JSEH (Jurnal Sosial Ekonomi dan Humaniora)
Volume 12 Nomor 2 Juni 2026 (PP. 68-81)
p-ISSN: 2461-0666
e-ISSN: 2461-0720

JURNAL SOSIAL EKONOMI DAN HUMANIORA
http://jseh.unram.ac.id
ISSN 2461-0666 (Print), e-ISSN 2461-0720 (Online)

Evaluation of SPBE Implementation in Regional Governments: Analysis of the SPBE Index and the Quality of Digital Public Services

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Keywords
Electronic-Based Government System (EBGS), Policy, Governance, Management, Public Service

Abstract
This study analyzes the influence of policy (X1), governance (X2), management (X3), and public services (X4) in the Electronic-Based Government System (EBGS) on the Government Digitalization Index. A quantitative approach was employed using multiple linear regression with Stata 17, while modern analysis was conducted using deep learning with the split-sample technique. Model validation was performed using the RMSE and MAE metrics to compare the accuracies of the traditional and modern methods. The results indicate that all variables have positive and significant effects. Public services (X4) is the most dominant variable, followed by governance (X2), management (X3) and policy (X1). The consistency of the coefficient values in the training and testing data confirmed the high accuracy of the model. Deep learning analysis strengthens the regression findings by showing that policy and governance serve as catalysts that reinforce public services, whereas management functions as a support system that ensures implementation consistency. Theoretically, the findings support the grand theory of governance, resource-based view (RBV), and public service theory, emphasizing governance, internal capacity, and quality of service as the main pillars of government digitalization. This study provides an empirical contribution to the literature on the key determinants of EBGS success and demonstrates the added value of using deep learning in public policy analysis.

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DOI: https://doi.org/10.29303/jseh.v12i2.1016
History Artikel: Received: 14 Juni 2026 | Accepted: 29 Juni 2026

INTRODUCTION

The implementation of the Electronic-Based Government System (EBGS) in Indonesia represents a significant advancement in bureaucratic reform and the transformation of public governance (Lukitasari.WA et al., 2025; Sulistya et al., 2019; Trilestari et al., 2024; Yanto et al., 2025; Yulianto et al., 2023, 2026). Following the issuance of Presidential Regulation No. 95 of 2018 regarding the electronic-based government system (Indonesia, 2018), the central government has underscored digitalization as a strategic imperative to enhance the transparency, efficiency, accountability, and accessibility of public services across all government level (Dogou, 2025; Korbayram et al., 2025; Milakovich, 2012; Pacific, 2022; Ugli, 2025). This regulation establishes a framework for local governments to integrate electronic services, streamline bureaucracy, and improve public organizational governance (Gond & Khicher, 2024; Jawad et al., 2021; Slivka & Ginda, 2021). Numerous studies have confirmed that EBGS serves as the foundation for modernizing government administration in Indonesia and bolstering public trust in institutions. Consequently, evaluating the implementation of the EBGS is of both academic and practical significance in ensuring the achievement of digitalization objectives at the regional level (M. Huda & Yunas, 2016; Kurhayadi, 2019; Rahmadany, 2021; Sudarsono & Lestari, 2018; Sulistya et al., 2019; Utama, 2020; Yulianto et al., 2023). This evaluation is pertinent given the disparities in regional capacities, bureaucratic complexity, and the necessity to adapt to global digital governance trends that emphasize efficient and responsive public services (Dobrolyubova, 2021; Guo et al., 2021; Lobonț et al., 2025; Melitski & Holzer, 2007; OECD, 2021). It remains integral to the nationwide reform efforts.

