency mechanisms not only improve operational clarity but also function as an embedded internal control system that reinforces compliance with Standard Operating Procedures (SOPs). The system's ability to generate real-time data and automated reports supports prompt decision-making, reduces ambiguity in inter-unit communication, and provides measurable evidence for audit verification. By ensuring that logistics information is readily accessible to authorized units, SAP aligns with Good Governance principles particularly transparency, accountability, and integrity as outlined by UNDP (1997).

Table 3. Internal Transparency Table

No	Type of Activity	Form of Openness	Access Unit	Access Duration	Risk
1	Goods Receipt	Real-time update	Warehouse, Control, Finance	Unlimited	Low
2	Goods Issue	Automatic report	Distribution, Warehouse, User Unit	Unlimited	Low
3	Internal Audit	Log file	Internal auditor	3 years	Very low

Transparency Implications

The analysis shows that SAP significantly enhances transparency through real-time information flow, verifiable audit trails, and automated reporting. These mechanisms support clearer monitoring, reduce reliance on manual communication, and provide strong evidence for oversight processes. However, several issues remain evident:

1. Access to transparency features is still limited internally and not extended to external oversight stakeholders.
2. The absence of open data policies restricts broader public transparency.
3. Not all units fully utilize SAP's monitoring features, reducing the uniformity of transparency practices.

Thus, while SAP strengthens internal transparency, expanding data accessibility, standardizing user practices, and promoting external information openness are necessary to achieve comprehensive transparency within the broader Good Governance framework.

Discussion

1. Synergy of Good Governance Principles in a Digital System

The study's findings show that the four core principles of Good Governance efficiency, effectiveness, accountability, and transparency interact synergistically to create an integrated and credible logistics governance system. Digital efficiency drives operational effectiveness, while internal transparency reinforces administrative accountability. This alignment resonates with the frameworks of UNDP (1997) and OECD (2015), both emphasizing system integration, information openness, and participatory data management as the pillars of modern governance.

In PHR's context, the SAP system functions not merely as a digital tool but as a digital governance instrument that accelerates logistics operations, enhances accuracy, and strengthens the credibility of organizational decision-making.

2. Implementation Challenges and Areas for Improvement

Despite high levels of efficiency and effectiveness, the study identifies several critical areas for improvement:

1. Cross-functional integration:

Some SAP modules are not yet fully synchronized between the warehouse and finance units, resulting in reporting delays on stock and billing.

2. Physical capacity limitations:

The digital system cannot fully compensate for limited warehouse space, which affects logistics responsiveness during peak periods.

3. External data transparency:

The absence of aggregated logistics data publication limits external accountability and public transparency.

Addressing these issues would enhance the legitimacy of PHR's digital governance and strengthen stakeholder trust both internally and externally.

3. Theoretical Implications for Digital Governance Reform in BUMN

Theoretically, these findings broaden the understanding of the relationship between digital governance and Good Governance within the BUMN context. Digitalization is not merely technological modernization it represents a form of institutional reform that transforms organizational values, procedures, and cultures.

PHR's model demonstrates that systems like SAP can serve as institutionalized mechanisms of data-based accountability, minimizing discretionary behavior and improving policy predictability. This supports Meijer's (2015) view that digital governance acts as both a control mechanism and an organizational learning tool within public institutions.

Furthermore, the emergence of digital transparency through SAP introduces a new theoretical dimension to Good Governance studies: how internal data openness can evolve into democratic external transparency. Hence, this research contributes to enriching the theoretical discourse on digital public governance in Indonesia.

4. Comparison with Similar Studies in Other BUMN

When compared to similar research on other BUMN, such as PT PLN (Kurniawan, 2023) and PT Pelindo (Pratama & Susanto, 2022), PHR demonstrates a higher level of digital governance maturity.

At PLN, the digital procurement system (e-procurement) still faces challenges in interunit coordination and resistance to new work cultures. Meanwhile, Pelindo's

logistics digitalization, through the Port Community System, remains at a foundational integration stage with limited real-time data analytics.

PHR, by contrast, has achieved a more advanced stage with full SAP integration across procurement, warehouse, and distribution modules. Nevertheless, this progress introduces new challenges, such as system complexity and heavy reliance on digital data integrity, which require enhanced human resource capabilities and stronger cybersecurity mechanisms.

This comparison illustrates that the level of digital governance maturity among Indonesian BUMN remains uneven, and PHR's experience can serve as a best practice model for strengthening digital logistics governance in other public enterprises.

5. Practical Implications and Policy Recommendations

Based on the findings and discussion, several strategic recommendations can be proposed to strengthen digital governance in BUMN logistics systems:

1. Enhance cross-functional integration across divisions through improved SAP interoperability and joint technical training.
2. Develop open data policies to make logistics information publicly accessible in aggregated and secure formats.
3. Improve digital human resource capacity, emphasizing data literacy, system integrity, and cybersecurity awareness.
4. Conduct regular digital audits to ensure compliance, detect potential deviations, and enhance accountability.

These steps will reinforce both internal governance and external accountability, advancing the overall integrity of logistics governance in state-owned enterprises.

In summary, this research demonstrates that the implementation of digital-based Good Governance at PT Pertamina Hulu Rokan has successfully established a logistics system characterized by efficiency, accountability, and transparency. Nevertheless, sustaining this governance reform requires structural support particularly in cross- functional integration, open data policies, and organizational capacity building.

The findings contribute theoretically to the development of public administration and digital governance studies, while practically offering a policy model for strengthening governance integrity within Indonesia's BUMN.

4. CONCLUSION

This study demonstrates that the implementation of Good Governance principles in the digital-based logistics management system at Warehouse OPT Zone 4A of PT Pertamina Hulu Rokan has significantly improved operational efficiency, internal accountability, and system transparency. The SAP system effectively reduces administrative errors, accelerates reporting processes, and strengthens inter-divisional coordination, thereby realizing the principles of effectiveness and efficiency, which are fundamental to Good Governance.

However, the study also finds that external accountability and public data transparency remain limited, indicating that full transparency has not yet been achieved. Key challenges include warehouse capacity constraints, dependency on digital infrastructure, and uneven human resource readiness. Theoretically, this research contributes to the integration of digital governance and Good Governance literature in the context of State-Owned Enterprises, emphasizing that digitalization is not merely technological modernization but also an institutional reform that strengthens data-driven governance and accountability. Practically, the findings offer strategic recommendations

for BUMNs, including enhancing cross-functional integration, implementing open data policies, improving digital literacy, and conducting regular digital audits to achieve more transparent, accountable, and effective logistics governance. Consequently, digital governance emerges as a key instrument to reinforce Good Governance principles in public sector logistics and serves as a best-practice model for other State-Owned Enterprises in Indonesia.

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