

How IT Integration and Management Accounting Systems Shape Public Performance: A Multi-Group Analysis of Regencies and Cities in North Sumatera, Indonesia

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Abstract. This study examines how IT integration across units, management accounting systems (MAS) design, decentralization, and e-government capabilities are associated with public performance in Indonesian local governments. Focusing on North Sumatera, where regencies and cities differ in service portfolios, administrative capacity, and digital readiness, we test a model that positions technology as an enabler whose effects materialize mainly through information design and performance information use (PIU). Using survey data from local governments and structural modeling with multi-group comparisons, we find that MAS design relates to higher PIU and, in turn, to public performance, indicating an indirect behavioral pathway. IT integration strengthens MAS inputs and is linked to performance primarily through MAS design and PIU, while e-government capabilities provide a parallel pathway associated with citizen-facing processes. Decentralization shows contingent associations with MAS design and PIU, and pathways differ between regencies and cities. The findings connect information systems, management accounting, and public administration and inform the design of mandated integration, managerial information packages, and authority arrangements in Indonesian local government. Given the cross-sectional design, associations should not be interpreted as causal.

Keywords: IT integration; management accounting systems; performance information use; public performance; e-government capabilities; regencies and cities

1. Introduction

Indonesia's digital government trajectory has moved from siloed digitization toward process and data integration across agencies, supported by Presidential Regulation No. 95 of 2018 on the Electronic-Based Government System and by Minister of Home Affairs Regulation No. 70 of 2019 on the Regional Government Information System (Republic of Indonesia, 2018; Ministry of Home Affairs, 2019).

United Nations e-government indicators for 2022 and 2024 show improvement at the national level, yet Indonesia's relative position remains mid-range, which underscores that local outcomes depend on whether jurisdictions operationalize these standards into interoperable systems and managerial routines (United Nations, 2022; United Nations, 2024; Janowski, 2015). We note that Indonesia's EGDI reached 0.799 in 2024 with a global rank of 64 (United Nations, 2024).

North Sumatera is among Indonesia's largest provinces with a population well above fifteen million and with pronounced urban and rural differences in household internet access, which motivates testing mechanisms separately for regencies and cities (BPS-Statistics Indonesia, 2024; BPS-Statistics Indonesia, 2025). Recent evidence documents digital divides across Indonesian regions and services, reinforcing that capacity and access constraints can shape how digital government capabilities translate into outcomes (Nababan, 2024).

Platform availability alone rarely improves public service performance, because value tends to emerge when digital technologies are coupled with organizational change and decision routines that officials actually use (Vial, 2019; Twizeyimana & Andersson, 2019). Digital government evolution emphasizes a shift from stand-alone digitization to contextualization and cross-domain interoperability, which positions data and service integration as a primary prerequisite for public value (Janowski, 2015).

In this study we therefore consider how e-government capabilities, management accounting systems (MAS) design, decentralization, and IT integration across units jointly shape outcomes in a setting where regencies and cities differ in service portfolios, administrative capacity, and digital readiness.

From an information systems and management control perspective, MAS design, defined by scope, timeliness, aggregation, and integration, shapes managerial attention, coordination, and adaptability in dynamic environments (Bedford et al., 2016; Chenhall & Moers, 2015). At the same time, IT integration across units through shared architecture, common data standards, and compatible processes enhances end-to-end information flow and cross-organizational coordination, which strengthens the inputs that MAS can leverage (Benitez et al., 2018; Cao et al., 2022). In government, however, such integration is largely mandated by national policy rather than pursued voluntarily, so implementation depends on compliance capacity, local resources, and interdepartmental routines that connect planning, finance, and service delivery (Republic of Indonesia, 2018; Ministry of Home Affairs, 2019).

Authority structure also determines whether available information is used by decision-makers, since moderate decentralization can support change and performance information use when units possess adequate systems and capabilities (Altamimi et al., 2023; Kroll, 2015). The characteristics of performance information influence how officials prioritize issues and allocate resources, which channels attention toward service improvement in public organizations (van der Voet & Lerusse, 2024; Kroll, 2015). These strands suggest that performance improvement is not only about systems and data but also about aligning the locus of authority and presenting high-quality information that prompts managerial action.

The public sector literature conceptualizes performance information use as a behavioral conduit that links information systems to outcomes, with evidence that data and system quality, leadership, results culture, and incentives foster use and are associated with better achievements (Kroll, 2015; Cantarelli

et al., 2023). Accordingly, in North Sumatera local governments, the influence of MAS design and IT integration on public performance is expected to operate directly through improved decision quality and indirectly through performance information use as the mechanism that channels system effects to service outcomes.

Despite this consolidated framework, important research gaps remain in Indonesia and in North Sumatera. First, the simultaneous relationships among IT integration, MAS design, decentralization, e-government capabilities, performance information use, and public performance are rarely tested within a single coherent model that specifies mediations and potential group differences (Janowski, 2015; Gil-Garcia et al., 2018). Second, local evidence on how cross-agency integration and authority patterns affect information use and performance is limited, even though national policies encourage cross-regional standardization (Republic of Indonesia, 2018; Ministry of Home Affairs, 2019). Third, although national indicators have improved, regional heterogeneity in digital readiness remains substantial, which motivates using North Sumatera as an empirical case to enrich a literature often based on developed-country contexts (United Nations, 2022; United Nations, 2024).

Based on these gaps, this study constructs and tests a model that explains how IT integration affects MAS design and e-government capabilities, how MAS design drives performance information use and public performance, how decentralization shapes MAS design and performance information use, and whether e-government capabilities strengthen the pathway from MAS design to public performance. We position technology as an enabler whose impact is realized mainly through information design and use, and we examine whether pathways differ between regencies and cities using multi-group analysis (MGA), thereby contributing cross-disciplinary evidence that connects information systems, management accounting, and public administration in the Indonesian regional context (Mergel et al., 2019; Twizeyimana & Andersson, 2019).

2. Literature Review

2.1 IT Integration Across Units

IT integration across units refers to the degree of architectural standardization, application compatibility, and data or activity interoperability that enables coordination and cross-process synergy across divisions. In complex organizational change such as mergers and acquisitions, IT infrastructure flexibility facilitates integration, strengthens coordination capability, and creates value in post-merger outcomes (Benitez, Ray, & Henseler, 2018). At the integration design and governance level, success in unifying processes and information is shaped by integration strategy choices and system compatibility, namely how “related” platforms, data, and processes are across units (Hedman & Sarker, 2015). More recent evidence underscores the role of standardization and enterprise system deployment breadth in building cross-unit coordination capabilities and increasing value for both acquirer and target (Cao, Ray, Subramani, & Gupta, 2022). On the market behavior side, cross-unit IT utilization also affects competition and coordination dynamics between entities in a multi-unit group, indicating that shared IT architecture is a material organizational lever (Du & Tanriverdi, 2023). In the public sector context, integration across units is largely mandated by national policy rather than voluntary, so realized benefits depend on compliance capacity, common data definitions, and interdepartmental routines that connect planning, finance, and service delivery in places such as North Sumatera.

2.2 Management Accounting System (MAS) Design

Modern MAS design is commonly operationalized with four information characteristics, namely broad scope, timeliness, aggregation, and cross-functional integration, which together frame managerial attention and coordination in dynamic settings. Broader, faster, aggregated, and integrated information is associated with improved decision quality (Chenhall & Moers, 2015). Measurement

studies have validated a second-order specification that models MAS with these four dimensions and links them to managerial performance (Pedroso & Gomes, 2020). Follow-up work shows stability of the 14-item instrument and relationships with top management support, user satisfaction, and decentralization (Pedroso & Gomes, 2024). Complementary control configurations aligned with strategy also strengthen the effectiveness of managerial information, highlighting the importance of context-appropriate control package design (Bedford & Malmi, 2015).

2.3 Decision-Making Decentralization

The centralization–decentralization balance shapes the demand, flow, and use of information in public organizations. Empirical evidence indicates non-linear associations in which moderate levels are most conducive to implementing change, including service contractualization, technology adoption, and performance information use (Altamimi et al., 2023). Theoretically, the performance impact of public management depends on fit between structure, strategy, and capabilities, so consequences of decentralization hinge on alignment with task environment and strategy (O’Toole & Meier, 2015). At the adaptation-process level, authority distribution affects how organizations respond to performance feedback and make continuation or termination decisions, with implications for information use behavior (Joseph et al., 2016).

2.4 E-Government Capabilities and Public Value

E-government capabilities, including cross-process and cross-organization service integration, data connectivity, and digital operation maturity, are positioned as antecedents of public value creation. Literature maps six public value domains: service improvement, administrative efficiency, transparency, ethics or professionalism, trust, and social value (Twizeyimana & Andersson, 2019). Digital government evolution emphasizes a shift from siloed digitization to contextualization and process or service interoperability (Janowski, 2015), and articulates practice-based digital transformation frameworks (Mergel, Edelmann, & Haug, 2019). At the macro level, United Nations surveys provide composite indicators that cover online services, telecommunications infrastructure, and human capital, which are relevant anchors of national digital capability (UN DESA, 2022). In local governments, however, the translation of these capabilities into outcomes depends on how information is designed and actually used in managerial routines.