The EBGS Index serves as a tool for assessing the maturity and effectiveness of digital governance within local governments (Akbar et al., 2021; Jang, 2001; Martínez et al., 2022; Nursafitri & Jayadi, 2023). It encompasses four domains—Policy, Governance, Management, and Services—that represent the strategic, structural, operational, and public service aspects of EBGS implementation (Hitham et al., 2017; Management Association, 2016; Smith, 2016). The policy domain evaluates regulations, strategies, and commitments that support digitalization; governance focuses on coordination, integration, and accountability; management assesses organizational capacity, human resources, and infrastructure; and services examine the quality, accessibility, and responsiveness of electronic public services (Borysenko, 2023; C. & N., 2025; Kumari et al., 2024; OECD, 2020; Pacific, 2022). Within this framework, the EBGS Index functions as both an administrative measurement tool and an indicator of regional readiness for future digital transformation challenges (Choudrie et al., 2017; Jadi & Jie, 2017; OECD, 2021). Domain-based evaluation facilitates a detailed analysis to identify the strengths and weaknesses of EBGS implementation (M. N. Huda et al., 2022; Koniyo et al., 2021; Management Association, 2017). This framework demonstrates the maturity of local governments and informs strategies for enhancing the quality of electronic public services.

The advancement of artificial intelligence, particularly in the realm of deep learning, has facilitated the evaluation of the EBGS Index (Carter et al., 2024; Dilip et al., 2024; Hornjak, 2024; Medaglia et al., 2023; Salem et al., 2024; Shukla & Tiwari, 2024; Spivakovskyy et al., 2026). In contrast to traditional statistical methods, which are typically linear and constrained to simple variable relationships, deep learning can process extensive heterogeneous datasets, identify complex patterns, and yield more precise predictions (Almasi, 2023). Within the EBGS framework, this technology facilitates a comprehensive analysis of domains 1–4, allowing for a more accurate determination of each domain's contribution to the overall index (Aborujilah et al., 2025; Chinnasamy et al., 2023; Gaur et al., 2022; Shukla & Tiwari, 2024; Z. Zhang & Zhang, 2025). Additionally, it can identify nonlinear interactions among domains, such as how policy and governance enhance the impact of digital public services on the index (Loginova et al., 2021; Mehmood, 2022; Mequanenit et al., 2025). Consequently, the evaluation of EBGS can extend beyond merely measuring achievements to offering data-driven recommendations for policy enhancement, management improvement, and elevating public service quality (Mukamurenzi Solange et al., 2016). This integration is consistent with global trends in digital governance, where artificial intelligence underpins evidence-based decision-making, enhances operational efficiency, and bolsters public trust in the government (Y. Cao, 2019; Fan, 2025; Salem et al., 2024; Waza, 2024). This development fortifies the digital transformation of local governments.

The effective implementation of the Electronic-Based Government System (EBGS) in China has established international standards for electronic governance (Du et al., 2019; Ma, 2020; Studies, 2023; Yang & Xu, 2017). China has successfully integrated digital systems into its bureaucratic processes, encompassing data management, public services, and evidence-based decision-making (G. Cao & Du, 2024; Huixia, 2024; Jiang, 2023; Sun & Yu, 2024; Yin et al., 2024; Zheyuan, 2025). This integration illustrates the potential of artificial intelligence, including deep learning, to enhance efficiency, improve the quality of public services, and foster trust in government institutions (Maalla, 2021; Mellouli et al., 2024;

Mulyasari & Jaya Wardana, 2025). The success of this initiative is underpinned by consistent national policies, investments in digital infrastructure, and a skilled workforce in technology utilization. For Indonesia, China's experience highlights that the success of EBGS relies not only on regulatory frameworks but also on consistent implementation, infrastructure preparedness, and robust political commitment at the regional level (Brimkulov & Baryktabasov, 2018; Malizal et al., 2024; Sodhi, 2016; Yanto et al., 2025). By comparing international practices, Indonesia can identify deficiencies in its EBGS implementation and develop strategies that are more adaptable to the local context. This benchmark underscores the necessity of incorporating analytical methods, such as deep learning, in EBGS evaluations to ensure that the outcomes are accurate and aligned with societal needs (Rahmadany, 2021; Saprudin, 2024; Yerina, 2024). International benchmarks suggest that the transformation of digital government is contingent on policy consistency, infrastructure readiness, and technological advancement.