2.5 Performance Information Use (PIU)

PIU functions as a behavioral mechanism that links systems to outcomes by directing attention, shaping prioritization, and aligning resources in managerial processes. Systematic reviews identify PIU drivers such as data quality, leadership, results culture, and incentives (Kroll, 2015). Recent syntheses show that performance information shapes stakeholder attitudes and behavior and helps public managers set issue priorities (Cantarelli et al., 2023; Van der Voet et al., 2024). Evidence from focused studies also links managers’ intensity of information use to objective performance indicators while stopping short of strong causal claims in cross-sectional settings (Han, 2022). Accordingly, MAS design is expected to relate to public performance indirectly through PIU, and any direct associations are interpreted cautiously given the cross-sectional nature of the data.

2.6 Public Sector Performance

Public sector performance concerns the extent to which government organizations create public value through service quality, operational efficiency, transparency, and accountability, typically assessed with multidimensional measures that combine outcomes, stakeholder satisfaction, and progress toward strategic goals (Twizeyimana & Andersson, 2019). In digital transformation contexts, performance is associated with technological capabilities, information system quality, and the ways decision makers use information in practice (Kroll, 2015; Cantarelli et al., 2023). Within the public

value perspective, results emerge from the interaction between digital infrastructure, management system design, and behavioral mechanisms of information use that connect systems to decisions (Janowski, 2015; Mergel et al., 2019).

2.7 Hypothesis Development

Cross-unit IT integration provides shared architecture, data governance, and standard processes that reduce cross-functional and cross-unit information exchange friction. Infrastructure flexibility and platform standardization smooth end-to-end process data consolidation, enabling organizations to produce information that is more integrated, timely, and at an aggregation level appropriate to decision needs (Benitez et al., 2018). When enterprise systems are standardized and usage coverage is broad, enterprise-level coordination capability increases and correlates with higher value achievement (Cao et al., 2022). Shared IT architecture transforms how information is produced and processed throughout the organization (Du & Tanriverdi, 2023). In local government settings, integration across units is largely mandated by national policy, so realized benefits depend on compliance capacity, shared data definitions, and interdepartmental routines.

H1: Cross-unit IT integration is positively associated with MAS design.

E-government maturity requires shared architecture, interoperability, and cross-unit data quality. Digital government evolution demands a shift from per-silo digitization toward cross-domain process integration and service contextualization, architecturally requiring data platform and process standardization (Janowski, 2015; Cao et al., 2022). Effective digital transformation depends on systems' ability to communicate with each other (Mergel et al., 2019). Therefore:

H2: IT integration is positively associated with local government e-government capabilities.

Besides indirect effects, IT integration can directly affect performance through operational efficiency, redundancy reduction, information flow acceleration, and data accuracy improvement (Benitez et al., 2018; Cao et al., 2022; Du & Tanriverdi, 2023).

H3: IT integration is positively associated with local government performance.

The degree of centralization-decentralization affects the demand, flow, and use of information within public organizations. Empirical findings show non-linear relationships where moderate levels tend to be most conducive to implementing change such as service contractualization, technology adoption, and performance information use (Altamimi, Liu, & Jimenez, 2023). Theoretically, public management's impact on performance highly depends on context and fit between structure, strategy, and capabilities; therefore, decentralization consequences depend on alignment with task environment and strategy (O'Toole & Meier, 2015). At the adaptation process level, authority distribution impacts how organizations respond to performance feedback and make continuation/termination decisions, thus affecting information use behavior (Joseph, Klingebiel, & Wilson, 2016).

H4: Decentralization is positively associated with MAS design.

Modern MAS design is understood through four core information characteristics: broad scope (non-financial, external, prospective), timeliness, level of aggregation, and cross-functional integration. Literature explains that management control evolution responds to innovation needs and uncertainty, so broader, faster, aggregated, and integrated information design is associated with better decision quality (Chenhall & Moers, 2015). Measurement-wise, multidimensional approaches modeling MAS as a second-order construct with these four dimensions have been validated and linked to managerial

performance (Pedroso & Gomes, 2020). Follow-up studies show the stability of this 14-item instrument and its relationship with organizational variables such as top management support, user satisfaction, and decentralization (Pedroso & Gomes, 2024). Beyond that, control configuration aligned with strategy also strengthens managerial information effectiveness, confirming the importance of context-appropriate control package design (Bedford & Malmi, 2015).

H5: MAS design is positively associated with local government performance.

PIU drivers include system and information quality; when systems provide high-quality information, managers are more capable and motivated to use it in data-based issue prioritization (Kroll, 2015; van der Voet et al., 2024; Pedroso & Gomes, 2024).

H6: MAS design is positively associated with PIU.

Mature e-government capabilities facilitate faster, cheaper, accountable services and increase transparency, professionalism, trust, and social value (Twizeyimana & Andersson, 2019; Mergel et al., 2019; Janowski, 2015).

H7: E-government capabilities are positively associated with local government performance.

Quality performance information availability requires behavioral mechanisms linking information with decisions and actions. High PIU is associated with sharper decisions and better achievements (Cantarelli, Belle, Longo, & Tommasi, 2023; van der Voet et al., 2024; Han, 2022; Kroll, 2015).

H8: PIU is positively associated with local government performance.

IT integration creates architectural foundation for mature e-government capabilities, which in turn increase local government performance. Interoperability and contextualization enabled by IT integration are key to evolution toward mature digital government (Janowski, 2015; Twizeyimana & Andersson, 2019).

H9: E-government capabilities mediate the association between IT integration and local government performance.

IT integration improves MAS design quality, MAS design increases PIU, and PIU increases performance. This serial mediation path captures the reality that technology does not directly change performance, but works through improving information system quality and actual information use intensity in decision processes (Benitez et al., 2018; Cao et al., 2022; Chenhall & Moers, 2015; Kroll, 2015; Cantarelli et al., 2023).

H10: MAS design and PIU sequentially mediate the association between IT integration and local government performance.

Decentralization increases demand for sophisticated information systems, which increases PIU and in turn increases performance. Authority distribution affects organizational sensitivity to performance feedback and PIU impact on issue prioritization (Altamimi et al., 2023; O'Toole & Meier, 2015; Joseph et al., 2016; Kroll, 2015; van der Voet et al., 2024).

H11: MAS design and PIU sequentially mediate the association between decentralization and local government performance.

3. Research Methods

This study uses a cross-sectional survey design on local governments in North Sumatera Province to test a structural model linking cross-unit IT integration, MAS design as a second-order construct, PIU, e-government capabilities, and Public Performance (PP). This approach was chosen because key variables are latent in nature and measured with perceptual indicators, and the model includes mediation mechanisms commonly analyzed through structural equation modeling. Estimation uses prediction-oriented PLS-SEM suitable for complex models, potentially non-normal data distributions, and second-order constructs (Shmueli et al., 2019; Henseler et al., 2015). Inferences are framed as associations given the cross-sectional design.

The target population is all local governments in North Sumatera Province with sampling frame from official lists of the Ministry of Home Affairs and North Sumatera Provincial Government. Unit selection uses stratified random sampling based on government type and regional typology. Respondents are officials directly involved in planning, budgeting, accounting, performance management, and ICT. Minimum sample size was calculated following the inverse square root method for Monte Carlo simulation-based PLS-SEM (Kock & Hadaya, 2018). With expectation of smallest path coefficient ≈ 0.20 and power 0.80, calculations show requirement of approximately 160 unique respondents; because of nested design, target was expanded to ≥ 250 respondents from multiple regional government agencies across Regencies/Cities. The sampling frame comprised 33 local governments in North Sumatera Province (25 regencies and 8 cities). We sent 535 eligible invitations and received 198 usable questionnaires (AAPOR RR1 = 37%). Sample composition by government type mirrored the population (regencies 75.8%, cities 24.2%). Nonresponse bias was assessed via early-late paired t-tests; summary results appear in the Results section. We report the sampling frame, invitations, completes, and the response rate, compare sample proportions to population proportions for regencies and cities to assess representativeness, and specify inclusion criteria (role, tenure, departmental coverage) and any exclusions to clarify the analytic sample.

Research instruments were developed through adaptation of verified scales. IT integration was operationalized as perception of platform standardization, data-process interoperability, and cross-unit system deployment coverage (Benitez et al., 2018; Cao et al., 2022). MAS design was measured as a reflective second-order construct with four dimensions (broad scope, timeliness, aggregation, integration) that are nomologically valid (Pedroso & Gomes, 2020, 2024). Decentralization was measured from perception of decision authority distribution and unit autonomy (Altamimi et al., 2023). E-government capabilities were operationalized through indicators of digital service maturity, cross-functional process integration, and data-system interoperability (Janowski, 2015; Twizeyimana & Andersson, 2019). Performance Information Use (PIU) and Public Performance (PP) were measured as reflective constructs (Kroll, 2015; Cantarelli et al., 2023; van der Voet & Lerusse, 2024). All survey items, sources, and scale anchors are provided in Appendix A, including translation and back-translation notes and wording used in the pilot.

Questionnaires used 1–7 Likert scales with language adaptation process following translation–back translation procedures and comprehensibility testing through cognitive interviewing with 20 local government officials. Distribution was conducted online through official letters to the Regional Secretariat, Regional Development Planning Agency, Regional Financial and Asset Management Agency, and Communication and Information Technology Office, followed by two-wave follow-up. Attention checks and instructed-response items were included; cases failing multiple checks were removed prior to analysis. Missing data were handled via pairwise deletion for descriptives and casewise estimation in PLS-SEM; sensitivity checks with mean imputation for sporadic missingness yielded similar results.

Reflective measurement models were evaluated for internal consistency reliability and convergent–discriminant validity. The rho_A coefficient was used as a reliability measure consistent and compatible with PLS consistency correction (Dijkstra & Henseler, 2015). Discriminant validity was tested using HTMT with 0.85–0.90 threshold and bootstrapped inference (Henseler et al., 2015). For second-order constructs, estimation used the two-stage approach (Sarstedt et al., 2019). Multi-group analysis used the three-step MICOM procedure (Henseler et al., 2016). Alternative measurement specifications (four-factor, one-factor, and bifactor representations) were compared via CFA and chi-square difference tests prior to structural modeling. Measurement invariance across regency and city groups was established using MICOM before MGA.

Structural models were estimated with path weighting scheme and 5,000 replication bootstrapping for confidence intervals and coefficient significance testing. Mediation significance was examined through indirect effects and bias-corrected confidence intervals. Predictive model fit was assessed with PLSpredict providing holdout-based predictions, with prediction error metrics compared to linear model benchmarks (Shmueli et al., 2019). Bootstrap settings were verified at 5,000 replications, and standard errors were inspected for plausibility. PLSpredict results are summarized alongside linear benchmarks to indicate practical predictive utility.

Common method bias (CMB) was addressed procedurally and statistically. Procedurally, questionnaires separated cause–effect variable measurement order, emphasized anonymity, and used several item formats. Statistically, CMB was evaluated through Harman's single factor test, full collinearity test (VIF), and marker variable technique (Podsakoff et al., 2024; Kock et al., 2021). Result interpretation considers the institutional context of North Sumatera Province within the national regulatory framework, with coefficient reading attending to recent behavioral findings in the public sector.

4. Results

4.1 Respondent Profile

Table 1 summarizes the demographic and organizational profile of the 198 respondents from 33 local governments (25 regencies and 8 cities) in North Sumatera Province. The respondent composition reflects representation across key organizational units involved in planning, budgeting, financial management, information technology, and performance monitoring. The survey achieved a 37% response rate (198 of 535 eligible invitations), covering officials from planning, finance, ICT/service, inspectorate, and organization/personnel units.

Table 1. Respondent Profile (N = 198)

Characteristic	Number	Frequency (%)
Regional Government Origin		
Regencies (25 regions)	150	75.8
Cities (8 regions)	48	24.2
Gender		
Male	124	62.6
Female	74	37.4
Age Group		
< 30 years	22	11.1
30-40 years	86	43.4
41-50 years	64	32.3
> 50 years	26	13.1
Respondent Work Unit		
Regional Development Planning Agency	52	26.3
Regional Financial and Asset Management Agency	46	23.2

Communication and Information Technology Office	42	21.2
Inspectorate	30	15.2
Organization/Personnel Division	28	14.1
Education Level		
Bachelor's (S1)	118	59.6
Master's (S2)	74	37.4
Other (D4/S3)	6	3.0
Length of Work in Local Government		
< 5 years	32	16.2
5-10 years	108	54.5
>10 years	58	29.3

Based on Table 1, respondent characteristics show a sample structure representative of local government context in North Sumatera Province. Of 198 respondents from 33 regencies/cities, the largest composition comes from regencies at 75.8% (150 respondents from 25 regencies), while 24.2% come from cities (48 respondents from 8 cities). This proportion aligns with North Sumatera Province's administrative distribution, which is structurally dominated by regency areas. Generalization is therefore limited to similar local-government contexts and should be interpreted in light of the observed composition. Demographically, respondents are majority male (62.6%) with dominant age range between 30–50 years (75.7%). This pattern depicts most respondents are at productive age with mature bureaucratic experience level, enabling accurate and reflective assessment of information system implementation and public organizational performance. Respondent education levels also show high competency profiles, where 59.6% hold bachelor's degrees and 37.4% hold master's degrees, indicating adequate cognitive capacity to understand technical concepts like cross-unit IT integration, management accounting systems (MAS) design, and performance information use behavior. From organizational structure side, work unit distribution shows cross-functional representation in local government strategic functions: Regional Development Planning Agency (26.3%) as development planner, Regional Financial and Asset Management Agency (23.2%) as regional financial manager, Communication and Information Technology Office (21.2%) as information technology manager, Inspectorate (15.2%) as internal auditor and performance supervisor, and Organization/Personnel Division (14.1%) as structure and human resource manager. With work experience majority in the 5–10 year range (54.5%) and more than 10 years (29.3%), respondents have significant institutional experience depth to assess system effectiveness and managerial practices in local government environments.

4.2 Non-Response Bias

Early–late comparisons showed no statistically significant differences between early and late respondents across all indicators (paired t , $n = 51$ pairs, $|t| \leq 1.56$, all two-tailed $p \geq .12$), suggesting negligible nonresponse bias (Meterko et al., 2015; Struminskaya et al., 2022). Given these diagnostics, we proceed to descriptive statistics and measurement model evaluation (Hair et al., 2024).

4.3 Descriptive Statistics

Following the non-response bias assessment, descriptive statistics were computed for all latent constructs to evaluate data distribution characteristics. As shown in Table 2, all constructs demonstrate adequate variation and acceptable distributional properties for variance-based SEM analysis

Table 2. Research Descriptive Statistics

Construct	Mean	Std Dev	Skewness	Kurtosis
IT Integration	4.008	1.246	0.091	-0.212
Decentralization	3.994	1.221	0.182	-0.182
MAS Design	4.000	1.194	0.101	-0.342
E-Gov	3.998	1.237	0.004	-0.210

PIU	3.987	1.233	-0.013	-0.241
PP	3.997	1.238	-0.124	-0.288

Based on Table 2, all constructs have mean values between 3.987 and 4.008 with standard deviations 1.194–1.246, showing substantial inter-local-government variation sufficient to detect structural relationships. Skewness values (−0.124 to 0.182) and kurtosis (−0.342 to −0.182) are within a conservative tolerance band ($|\text{skew}| < 0.5$; $|\text{kurtosis}| < 1.0$), indicating stable distributions without extreme outliers. These distributional properties support the use of variance-based SEM with bootstrap inference for the present data.

4.4 Common Method Bias

Given that data were collected from a single source using self-reported measures, the potential for common method bias (CMB) was assessed using three complementary approaches. Table 3 summarizes the results of Harman's Single Factor Test, Full Collinearity Test, and Marker Variable technique.

Table 3. Common Method Bias Test Results

CMB Test Type	Method/Indicator	Main Result	Reference Criteria
Harman's Single Factor Test	First component explains 29.039% of total variance.	One factor explains less than 50% of total variance.	If one factor explains < 50%, common method bias is not considered a serious problem (Podsakoff et al., 2003).
Full Collinearity Test (VIF - Kock, 2015)	Highest VIF value: 1.379; lowest value: 1.000 across all latent constructs.	All VIF values ≤ 3.3 .	If all VIF values ≤ 3.3 , model is declared free from multicollinearity and common method bias (Kock, 2015).
Marker Variable (Measured Latent Marker Variable - MLMV)	MV1 $\rightarrow$ IT Integration ($t=0.674$; $p=0.500$) MV2 $\rightarrow$ Decentralization ($t=0.450$; $p=0.653$) MV3 $\rightarrow$ MAS Design ($t=0.810$; $p=0.418$) MV4 $\rightarrow$ E-Government ($t=1.093$; $p=0.274$) MV5 $\rightarrow$ Performance Information Use ($t=0.260$; $p=0.795$) MV6 $\rightarrow$ Public Performance ($t=0.865$; $p=0.387$).	All paths not significant ($p > 0.05$).	If all paths from marker variable to substantive constructs are not significant, common method bias does not exist (Podsakoff et al., 2003; Kock & Lynn, 2012).

Based on Table 3, evaluation of potential common method bias was conducted using three complementary approaches (Podsakoff et al., 2003; Kock, 2015; Kock & Lynn, 2012). Harman's single-factor test shows the first component only explains 29.039% of total variance, far below the 50% threshold, indicating no single common factor dominates the data. Full collinearity VIFs are far below the 3.3 limit, indicating no extreme multicollinearity that could indicate common method bias. The measured latent marker variable analysis shows all paths between the marker and the main constructs are not significant ($t = 0.260$ – 1.093 ; $p = 0.274$ – 0.795), confirming that inter-variable correlations are substantive, not artifacts of common method. Taken together, these diagnostics suggest that common-method variance is unlikely to bias the substantive relations reported here. With sample characteristics, nonresponse diagnostics, and CMB checks reported, we now turn to the measurement and structural model results.