Although the EBGS regulation offers a framework for local governments, research in Indonesia has predominantly relied on traditional statistical evaluations (Irwansyah et al., 2025; Rossa Ilma Silfia, 2025; Ulum & Soesatyo, 2025). Most studies concentrate on factors affecting the success of EBGS implementation, index measurements, and descriptive analyses of achievements within each domain (Alakash et al., 2024; Rahayu, 2017). While these studies provide an overview, they fail to address the complexity of inter-domain relationships or the nonlinear patterns in government digitalization. In contrast, international literature indicates that integrating artificial intelligence, particularly deep learning, enhances e-government evaluation and produces more accurate and predictive results (Hornjak, 2024; Salem et al., 2024; Shukla & Tiwari, 2024). However, the application of such methods in Indonesia is rare, highlighting a significant research gap. This study aims to fill this gap by employing a deep learning approach to offer more precise empirical contributions in measuring EBGS Index achievements and identifying key factors for successful local implementation in Indonesia (Chinnasamy et al., 2023; Gaur et al., 2022; Lu & Liu, 2025). These limitations present opportunities for integrating deep learning, thereby enabling more accurate EBGS evaluations and providing relevant policy recommendations for local governments to consider.

Digitization of public services is a fundamental aspect of government modernization. Transitioning from manual, paper-based systems to electronic services represents an effort to address traditional bureaucratic challenges, including slow administrative processes, restricted access to information, and limited transparency (Garayová, 2021; Mariniello, 2022; Piridi, 2025; Syahrial & Narastri, 2026). Electronic public services provide the community with faster, more efficient, and interactive access to administrative needs, ranging from licensing to social services (Danu et al., 2023; Selvakumar et al., 2025; M. Zhang & Kaur, 2024). Nevertheless, a significant challenge is ensuring that these digital services adequately respond to the diverse needs of the public. Deep learning is crucial in this context because it can analyze large-scale data, identify patterns in citizens' needs, and predict which services should be prioritized. Additionally, it can personalize public services, ensuring that each citizen receives an experience that is relevant to their local context. Consequently, integrating this technology enhances the quality of public services and bolsters government legitimacy through more transparent and data-driven governance (B. Raja et al., 2023; Durugkar, 2023; Ogunleye, 2023; Zhong, 2024). In Indonesia, digitization is an urgent necessity, and deep learning can facilitate the development of efficient and responsive electronic-based services, thereby increasing public trust in the local government.

This study evaluates local government EBGS Index achievement in Indonesia across four domains: policy, governance, management, and services. It measures the extent to which EBGS implementation has delivered public benefits, particularly the transparency, efficiency, and accessibility of public services. It also identifies the factors influencing successful regional EBGS implementation, providing a comprehensive overview of the actual state of government digitalization. Integrating deep learning into the analysis is expected to improve evaluation accuracy, clarify domain interactions, and provide targeted recommendations. Theoretically, this study is grounded in public administration and governance theories, which emphasize policy, governance, management, and service quality as pillars of bureaucratic reform and digital transformation. Accordingly, it contributes academically by strengthening the literature on digital governance in Indonesia and practically by helping local governments design strategies to improve electronic public services through domain 1–4 EBGS Index analysis and more effective policy recommendations, while increasing the accuracy and relevance of the evaluation results.

RESEARCH METHODS

This study employed a quantitative approach with three main stages of analysis: descriptive statistics, multiple linear regression, and deep learning.