4.5 Measurement Model (First and Second Order)

Following the confirmation that the data are free from common method bias, the next stage evaluates the quality of the measurement model. Figure 1 presents the first-order measurement model, showing the relationships between observed indicators and their respective latent constructs. Estimation follows the two-stage approach for higher-order constructs (Sarstedt et al., 2019), and all inferences rely on 5,000-replication bootstrap confidence intervals with two-tailed tests. Indicator-level collinearity was screened and found acceptable (all indicator VIF < 3.3).

validity. Cross-loadings were also inspected, and each indicator loaded higher on its intended dimension than on other dimensions.

Table 5. HTMT Test Results (First-Order Measurement Model)

Dimension	Aggregation	Broad Scope	Integration	Timeliness
Aggregation				
Broad Scope	0.429			
Integration	0.498	0.447		
Timeliness	0.351	0.47	0.333	

Results in Table 5 show all MAS Design dimensions meet discriminant validity criteria: the highest HTMT value is 0.498 (Integration–Aggregation), well below 0.85 (Henseler et al., 2015). Cross-loadings were also inspected, and each indicator loaded higher on its intended dimension than on other dimensions. At the second stage, the reflective second-order construct for MAS Design was estimated from its four first-order dimensions. All second-order outer weights and loadings were significant under bootstrap and free from critical collinearity ($VIF < 3.3$), supporting the composition of MAS Design from Aggregation, Broad Scope, Integration, and Timeliness. Following the validation of the first- and second-order measurement models, the analysis advances to the structural relations among constructs. Figure 2 depicts the structural model with standardized path coefficients.

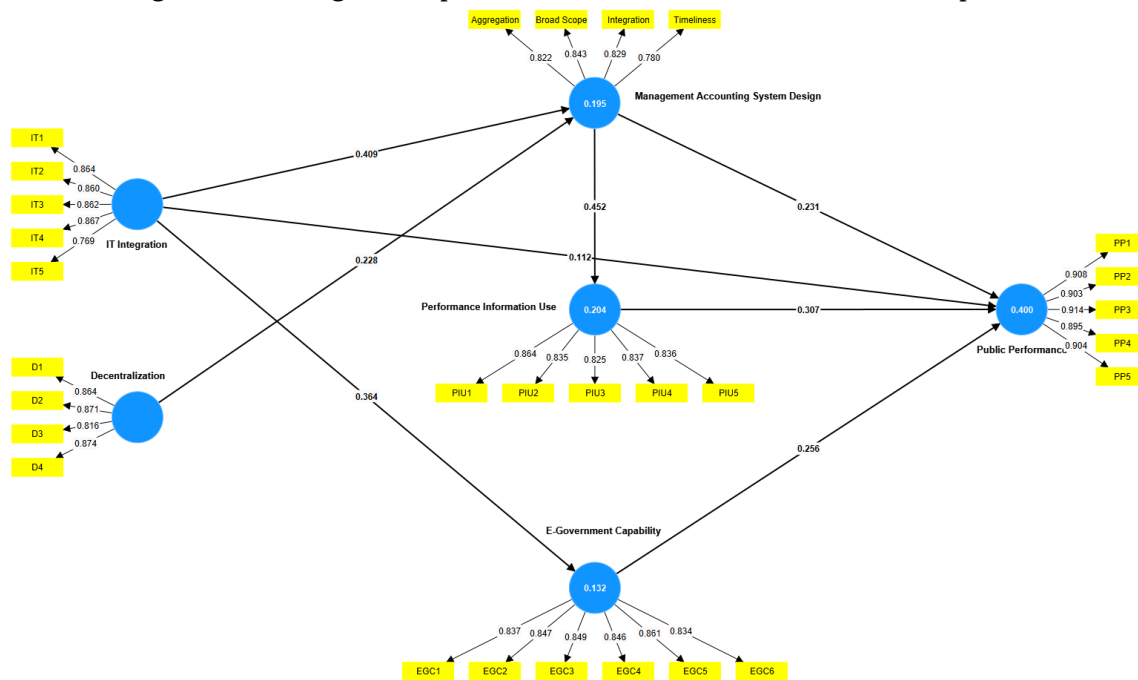


Fig.2: Structural Model with Standardized Path Coefficients

The structural model in Figure 2 highlights the role of MAS Design as a second-order construct with strong links to its four dimensions (second-stage outer weights ≈ 0.78 – 0.84 ; all $p < 0.05$). The associational path structure indicates that IT Integration ($\beta = 0.409$) and Decentralization ($\beta = 0.228$) are positively related to MAS Design; MAS Design relates positively to Performance Information Use ($\beta = 0.452$); and both Performance Information Use ($\beta = 0.307$) and E-government Capability ($\beta = 0.256$) are associated with Public Performance. Complete reliability and validity statistics for all six constructs—including MAS Design as a higher-order construct—are summarized in Table 6, and bootstrap confidence intervals for all paths are reported in the Hypothesis Testing section. Following the visual presentation of the structural model, formal assessment of measurement quality is required before hypothesis testing. Table 6 reports the validity and reliability statistics for all six constructs, including MAS Design as a second-order construct and the five other first-order constructs (IT

Integration, Decentralization, E-Government Capabilities, Performance Information Use, and Public Performance).

Table 6. Construct Validity and Reliability Test Results (Second-Order)

Construct	Indicator Range	Outer Loading	CA	CR	AVE
MAS Design	Aggregation-Timeliness	0.780 - 0.843	0.836	0.891	0.671
Decentralization	D1-D4	0.816 - 0.874	0.881	0.917	0.733
E-Gov	EGC1-EGC6	0.834 - 0.861	0.920	0.938	0.715
IT Integration	IT1-IT5	0.769 - 0.867	0.900	0.926	0.714
PP	PP1-PP5	0.895 - 0.914	0.945	0.958	0.819
PIU	PIU1-PIU5	0.825 - 0.864	0.896	0.923	0.705

As shown in Table 6, all constructs in the second-order model demonstrate very solid measurement quality and meet all reliability and convergent validity criteria. Outer loading values range between 0.769-0.914, confirming strength of indicator contribution to latent constructs. Cronbach's Alpha is in the range 0.836-0.945, and Composite Reliability (CR) between 0.891-0.958, both far above the 0.70 minimum threshold, indicating very high internal consistency (Hair et al., 2024). Additionally, Average Variance Extracted (AVE) shows values between 0.671-0.819, all exceeding the 0.50 threshold, meaning each construct can explain more than half its indicator variance. These findings strengthen convergent validity of all constructs, both MAS Design as second-order construct and other reflective constructs (Decentralization, IT Integration, E-Government Capabilities, Performance Information Use, and Public Performance). Overall, these results confirm the model has very good measurement stability and construct integrity for further structural analysis.

4.6 Discriminant Validity

The final step in measurement model validation is discriminant validity assessment, which examines whether constructs are sufficiently distinct from one another. Table 7 presents the results of two established discriminant validity tests. First, the Heterotrait–Monotrait (HTMT) ratio is evaluated using the conservative threshold of 0.85 (Henseler et al., 2015), with all HTMT values below this cutoff indicating adequate discriminant validity. In addition, bias-corrected bootstrap confidence intervals for HTMT did not include 1.00, reinforcing discriminant validity. Second, the Fornell–Larcker criterion is assessed, requiring that each construct's square root of AVE (diagonal values in bold) exceeds its correlations with all other constructs (off-diagonal values).

Table 7. Discriminant Validity Test Results

Panel A: HTMT Ratios

Construct	MAS	D	EGC	IT	PP	PIU
MAS						
D	0.197					
EGC	0.251	0.069				
IT	0.430	0.149	0.394			
PP	0.527	0.090	0.419	0.409		
PIU	0.517	0.048	0.152	0.333	0.519	

Panel B: Fornell-Larcker Criterion

Construct	MAS	D	EGC	IT	PP	PIU
MAS	0.819					
D	0.176	0.856				
EGC	0.222	-0.054	0.846			
IT	0.380	-0.127	0.364	0.845		
PP	0.469	0.074	0.392	0.386	0.905	
PIU	0.452	-0.012	0.141	0.304	0.481	0.840

Note: Bold diagonal values in Panel B represent the square root of Average Variance Extracted (AVE). HTMT values below 0.85 and diagonal values exceeding off-diagonal correlations indicate adequate discriminant validity.

As shown in Table 7, discriminant validity test results using two approaches (HTMT and Fornell–Larcker) are consistent. The highest HTMT value of 0.527 (between MAS Design and Public Performance) is below the conservative 0.85 threshold (Henseler et al., 2015). Bias-corrected HTMT confidence intervals not crossing 1.00 provide additional support. Similarly, the Fornell–Larcker criterion is met, with the square root of AVE on the diagonal (0.819–0.905) exceeding inter-construct correlations off the diagonal. These findings indicate that each construct—IT Integration, Decentralization, MAS Design, E-government Capability, Performance Information Use, and Public Performance—captures a distinct theoretical domain without evidence of construct redundancy.

An important assumption in structural equation modeling is the absence of excessive multicollinearity, which can inflate standard errors and destabilize estimates. To verify this assumption, Variance Inflation Factor (VIF) values were computed for all indicators in the measurement model. Table 8 presents the VIF ranges for each construct, with the conservative threshold of 5.0 used to flag potential concerns (Hair et al., 2024). VIF values below 3.0 are considered ideal, while values between 3.0 and 5.0 are acceptable.

Table 8. Multicollinearity Test Results

Construct	Indicator Range	VIF
MAS Design	Aggregation-Integration	1.619 - 1.940
Decentralization	D1-D4	2.093 - 2.590
E-Government Capability	EG1-EG6	2.362 - 2.702
Information Technology Integration	IT1-IT5	1.865 - 2.545
Public Performance	PP1-PP5	3.326 - 3.962
Performance Information Use	PIU1-PIU5	2.168 - 2.476

Based on Table 8, indicator-level VIF values are in the range 1.619–3.962, with most values below 3.0. Although the Public Performance indicators are relatively higher (3.326–3.962), they remain below the conservative 5.0 limit (Hair et al., 2024). For completeness, inner (structural) VIFs among predictors of each endogenous construct were also examined and remained below 3.3, indicating no critical collinearity in the path model. Overall, the model appears free from problematic multicollinearity that could distort structural estimation, supporting the interpretability of path coefficients and indirect effects in subsequent analyses.

4.7 Hypothesis Testing

Following the validation of measurement model quality in Tables 6–8, the analysis proceeds to test the hypothesized structural relationships. Table 9 presents the results for all eleven hypotheses: eight direct associations (H1–H8) among constructs and three indirect (mediation) pathways (H9–H11). The structural model was estimated using bootstrapping with 5,000 replications and two-tailed, bias-corrected confidence intervals to obtain robust standard errors and interval estimates. Path coefficients, t-statistics, and 95% confidence intervals are reported for each hypothesis.

Table 9. Hypothesis Testing Results

Code	Hypothesized Path	β (Path Coeff.)	Biasboot	SE (σ)	t(β/σ)	95% [LL; UL]	Remarks
H1	IT Integration → MAS Design	0.409	+0.002	0.059	6.984	[0.282; 0.512]	Yes
H2	IT Integration → e-Gov Capability	0.364	+0.004	0.061	6.008	[0.234; 0.472]	Yes
H3	IT Integration → PP	0.112	-0.002	0.055	2.025	[0.007; 0.224]	Yes
H4	Decentralization → MAS Design	0.228	+0.009	0.056	4.043	[0.095; 0.318]	Yes
H5	MAS Design → PP	0.231	+0.001	0.063	3.653	[0.100; 0.354]	Yes
H6	MAS Design → PIU	0.452	+0.002	0.056	8.113	[0.332; 0.551]	Yes
H7	e-Gov Capability → PP	0.256	+0.001	0.056	4.557	[0.142; 0.360]	Yes

H8	PIU → PP	0.307	0.000	0.056	5.469	[0.193; 0.417]	Yes
H9	IT Integration → e-Gov Capability → PP	0.093	+0.002	0.027	3.443	[0.047; 0.153]	Yes
H10	IT Integration → MAS → PIU → PP	0.057	+0.001	0.016	3.490	[0.030; 0.095]	Yes
H11	Decentralization → MAS → PIU → PP	0.032	+0.001	0.011	2.838	[0.014; 0.055]	Yes

Table 9 indicates that all eleven hypotheses are supported at the 95 percent level: all t-values exceed 1.96 and all 95 percent confidence intervals exclude zero. Cross-unit IT Integration is positively associated with MAS Design ($\beta = 0.409$, $t = 6.984$, $p < .001$), supporting H1 and aligning with the view that platform standardization and data interoperability across units relate to higher-quality managerial information systems. IT Integration is also positively associated with E-government Capability ($\beta = 0.364$, $t = 6.008$, $p < .001$), supporting H2 and indicating that shared IT architecture is aligned with more mature digital services. Beyond mediated pathways, IT Integration shows a small positive association with Public Performance ($\beta = 0.112$, $t = 2.025$, $p < .05$), supporting H3 and suggesting possible efficiency linkages that operate alongside indirect relations.

Decentralization is positively associated with MAS Design ($\beta = 0.228$, $t = 4.043$, $p < .001$), supporting H4 and indicating that distributing decision authority is aligned with greater demand for timely, aggregated, and integrated information. MAS Design is positively associated with both Public Performance ($\beta = 0.231$, $t = 3.653$, $p < .001$) and Performance Information Use ($\beta = 0.452$, $t = 8.113$, $p < .001$), supporting H5 and H6. The comparatively stronger association with Performance Information Use underscores the role of information quality in supporting data-informed managerial behavior. E-government Capability is positively associated with Public Performance ($\beta = 0.256$, $t = 4.557$, $p < .001$), supporting H7 and aligning with the public-value perspective on digital service maturity. Performance Information Use is likewise positively associated with Public Performance ($\beta = 0.307$, $t = 5.469$, $p < .001$), supporting H8 and highlighting the behavioral mechanism translating systems into outcomes.

For the indirect relations, E-government Capability partly carries the association between IT Integration and Public Performance ($\beta_{\text{indirect}} = 0.093$, $t = 3.443$, $p < .001$), supporting H9. The serial pathway from IT Integration through MAS Design and Performance Information Use to Public Performance is positive and statistically significant ($\beta_{\text{indirect}} = 0.057$, $t = 3.490$, $p < .001$), supporting H10 and consistent with a sequence in which enhanced information quality relates to greater information use and, in turn, to better reported outcomes. Similarly, the serial pathway from Decentralization through MAS Design and Performance Information Use to Public Performance is positive ($\beta_{\text{indirect}} = 0.032$, $t = 2.838$, $p < .01$), supporting H11 and suggesting that organizational structure relates to outcomes through information system sophistication and use patterns.

Bootstrap diagnostics support these results: bias values are negligible (-0.002 to $+0.009$), and confidence intervals exclude zero for all reported paths. Regarding relative importance, the largest f^2 values arise for MAS Design → Performance Information Use ($f^2 = 0.256$) and IT Integration → MAS Design ($f^2 = 0.204$), which fall in the medium-to-large range under Cohen's guidelines. E-government Capability → Public Performance ($f^2 = 0.094$) and Performance Information Use → Public Performance ($f^2 = 0.122$) are small but meaningful. Taken together, these patterns point to MAS Design and cross-unit IT Integration as comparatively stronger contributors to explained variance among the modeled associations. After confirming the individual hypotheses, we assessed the approximate fit of the structural model. Table 10 reports standard diagnostics available in variance-based SEM (SRMR, d_ULS, d_G, and NFI). In PLS-SEM these indices are descriptive rather than decisive; model adequacy is judged in combination with explanatory power (e.g., R^2) and out-of-sample predictive assessment (e.g., PLSpredict).

Table 10. Model Goodness of Fit Test Results

Statistical Indicator	Estimated Model	Assessment Criteria
SRMR	0.057	< 0.08 often interpreted as acceptable discrepancy
d_ ULS	1.429	Lower values indicate smaller residual discrepancy
d_ G (Geodesic)	0.459	Lower values indicate smaller residual discrepancy
Chi-Square	530.310	Reported for completeness; large-sample sensitive
NFI	0.912	≥ 0.90 often seen as acceptable

The SRMR of 0.057 indicates a modest residual discrepancy between model-implied and observed correlations. The d_ ULS (1.429) and d_ G (0.459) values are consistent with an adequately specified model, noting that absolute cutoffs are not universally established and these metrics are interpreted comparatively. The NFI of 0.912 exceeds a commonly used 0.90 benchmark and provides additional descriptive evidence of acceptable fit. As expected with complex models, the chi-square statistic (530.310) is significant and is not used as a sole criterion in PLS-SEM. Taken together with the results below on explanatory and predictive performance, these diagnostics suggest the specification is adequate for testing the theorized associations and mediation pathways. With overall discrepancy assessed, we next examine explanatory power for each endogenous construct. Table 11 presents the R^2 values and adjusted R^2 .

Table 11. Coefficient of Determination Test Results

Endogenous Construct	R^2	R^2 Adjusted	Category
E-Government Capability	0.132	0.128	Weak (Cohen, 1988)
Management Accounting System Design	0.195	0.187	Weak (Cohen, 1988)
Performance Information Use	0.204	0.200	Moderate (Hair et al., 2021)
Public Performance	0.400	0.388	Substantial (Hair et al., 2021)

The R^2 values show substantial variation across endogenous constructs. Public Performance exhibits the highest R^2 at 0.400 (adjusted $R^2 = 0.388$), indicating that the model accounts for roughly 40% of the variance in reported performance—substantial under common benchmarks. By contrast, E-government Capability ($R^2 = 0.132$) and MAS Design ($R^2 = 0.195$) are modest, and Performance Information Use ($R^2 = 0.204$) is in the weak-to-moderate range. This pattern is compatible with a mediation framework in which intermediate constructs are shaped by multiple unmodeled drivers (e.g., budget constraints, leadership, infrastructure quality); we therefore interpret the intermediate R^2 values cautiously and focus on the pathways to Public Performance. Importantly, explanatory power does not imply predictive capability. To assess how well the model predicts new observations, we conducted out-of-sample prediction using PLSpredict (Shmueli et al., 2019). We report Q^2_{predict} values and compare PLS errors with linear model benchmarks in the next subsection. Table 12 compares prediction errors from the PLS-SEM model against a linear model (LM) benchmark and reports both in-sample Q^2 (blindfolding) and out-of-sample Q^2_{predict} (PLSpredict).