Data and Sample

The research data were sourced from the SPBE

Evaluation Report of the Ministry of PANRB for the 2021–2024 period, which includes official indicators of policy, governance, management, and public services. The study population covered all provinces in Indonesia, totaling 38 provinces. However, owing to regional expansion in 2022, only 33 provinces have complete data since 2021. Five new provinces were not included because they did not have consistent data throughout the study period. Thus, the research sample consists of 33 provinces with a total of 132 observations (33 provinces × four years).

Descriptive Statistics

The initial analysis stage used descriptive statistics to outline the characteristics of the data. These statistics include the mean, standard deviation, minimum, and maximum values for each variable (X1–X4 and SPBE Index). The purpose of the descriptive analysis was to provide an overview of the data distribution, level of homogeneity, and indications of variation among provinces.

Multiple Linear Regression

The next stage was a multiple linear regression analysis using Stata 17 software. This model was used to measure the direct contributions of policy (X1), governance (X2), management (X3), and public services (X4) to the SPBE/EBGS Index (Y). The basic regression equation used is as follows:

$$Y=\beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+\varepsilon$$

where Y is the SPBE Index, β0 is the constant, β1–β4 are the regression coefficients, and ε is the error term. This analysis aimed to determine the significance and magnitude of each variable's influence on the index.

Deep Learning Analysis

In addition to traditional regression, this study integrated a deep learning approach to capture the nonlinear relationships among the variables. The data were split by year: 2021–2022 as the training set (score 1) and 2023–2024 as the testing set (score 0). This temporal division allows for testing the model's generalization on new data.

The deep learning model was built using a split-sample technique, employing a simple multilayer perceptron (MLP) architecture with ReLU activation function and Adam optimization. Validation was performed using the Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) metrics, providing an overview of the prediction accuracy and model error rates.

Integrated Analysis

By combining descriptive statistics, linear regression, and deep learning, this study not only emphasizes the direct contribution of each variable but also reveals the complex interactions among the SPBE domains. This approach is expected to produce a more comprehensive, accurate, and replicable evaluation while providing relevant policy recommendations for local governments.

RESULTS AND DISCUSSION

Descriptive Statistics

Descriptive statistics provide a comprehensive overview of the research data characteristics. The following table presents the results of the descriptive statistics.

Table 1 Descriptive Statistics

Variable	Mean	Std. Dev	Min	Max
Y	3.00	0.77	1.00	4.73
X1	3.03	1.12	0.60	5.00
X2	2.62	0.92	1.00	4.90
X3	1.76	0.80	1.00	3.82
X4	3.64	0.76	1.00	5.00

Source: Primary data processed, 2026

The dependent variable Y has a mean of 3.00, a standard deviation of 0.77, a minimum value of 1.00, and a maximum of 4.73. The median of 3.01 indicates a relatively symmetrical data distribution; therefore, Y can be considered fairly stable with moderate variation. Variable X1 had a mean of 3.03 with a standard deviation of 1.12, with values ranging from 0.60 to 5.00. This indicates that X1 has considerable variation with a distribution approaching normality. Variable X2 had a mean of 2.62 with a standard deviation of 0.92, with values ranging from 1.00 to 4.90. The distribution of X2 was slightly skewed to the right, indicating a predominance of lower values, but still within a reasonable range. Variable X3 has a mean of 1.76 with a standard deviation of 0.80, with values ranging from 1.00 to 3.82. The median of 1.55 indicates that most of the X3 data fall below the mean, with a distribution skewed to the right. Variable X4 has the highest mean, namely 3.64 with a standard deviation of 0.76, with values ranging from 1.00 to 5.00. The median of 3.69 indicates a left-skewed distribution, suggesting a predominance of higher values. Overall, these descriptive statistics show that the research data exhibit fairly diverse variation, mostly approaching a normal distribution, and are thus suitable for regression analysis.

Regression Results

Multiple regression analysis shows that all independent variables have a positive and significant effect on Y. The R^2 value of 0.9973 and the Adj R^2 of 0.9972 indicate that the model can explain 99.73% of the data variation. The regression coefficients for each variable are as follows.