Table 12. Model Predictive Power Test Results (PLS-Predict Assessment)

Construct	Indicator Range	PLS-SEM RMSE	LM RMSE	Q^2 Blindfolding	Q^2_{predict} PLSpredict	Predictive Strength
MAS-Design	Aggregation-Integration	1.121 - 1.142	1.146 - 1.180	0.127	0.174	Moderate
E-GovCap	EGC1-EGC6	1.142 - 1.207	1.177 - 1.241	0.090	0.121	Small
PP	PP1-PP5	1.131 - 1.194	1.129 - 1.218	0.320	0.151	Moderate
PIU	PIU1-PIU5	1.173 - 1.229	1.209 - 1.246	0.137	0.066	Small

The PLSpredict results indicate mixed-to-moderate predictive utility. Public Performance (PP) shows the strongest out-of-sample signal ($Q^2_{\text{predict}} = 0.151$; blindfolding $Q^2 = 0.320$), which we characterize as small-to-moderate practical relevance—not a percentage of variance explained. MAS Design also presents moderate indications ($Q^2_{\text{predict}} = 0.174$; $Q^2 = 0.127$). By contrast, E-government Capability ($Q^2_{\text{predict}} = 0.121$; $Q^2 = 0.090$) and Performance Information Use ($Q^2_{\text{predict}} = 0.066$; $Q^2 = 0.137$) exhibit small but positive predictive relevance. Importantly, all Q^2 values are positive, indicating performance above a naive mean baseline.

The RMSE comparison is mixed: for many indicators, PLS-SEM yields errors comparable to or slightly lower than LM (e.g., PP indicators: 1.131–1.194 vs. 1.129–1.218), while differences on others are minimal. Following Shmueli et al. (2019), this pattern supports adequate out-of-sample predictive validity for PP and MAS Design, with limited predictive strength for E-government Capability and PIU. Overall, the model is primarily explanatory and shows practical predictive utility for the key outcome (Public Performance), with modest prediction for intermediate constructs.

4.8 Group Comparisons (MICOM and MGA)

Before comparing groups, we established measurement invariance using the MICOM procedure. Configural invariance was satisfied by using identical model specifications across groups; compositional invariance tests did not indicate systematic violations; and equality of composite means/variances was not rejected at the construct level. These results support meaningful comparison of structural relations between Regencies and Cities. Given that the sample includes both Regencies and Cities, we tested whether structural relations differ across these contexts. Permutation-based MGA with 5,000 permutations and two-tailed p-values was used under exchangeability assumptions consistent with MICOM.

Table 13. Multi-Group Analysis

Structural Path	β (Regencies)	β (Cities)	Permutation p-value
IT Integration → MAS Design	0.424	0.262	0.265
IT Integration → e-Government Capability	0.412	0.178	0.133
IT Integration → Public Performance	0.125	0.127	0.949
Decentralization → MAS Design	0.279	-0.186	0.260
MAS Design → Public Performance	0.301	-0.032	0.048
MAS Design → Performance Information Use	0.453	0.480	0.796
e-Government Capability → Public Performance	0.206	0.444	0.038
Performance Information Use → Public Performance	0.266	0.414	0.280
IT Integration → e-Gov Capability → Public Performance	0.085	0.079	0.964
IT Integration → MAS → PIU → Public Performance	0.051	0.052	0.998
Decentralization → MAS → PIU → Public Performance	0.034	-0.037	0.360

The multi-group analysis indicates both similarities and context-specific differences. In Regencies, associations from IT Integration to both MAS Design ($\beta = 0.424$) and E-government Capability ($\beta = 0.412$) are larger than in Cities ($\beta = 0.262$ and $\beta = 0.178$), although these differences are not statistically significant ($p > .05$). A noteworthy sign reversal appears for Decentralization → MAS Design (positive in Regencies, $\beta = 0.279$; negative in Cities, $\beta = -0.186$), yet the difference is not significant ($p = 0.260$). This pattern suggests that authority distribution may have different operational implications: in Regencies it may stimulate information needs that align with MAS development, whereas in Cities additional decentralization may fragment coordination unless enterprise standards are strong. Two paths differ significantly across groups. First, MAS Design → Public Performance is stronger in Regencies ($\beta = 0.301$) than in Cities ($\beta = -0.032$; $p = 0.048$), indicating that internal management information systems are relatively more consequential for performance in Regency contexts. Second, E-government Capability → Public Performance is stronger in Cities ($\beta = 0.444$) than in Regencies ($\beta = 0.206$; $p = 0.038$), consistent with the idea that urban governments derive greater performance benefits from mature citizen-facing digital services. By contrast, MAS Design → Performance Information Use is strong and statistically similar across groups (Regencies $\beta = 0.453$; Cities $\beta = 0.480$; $p = 0.796$), indicating that high-quality managerial information supports data use regardless of context. Indirect (mediation) paths do not differ significantly (all $p > .05$).

Regencies should prioritize strengthening internal MAS and decision-support capabilities, while Cities should emphasize E-government Capability and service integration for citizen interaction.

These differentiated emphases align with the observed patterns and argue against a one-size-fits-all digital transformation strategy.

5. Discussion

The findings provide evidence consistent with the proposed digital transformation framework in North Sumatera's local governments. All eleven hypotheses are supported at conventional levels, indicating that IT Integration, Management Accounting System (MAS) Design, E-government Capability, and Performance Information Use (PIU) are jointly associated with higher public sector performance. Rather than operating in isolation, these elements appear as an interconnected system in which technology relates to information design, information design relates to use, and use relates to outcomes.

IT Integration plays an enabling role, and its influence operates mainly through indirect rather than direct associations. The positive association with MAS Design ($\beta = 0.409$) suggests that when local governments standardize platforms and enable data sharing across units, conditions consistent with more sophisticated management information systems are more likely. This pattern aligns with Benitez et al. (2018), who show that IT infrastructure flexibility facilitates organizational integration and coordination. In the North Sumatera context, this implies that officials can connect planning decisions with budget allocations and service outcomes through integrated dashboards rather than relying on fragmented, siloed data. IT Integration is also positively associated with E-government Capability ($\beta = 0.364$), consistent with Janowski (2015) that digital service maturity depends on back-end interoperability as well as front-end applications. The relatively modest direct association with performance ($\beta = 0.112$) reinforces a practical lesson: technology alone rarely suffices; benefits tend to materialize alongside improvements in information system design and managerial behavior.

Management information systems play a particularly important role in this process. MAS Design is positively associated with performance ($\beta = 0.231$) and with PIU ($\beta = 0.452$), and PIU in turn relates to outcomes. This pattern suggests that information systems function not only as repositories of data, but as organizational arrangements that help focus managerial attention. When systems provide timely, integrated, and appropriately aggregated information, managers are more likely to consult data in decision-making. This aligns with Kroll (2015), who finds that data quality is a primary driver of PIU in government. The comparatively strong association between MAS Design and PIU ($\beta = 0.452$) indicates that design quality is a salient leverage point for cultivating data-informed decision cultures. These findings support Chenhall and Moers (2015) on the continued relevance of MAS design characteristics in contemporary management control.

The role of decentralization is more nuanced than simple structural determinism would suggest. Decentralization is positively associated with MAS Design ($\beta = 0.228$), presumably because operational units with greater autonomy require better information to make effective local decisions. This is consistent with Altamimi et al. (2023), who show that moderate levels of centralization and decentralization are conducive to organizational change and innovation adoption. However, the association with performance operates indirectly, via information system sophistication and subsequent information use (serial indirect $\beta = 0.032$). In policy terms, decentralization should be calibrated with investments in decision-support systems; autonomy without adequate information infrastructure may not yield better decisions.

The mediation analyses indicate a sequential pattern. IT Integration relates to performance partly through E-government Capability ($\beta_{\text{indirect}} = 0.093$), suggesting that infrastructure investments are connected to improvements in digital services to citizens. A more complex serial pathway from IT Integration to MAS Design to PIU to performance ($\beta_{\text{indirect}} = 0.057$) illustrates how technology's influence may unfold over multiple steps. First, integrated systems are linked to better information design; second, better information is linked to greater use; third, data-informed decisions are linked to

improved outcomes. This sequence implies that organizations are unlikely to obtain immediate effects from technology investments without parallel attention to information systems and behavior, which is consistent with Mergel et al. (2019), who characterize digital transformation as gradual and multi-stage.

Multi-group analysis indicates that mechanisms differ between Regencies and Cities. MAS Design relates more strongly to performance in Regencies ($\beta = 0.301$) and shows essentially no association in Cities ($\beta = -0.032$; $p = 0.048$ for the difference), whereas E-government Capability shows the opposite pattern ($\beta = 0.206$ in Regencies versus $\beta = 0.444$ in Cities; $p = 0.038$). These differences are intuitive. Regencies, often geographically dispersed with less organizational complexity, appear to benefit most from internal coordination and decision-support systems. Cities, facing higher population density and more demanding citizens, gain more from mature digital services that improve service delivery speed and accessibility. This contextual variation is consistent with Twizeyimana and Andersson (2019), who argue that E-government creates public value through multiple pathways that vary by organizational context. Notably, the association from MAS Design to PIU remains consistently strong across both contexts, and the difference between groups is not significant ($p = 0.796$), indicating a broadly similar behavioral linkage even if downstream performance payoffs differ. Recent Indonesian evidence is consistent with this split: service quality in urban e-government settings relates to citizen satisfaction and trust (Pramuditha et al., 2024); user-centric evaluations of the national Mobile JKN application using a software quality attributes framework highlight usability, reliability, interoperability, and data accuracy that parallel the role of MAS Design in supporting managerial information use (Lusiani & Princes, 2024); and technology-prioritization studies suggest context-sensitive sequencing, with cities emphasizing citizen portals and integrated workflows while regencies first strengthen internal decision support (Mariane et al., 2024).