Table 2 Regression Result

Variable	Coefficient	Std. Error	t-Stat	p-Value	95% CI
X1	0.1030	0.0046	22.17	0.000	0.0938 – 0.1122
X2	0.2687	0.0086	31.24	0.000	0.2517 – 0.2857
X3	0.1736	0.0077	22.58	0.000	0.1584 – 0.1889
X4	0.4658	0.0077	60.29	0.000	0.4505 – 0.4811
Constant	-0.0175	0.0182	-0.96	0.338	-0.0536 – 0.0185

Source: Primary data processed, 2026

Model Validation (Training vs Testing)

To assess the generalization ability of the model, validation was performed by splitting the data into a training subset (T=1) and a testing subset (T=0).

Table 3 Model Validation Result

Dataset	R^2	Adj R^2	RMSE	Coefficient X1	Coefficient X2	Coefficient X3	Coefficient X4
Training (T=1)	1.0000	1.0000	0.0031	0.1302	0.2495	0.1657	0.4543
Testing (T=0)	0.9944	0.9941	0.0527	0.0846	0.2928	0.1669	0.4581

Source: Primary data processed, 2026

The regression results for the training subset (T=1) show an R^2 value of 1.0000, indicating that the model can explain all the variations in the training data. However, in the testing subset (T=0), the R^2 value decreased to 0.9944. Although this decrease is relatively small, it indicates mild overfitting, where the model fits the training data too closely, such that the accuracy on the test data declines slightly. The coefficient analysis shows that variable X4 has the most dominant influence on Y in both the training (0.4543) and testing (0.4581) data. Variable X2 showed an increased influence in the testing data (0.2928 compared to 0.2495), indicating a stronger relevance in the new data. Variable X3 is relatively stable, with almost identical coefficients in both subsets, while variable X1 shows a decrease in influence from 0.1302 in the training data to 0.0846 in the testing data. Overall, these results indicate that the regression model has high accuracy, with X4 as the main factor, X2 as a factor that is increasingly relevant in the test data, X3 as a stable factor, and X1 as a factor that is stronger in the training data.

The Influence of Internal Policy Aspects of the Electronic-Based Government System on the Index

The regression results show that variable X1 has coefficients of 0.1302 and 0.0846 in the training and testing data, respectively, with a p-value < 0.01. This indicates that X1 has a positive and significant effect on Y in both the training and testing datasets. X1's contribution to Y ranged from 8% to 13%, making it the variable with the smallest influence compared to X2, X3, and X4. Nevertheless, the statistical significance indicates that X1 still plays an important role in explaining the variation in Y.

Substantively, X1 represents the EBGS policy domain, which emphasizes regulation, strategy, and local governments' commitment to supporting digitalization (Dogou, 2025; Indonesia, 2018; Pacific, 2022). These findings support the phenomenon described in the background, namely, that policy serves as the foundational basis for government digitalization (OECD, 2020). Regulations such as Presidential Regulation No. 95 of 2018 provide a strategic framework ensuring that digitalization is not merely an option but an imperative for improving transparency, accountability, and the efficiency of public services .

However, the relatively small contribution of X1 compared to other variables indicates that policy alone is insufficient to drive significant changes. This is consistent with the literature, which asserts that formal policy often functions only as an "enabler" or initial driver, but the success of EBGS implementation depends heavily on governance, management, and the quality of public services (Sulistya et al., 2019; Utama, 2020). In other words, policy provides a strategic direction, but its tangible impact on society becomes evident only if it is followed by inter-agency coordination, organizational capacity, and responsive public services.

From a theoretical perspective, these results support the grand theory of governance (Bevir, 2013), which underscores the importance of policy as an instrument of legitimacy and strategic direction but also highlights its limitations if not integrated with other domains. Previous studies in Indonesia have also found that even though the digitalization policy is clear, disparities in capacity between regions and bureaucratic complexity often hinder the achievement of optimal outcomes (Kurhayadi, 2019; Malizal et al., 2024; Rahmadany, 2021)(Kurhayadi, 2019; Rahmadany, 2021). Thus, these empirical findings reinforce the literature that policy is an important factor but not the primary determinant of EBGS success.

Additionally, the difference in coefficient values between the training (0.1302) and testing data (0.0846) indicates that the effect of policy on Y is stronger in the training data but weakens when tested on new data. This

phenomenon can be interpreted as an indication that policy is often more effective in internal contexts (for example, planning documents and formal commitments) but less consistent in real implementation as experienced by the public. This aligns with the background findings that the success of the EBGS depends not only on regulation but also on implementation consistency, infrastructure readiness, and political commitment at the local level (Yanto et al., 2025; Yulianto et al., 2023).

Deep Learning Analysis of Internal Policy

Deep learning analysis provides an additional perspective on the role of policies (X1). The model shows that X1 acts as a catalyst, strengthening the influence of governance (X2) and public services (X4) on the SPBE Index. Although its direct contribution is relatively minor, policy increases the effectiveness of other domains when governance is strong, and public services are responsive. This interaction is not fully captured by linear regression but is identified through deep learning, which can detect nonlinear patterns between variables.

From a theoretical perspective, these findings are consistent with the grand theory of governance (Bevir, 2013), which emphasizes that policy confers legitimacy and strategic direction, but its strength becomes optimal only when it is integrated with governance and the quality of public service.

The Influence of Electronic-Based Government System Governance Aspects on the Index

The regression results show that variable X2 has a coefficient of 0.2495 in the training data, which increases to 0.2928 in the testing data, with a p-value < 0.01. This means that X2 has a positive and significant effect on Y in both the training and testing data. The contribution of X2 to Y is in the range of 25–29%, making it a variable with a considerable impact, which is even stronger in the testing data. The increase in the coefficient from training to testing indicates that the influence of X2 becomes more relevant when tested on new data; thus, this variable can be considered a factor that strengthens the model's generalizability.

Substantively, X2 represents the EBGS governance domain, which emphasizes coordination, integration, and accountability in the management of electronic-based government systems (Jawad et al., 2021; OECD, 2021). Strong governance ensures that policies do not stop at formal documents but are truly implemented through inter-agency coordination, system integration, and clear accountability mechanisms.

These results support the grand theory of governance (Bevir, 2013), which posits that governance is central to bureaucratic reform and digitalization in the public sector. Governance acts as a connecting mechanism between policy, management, and public services. With a contribution of 25–29%, X2 proves to be stronger than policy (X1) and plays an important role in ensuring the success of the EBGS at the regional level. Governance theory asserts that without good governance, policies will remain merely normative documents, management will not function effectively, and public services will not be responsive.

Previous studies have confirmed that interagency coordination is a key factor in the success of EBGS. For example, (Yulianto et al., 2023) and (Kurhayadi, 2019) found that regions with good governance tend to have higher EBGS indices than regions with weak coordination. These empirical findings reinforce the literature that governance is a relevant and increasingly important variable in the context of actual implementation.

Moreover, the increase in the X2 coefficient in the testing data indicates that governance is not only relevant in the internal (training) context but is even stronger when tested on new data. This phenomenon can be interpreted as evidence that good governance is durable and relevant in the long term, thereby strengthening public trust in the government. This aligns with the background emphasizing that EBGS should be viewed as a strategic foundation for government digitalization, where governance serves as the main link between policy and public service (Dobrolyubova, 2021; OECD, 2021).

Deep Learning Analysis of Governance

Deep learning analysis provides an additional perspective on governance (X2). The model shows that governance functions not only as a direct predictor but also as a structural connector that strengthens interactions across domains. Nonlinear relationships are evident; strong governance makes policies (X1) more effective in implementation and improves the quality of public services (X4). In other words, governance acts as a mediator that ensures that regulations and management capacity are translated into responsive public services.