These contextual differences have clear policy implications. Indonesia's national digital government frameworks aim for standardization (Republic of Indonesia, 2018; Ministry of Home Affairs, 2019). While standardization offers efficiency benefits, the results here suggest that implementation priorities should vary by context. Regencies should emphasize internal management information systems, staff analytical capabilities, and cross-departmental data integration. Cities should prioritize citizen-facing platforms, service portals, and service and process integration. A single, uniform strategy risks misallocation of resources across settings.

The findings also speak to broader theoretical debates about how IT creates value in public organizations. The overall pattern supports a mediated-technology perspective: IT matters, but largely through its associations with information system quality, organizational structure, and behavior. The small direct IT–performance coefficient ($\beta = 0.112$), alongside indirect pathways through MAS Design and E-government Capability, suggests that technology functions as an enabler rather than a stand-alone solution. This perspective is consonant with Cao et al. (2022), who show that enterprise system breadth increases value primarily through coordination mechanisms rather than direct operational gains, and it extends that logic to public sector settings.

From a management accounting perspective, the results support the multidimensional approach of Pedroso and Gomes (2020), which models MAS as a second-order construct with four dimensions. The moderate R^2 for MAS Design (0.195) suggests that IT Integration is necessary but not sufficient. Organizations must deliberately design systems to provide the right information at the right level of detail for different decision contexts. The strong association from MAS Design to PIU ($\beta = 0.452$) underscores that these design choices have behavioral consequences for how information is actually used, echoing Bedford and Malmi (2015) on the importance of control-package configuration.

Finally, public value creation in digital government appears to operate through multiple, complementary mechanisms. E-government Capability is associated with citizen-facing value ($\beta = 0.256$), MAS Design is associated with internal decision quality ($\beta = 0.231$), and PIU provides the

bridge between systems and outcomes ($\beta = 0.307$). Digital transformation therefore resembles a portfolio of coordinated changes across technology infrastructure, information design, citizen services, and organizational culture. This multi-pathway perspective aligns with Twizeyimana and Andersson (2019), who identify several types of value created through E-government, including service quality, efficiency, transparency, professionalism, trust, and social value.

5.1 Theoretical Implications

The study makes several important theoretical contributions that advance understanding of digital transformation in public organizations. Most fundamentally, it provides empirical validation offers evidence consistent with an integrated framework linking IT integration, MAS Design, E-government Capability, decentralization, and performance information use. While existing research has examined these elements separately, this study demonstrates how they interact as a system to influence organizational performance illustrates how they can be considered jointly in relation to organizational performance. This holistic perspective is particularly valuable in developing country contexts where digital transformation faces distinct institutional and resource constraints.

A central theoretical insight concerns the mediating intervening role of management accounting systems between technology and performance. The findings show that IT integration influences outcomes primarily through its effects on information system quality is positively associated with information system quality ($\beta = 0.409$) rather than directly. This pattern extends adds to information systems theory by suggesting that technology value depends on complementary organizational capabilities, specifically the design of management information systems. The strong relationship between MAS Design and information use behavior ($\beta = 0.452$) further reveals indicates that information systems shape not just what information is available, but whether and how managers actually use it in decisions. This helps bridge two research streams that have largely developed independently: IT infrastructure studies and management control systems literature.

The research also advances public administration theory by revealing the complex role of organizational structure in digital transformation. Decentralization creates demand for is positively associated with demand for sophisticated information systems ($\beta = 0.228$), presumably because autonomous units need better information to make effective local decisions. However, this structural reform influences performance entirely indirectly relates to performance indirectly through information system development and subsequent information use ($\beta = 0.032$), rather than directly. This finding supports contingency perspectives emphasizing that structural changes must be aligned with supporting capabilities. More practically, it suggests that decentralization without corresponding information infrastructure investments may harm rather than help performance fail to yield expected performance improvements.

The validation of the public value framework of public value logic in a developing country setting represents another contribution. E-government Capability mediates the relationship appears to carry part of the association between IT integration and performance ($\beta = 0.093$), providing quantitative indication that digital service maturity can amplify infrastructure benefits. The multi-group analysis extends this by showing that this pathway operates more strongly in Cities than Regencies, suggesting that the public value associated with E-government Capability depends on contextual factors like urbanization and citizen expectations. This contingency enriches the largely universal framings of digital government value found in existing literature.

Perhaps the most novel contribution lies in demonstrating the behavioral mechanisms linking systems to outcomes. Performance information use emerges as a critical pathway salient pathway ($\beta = 0.307$) through which both MAS Design and technology relate to results. This finding enriches evidence-based management literature by showing that information systems enable but do not guarantee data-informed decision-making. The organizational culture, routines, and incentives that encourage

information use are themselves important outcomes of system design choices. This behavioral perspective shifts attention from technical capabilities to the organizational conditions that determine whether those capabilities actually translate into better decisions.

The multi-group analysis reveals important boundary conditions for digital transformation theory. The finding that MAS Design matters more in Regencies while E-government Capability matters more in Cities demonstrates that transformation mechanisms vary with organizational context. This extends contingency theory by identifying urbanization and organizational complexity as potential moderators of digital transformation pathways. It suggests that universal prescriptions for digital government may be inappropriate across heterogeneous institutional settings, even within a single country.

5.2 Practical Implications

The results suggest viewing IT Integration as an enabling investment whose value is realized through its associations with MAS Design and E-government Capability. In practical terms, local governments should prioritize interoperability, standardized data architecture, and enterprise deployment that connect planning, finance, and service delivery. Infrastructure on its own is unlikely to be sufficient. Expenditure on technology is more effective when accompanied by improvements in information system design and by routines that foster the use of data in decisions. Examples include capacity building for data interpretation, meeting practices that require dashboard review, and accountability mechanisms that recognize evidence use. Sequencing matters. Adjustments to authority structures are best coordinated with the development of decision-support capacity so that autonomy does not exceed the available information infrastructure.

For Regencies, a workable sequence is to strengthen internal MAS Design and the underlying data pipeline, integrate the end-to-end flow from planning to budgeting to execution and reporting, establish a cross-department analytics workbench with regular PIU routines, and only then publish selected indicators to citizen portals once internal quality is stable. Core modules typically include a planning–budget–realization chain, a cross-unit data warehouse with a semantic layer that unifies finance, planning, and service data, managerial dashboards for unit performance, activity tracking, procurement, and cash flow, and PIU enablers such as agenda generators with dashboard snapshots, decision logs, and follow-up trackers. As indicative ranges for scoping, initial integration and dashboard work often require about IDR 750 million to 1.8 billion depending on scope and vendor mix, with an additional IDR 150 to 400 million for capacity building and change management in the first year. These figures should be validated through local market testing and procurement processes. Data standards should cover unified organization and account codes aligned to national standards, master data with unique identifiers for programs, activities, locations, and vendors, JSON or CSV exchanges governed by versioned schemas and a data dictionary, authenticated APIs with pagination and timestamped change logs, and basic data-quality rules for completeness, timeliness, duplicate detection, and reconciliation to financial statements. Progress can be tracked with concise indicators: dashboard uptime as a share of scheduled hours, the share of budget decisions that cite dashboard evidence, the lag from month-end close to dashboard availability, the share of transactions captured digitally along the planning–budget–realization chain, the number of cross-unit data issues resolved per month, and PIU adoption as the share of leadership meetings with recorded data references.

For Cities, the sequence begins by stabilizing core MAS Design for internal coordination, then prioritizing citizen-facing E-government services and service integration, connecting the service portal to back-office processes and the data hub, and institutionalizing PIU routines that incorporate citizen demand signals and service metrics into managerial deliberation. Typical modules include an integrated citizen service portal with single sign-on, ticketing, and case management; process interoperability for permits, taxes, civil registration, complaints, and scheduling; real-time operations dashboards for queue times, service-level compliance, and incident response; and feedback analytics that summarize citizen submissions. As planning guidance, a portal with integration middleware and

case management commonly falls in the range of IDR 1.2 to 3.0 billion for initial rollout depending on scope, with about IDR 200 to 500 million for service design, accessibility, and public outreach. Actual budgets should be set after detailed scoping. Data standards should specify a common service taxonomy and case types with unique identifiers, an API-first approach using JSON payloads and standard pagination, event logs with timestamps for each service step to compute time to serve, privacy and consent records with audit trails, and interoperability profiles for payment, notification, and identity providers. Suitable indicators include portal availability, digital uptake as the share of requests submitted online, median end-to-end service time for priority services, first-contact resolution rate, post-transaction citizen satisfaction scores, and the share of leadership meetings that review service KPIs and record actions.