These findings are consistent with the grand theory of governance (Bevir, 2013), which emphasizes that governance is at the core of bureaucratic reform and digitalization in the public sector. Deep learning reinforces this theory by demonstrating that governance is not only a statistically significant contributor but also an integration hub that connects policy, management, and public services within the non-linear structure of the EBGS.

The Influence of Electronic-Based Government System Management Aspects on the Index

The regression results show that variable X3 has a coefficient of 0.1657 in the training data and 0.1669 in

the testing data, with a p-value < 0.01. This indicates that X3 has a positive and significant effect on Y in both the training and testing datasets. The contribution of X3 to Y was in the range of 16–17%, making it a variable with a moderate effect that was relatively stable across both data subsets. The consistency of this coefficient value indicates that X3 is a robust and reliable variable for explaining the variation in Y.

Substantively, X3 represents the domain of EBGS management, which includes organizational capacity, human resources, and supporting infrastructure (Koniyo et al., 2021; Management Association, 2016). These findings support the phenomenon described in the background, namely, that one of the main challenges of government digitalization in Indonesia is the disparity in capacity between regions and the limitations of bureaucratic management. With a contribution of 16–17%, X3 shows that management capacity plays an important role in the success of EBGS, although not as much as public services (X4) or governance (X2).

This result supports the grand theory of the resource-based view (RBV) (Wernerfelt, 1984), which emphasizes that an organization's internal capacity—be it HR, management structure, or infrastructure—is a determining factor in the success of digital transformation. With a stable contribution to training and testing, X3 demonstrates that management is a consistent and generalizable variable. RBV theory asserts that organizations with strong internal capacity can implement digitalization policies effectively and deliver high-quality public services.

Previous studies in Indonesia have also highlighted that limitations in HR and infrastructure are often the main obstacles to the implementation of EBGS (Rahmadany, 2021; Sudarsono & Lestari, 2018). Thus, these empirical results reinforce the literature that management is a stable factor that always influences the success of EBGS, even though it is not the most dominant variable in this study.

In addition, the consistency of the X3 coefficient values in the training and testing data shows that the effect of management on Y is relevant in the internal context and remains significant when tested on new data. This phenomenon can be interpreted as evidence that management capacity is durable in the long term, making it one of the key pillars for ensuring the success of government digitalization across various regions.

Deep Learning Analysis of Management

Deep learning analysis adds a new perspective to the role of management (X3). The model shows that management functions as a support system that maintains consistency and strengthens interactions among domains. Strong management capacity ensures that governance (X2) is implemented effectively and supports public service quality (X4). Thus, management acts as the operational backbone that enables policies (X1) and governance to be translated into tangible public service.

Furthermore, deep learning confirms the stability of X3 as a consistent variable in reducing the prediction error and maintaining model accuracy on new data. This indicates that management capacity has long-term resilience in supporting the successful implementation of SPBE.

These findings are in line with the grand theory of resource-based view (RBV) (Wernerfelt, 1984), which emphasizes that an organization's internal capacity—human resources, structure, and infrastructure—is the main factor in the success of digital transformation. Deep learning reinforces this view by showing that management is not only a direct contributor but also a stabilizing factor that ensures the sustainability of EBGS's implementation.

The Influence of Electronic-Based Government System Service Aspects on the Index

The regression results show that variable X4 has coefficients of 0.4543 and 0.4581 for the training and testing data, respectively, with a p-value < 0.01. This indicates that X4 has a positive and significant effect on Y in both the training and testing data. The contribution of X4 to Y ranged from 45% to 46%, making it the variable with the greatest influence compared to X1, X2, and X3. In other words, almost half of the variation in Y can be explained by X4, making this variable a key factor in our model.

Substantively, X4 represents the EBGS service domain, which emphasizes the quality, accessibility, and responsiveness of electronic public services (OECD, 2020; Pacific, 2022). This finding supports the phenomenon described in the background, that the digitalization of public services is a main pillar of bureaucratic modernization in Indonesia. The shift from manual systems to electronic-based services has accelerated administrative processes, increased transparency, and broadened public access to government services (Garayová, 2021; Syahrial & Narastri, 2026).

This result supports the grand theory of public service (Denhardt & Denhardt, 2003), which emphasizes that service quality is the main indicator of the success of digitalization and bureaucratic reforms. With a contribution of 45–46%, X4 is the most dominant variable in explaining Y. Public service theory asserts that the success of a policy or governance is ultimately measured by the public's perception of the quality of the services provided. Thus, these empirical results reinforce the literature that public services are the key variable determining the level of public trust in the

government.

Previous studies have also affirmed that public service is the most perceived aspect by the public and serves as a benchmark for EBGS success. For example, Rahayu (2017) and Yulianto et al. (2023) found that the quality of electronic public services is directly related to community satisfaction and the legitimacy of local governments. With a contribution of nearly half of the total variation in Y, the findings of this study are consistent with the literature that public service is the main factor in the success of the digital government.
In addition, the consistency of the X4 coefficient values in the training and testing data shows that the effect of public service on Y is stable and generalizable. This indicates that the quality of electronic public services is relevant in the internal context and remains significant when tested with new data. This phenomenon can be interpreted as evidence that public service has long-term resilience, thus becoming the main pillar in ensuring the success of EBGS across regions.

Deep Learning Analysis of Public Service

These findings are in line with the grand theory of resource-based view (RBV) (Wernerfelt, 1984), Deep learning analysis affirms the role of public services (X4) as both the most dominant variable and the main outcome of integrating all EBGS domains. The model shows that X4 has a strong non-linear relationship with policy (X1) and governance (X2); thus, the quality of public services increases significantly when regulations are clear and government coordination is effective. Thus, public services do not stand alone but reflect the effectiveness of policy, governance, and management capacity.

In addition, deep learning confirms the stability of X4 as a core variable that consistently maintains the prediction accuracy of new data. This demonstrates that public services have long-term resilience and remain the main pillar of successful government digitalization.

These findings are consistent with the grand theory of public service (Denhardt & Denhardt, 2003), which emphasizes service quality as the primary indicator of successful bureaucratic reform and digitalization. Deep learning reinforces this theory by showing that public service is not only the direct result of policy but also a reflection of the complex interactions among EBGS domains.

CONCLUSIONS

This study demonstrates that all variables within the EBGS domain have a positive and significant effect on the government digitalization index (DGI). Public services (X4) emerged as the most dominant variable, contributing 45–46%, reinforcing service quality as the primary benchmark of EBGS success. Governance (X2) contributes 25–29% and becomes stronger in the test data, underscoring its role as the main connector between domains. Management (X3) remained stable, with a contribution of 16–17%, functioning as the factor that maintained implementation consistency. Policy (X1) contributes 8–13%, acting as the normative foundation that provides strategic direction.

The integration of regression analysis and deep learning strengthens the findings. Linear regression confirms the direct contribution of each variable, while deep learning reveals non-linear interactions: policy and governance reinforce public services, and management functions as a support system. These results are consistent with grand theory governance, resource-based view (RBV), and public service theory, all of which emphasize governance, internal capacity, and service quality as the main pillars of government digitalization.

This study has limitations, including a limited data period, a regression model that only captures linear relationships, and the lack of analysis of external factors such as local politics, organizational culture, and community participation. Additionally, field implementation may differ because of disparities in capacity between regions.

The main contribution of this study is the presentation of an integrative approach that combines traditional regression and deep learning to evaluate the EBGS, thereby providing more comprehensive and replicable empirical evidence to strengthen the academic literature and generate more relevant policy recommendations for local governments.

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