At the national and partner level, success metrics are more informative when they focus on behavior and outcomes rather than counts of systems or users. Measures such as PIU intensity, time to decision, reductions in service time, and complaint resolution speed are appropriate. Publishing minimal interoperability profiles that include organization codes, chart-of-accounts alignment, versioned JSON schemas, and an open API catalog can align vendors and jurisdictions to consistent specifications. Multi-year funding that combines technology, capacity building, and governance, with stage gates tied to movement in agreed KPIs rather than deployment milestones, is likely to support sustained implementation quality.

5.3 Limitations and Future Research

This study has several limitations that point to directions for further work. First, the cross-sectional design observes relationships at a single moment in time, which constrains causal interpretation. Although the theoretical arguments and diagnostics are consistent with directional claims, stronger tests require longitudinal evidence. Panel designs that follow local governments as they implement digital initiatives could help assess whether changes in IT Integration and MAS Design precede changes in performance. Natural experiments that leverage policy shifts or staggered technology rollouts may also offer better leverage.

Second, the measures rely on key informant perceptions. These indicators are suitable for latent constructs such as information quality and decision behavior, and procedural and statistical steps were taken to limit common method bias. Even so, pairing perceptual data with objective indicators would strengthen confidence. Future studies might triangulate surveys with IT budgets, technical audit scores of system integration, usage and uptake logs, and outcome metrics such as service time and citizen satisfaction. Mixed methods that combine surveys and administrative records are a plausible next step.

Third, the analysis focuses on a single province. North Sumatera's administrative arrangements, digital infrastructure, and institutional norms may differ from other Indonesian regions and from other countries. Replication across multiple provinces and cross-national settings with different levels of digital maturity, capacity, and governance quality could clarify the scope of generalizability. Comparative work might also examine how national institutions and development levels shape digital transformation processes.

Fourth, some contextual influences are likely omitted. Leadership commitment, organizational culture, political economy, resource constraints, and citizen digital literacy may condition the relationships in the model. Extending the framework to include these factors could provide a more complete account. Configurational approaches, such as fuzzy-set qualitative comparative analysis, might identify combinations of conditions associated with successful transformation and allow for multiple pathways.

Fifth, the study does not model the timing of implementation. Digital transformation often unfolds over several years through initiation, implementation, and routinization. Process tracing or event history analysis could map these stages, identify critical junctures and feedback loops, and describe path dependencies that influence outcomes. A clearer view of sequence may help practitioners anticipate challenges and select stage-appropriate interventions.

Sixth, while the multi-group analysis indicates differences between Regencies and Cities, the mechanisms behind these differences are not examined in depth. It remains uncertain whether the patterns reflect urbanization, organizational size, political economy, or other features. Qualitative comparative case studies could explain why and how transformation proceeds differently across government types. Close analyses of both successful and unsuccessful cases may illuminate the processes behind the statistical patterns.

Finally, the outcomes are observed at the organizational level rather than at the level of citizens. Better organizational performance is expected to translate into better services, but this link should be tested directly. Future research could connect digital transformation indicators with citizen outcomes such as satisfaction, trust in government, civic engagement, and perceived effectiveness, using multilevel designs that link organizations to individuals. Such designs would clarify how system-level changes reach citizens and whether benefits are broadly shared or unevenly distributed.

6. Conclusions

This research examined mechanisms through which digital transformation relates to performance in Indonesian local governments. The results point to a simple core insight with context-dependent complexity. At its core, technology appears to matter primarily through a chain of associations: IT Integration is linked to better information systems, better information systems are linked to greater information use in decisions, and greater information use is linked to improved reported outcomes. The complexity arises because this chain varies by organizational context, requires coordination across multiple domains, and depends on behavioral change alongside technical change.

The empirical evidence is consistent with this perspective. All hypothesized relationships were supported in a sample of 198 officials from 33 local governments in North Sumatera. IT Integration is positively associated with both information system quality (MAS Design) and E-government Capability. MAS Design is positively associated with performance and with Performance Information Use (PIU), and PIU relates positively to performance. Decentralization shows a positive association with MAS Design and operates indirectly through information systems and PIU. Importantly, effect magnitudes differ across contexts: Regencies show stronger links between MAS Design and performance, while Cities show stronger links between E-government Capability and performance.

These patterns temper several common assumptions about digital government. Technology by itself rarely transforms organizations; the direct association between IT Integration and performance is modest. System deployment does not guarantee use; organizational culture and routines matter. Universal best practices risk misallocating resources because what works in Cities may differ from what works in Regencies. Overall, success appears to depend less on acquiring the latest technology and more on aligning technology investments with information system design, organizational structure, behavioral norms, and local context.

The study offers both theoretical and practical contributions. Theoretically, it provides evidence consistent with an integrated framework in a developing-country setting, highlights the intervening role of information systems between technology and performance, underscores behavioral mechanisms linking systems to outcomes, and identifies contextual contingencies across government types. Practically, it informs priorities for technology investment, information system design choices,

sequencing of decentralization with decision-support capabilities, context-appropriate strategies, and success metrics that emphasize behavior and outcomes rather than adoption counts.

Several caveats apply. The cross-sectional design limits causal inference. Perceptual measures, while procedurally and statistically assessed, would benefit from triangulation with objective indicators. The single-province focus raises generalizability questions. Potentially important factors such as leadership and political economy are not modeled, temporal dynamics are not observed, and citizen-level impacts are not directly measured. These limitations motivate future research using longitudinal and multi-method designs, broader comparative settings, expanded models that include contextual determinants, process-oriented analyses, and explicit links to citizen outcomes.

Despite these limitations, the findings suggest practical lessons for jurisdictions pursuing digital government. Digital transformation is primarily an organizational change process requiring alignment across technology, systems, structures, behaviors, and context. Technology procurement alone is unlikely to suffice; sustained attention to information system design, capability building, and usage routines is essential. The mechanisms through which technology creates value are multifaceted and contingent, calling for flexibility and local tailoring rather than standardized blueprints.

The North Sumatera experience illustrates both promise and challenge. Local governments have progressed on IT infrastructure and E-government Capability, as reflected in the positive associations observed. At the same time, moderate explanatory power for intermediate constructs and context-sensitive differences indicate that substantial learning and adaptation remain. For policymakers, the implication is to invest patiently and in a coordinated manner across technology, systems, structures, culture, and capabilities. For researchers, the observed variation across contexts provides opportunities to deepen understanding of how digital technologies can be harnessed to improve government effectiveness and create public value in diverse institutional settings.

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Appendix

Appendix A. Survey Items, Sources, and Anchors

All items used 1–7 Likert scales (1 = strongly disagree, 7 = strongly agree) unless noted. Items are adapted for local government context from the cited sources.

A1. Cross-unit IT Integration (adapted from Benitez et al., 2018; Cao et al., 2022)

1. Our departments use standardized IT platforms that are compatible across units.
2. Data and process definitions are harmonized so that systems can exchange information.
3. Information systems are deployed broadly across departments involved in end-to-end processes.
4. Key applications interoperate without manual re-entry of data.
5. Shared architecture guidelines are followed in new system initiatives.

A2. MAS Design (second-order: broad scope, timeliness, aggregation, integration) (adapted from Pedroso & Gomes, 2020, 2024; Chenhall & Moers, 2015)

Broad scope

Timeliness

1. Reports include non-financial indicators relevant to service outcomes.
2. Reports cover external and prospective information beyond historical figures.

Timeliness

3. Information is available quickly enough to support managerial response.
4. Reporting frequency matches the speed of service decisions.

Aggregation

5. Information is aggregated at levels appropriate for managerial decisions.
6. Summaries allow quick comparisons across programs and units.

Integration

7. Reports combine financial and non-financial data.
8. Information links planning, budgeting, implementation, and reporting stages.

A3. Decentralization (adapted from Altamimi et al., 2023)

1. Decision authority for service operations is delegated to responsible units.
2. Units have autonomy to adapt procedures within agreed standards.
3. Managers at the unit level can allocate resources within their remit.
4. Strategic decisions require consultation but not full central approval.

A4. E-government Capabilities (adapted from Janowski, 2015; Twizeyimana & Andersson, 2019; Mergel et al., 2019)

1. Online services support end-to-end processing for key citizen services.
2. Back-office processes are integrated across departments for those services.
3. Data are interoperable across systems used in service delivery.
4. Digital operations are routinely monitored and improved.
5. Service channels provide transparency and accountability to the public.

A5. Performance Information Use (PIU) (adapted from Kroll, 2015; Cantarelli et al., 2023; van der Voet & Lerusse, 2024)

1. Performance information is consulted when setting priorities.
2. Performance information is used to adjust resource allocation.
3. Performance results are discussed in managerial meetings.
4. Performance indicators inform follow-up actions on service issues.

A6. Public Performance (PP) (adapted from Twizeyimana & Andersson, 2019)

1. Service quality has improved in priority programs.
2. Processes operate more efficiently than in prior periods.
3. Transparency and accountability have strengthened.
4. Stakeholder satisfaction with services has increased.

Note: Wording reflects local government context in North Sumatera. Translation and back-translation notes for each item are archived and available upon request.