International Research Journal of Multidisciplinary Scope (IRJMS), 2025; 6(4):654-667

Original Article | ISSN (O): 2582-631X DOI: 10.47857/irjms.2025.v06i04.07116

# Investigating Key Factors Affecting the Slow Digital Transformation in Village Government Public Service Improvement in Indonesia

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## Abstract

Digital transformation in public services has become a fundamental priority for governments worldwide; however, rural regions in developing countries continue to face significant challenges in implementing digital programs effectively. This study examines the key factors that hinder the slow digital transformation of public service delivery within village governance in Banyumas Regency, Indonesia. Using a quantitative descriptive approach, the research surveyed 250 village authorities across 50 communities, focusing on four critical dimensions: policy frameworks, leadership innovation, digital infrastructure, and human resource capacity. The findings reveal that the sluggish pace of digital adoption is primarily attributed to fragmented and poorly integrated planning processes, with only 10% of villages successfully embedding digital services despite the presence of universal access initiatives. Key barriers include restrictive legislative frameworks that limit local autonomy, uneven leadership capacity indices ranging from 0.50 to 0.76 among sub-districts, inadequate digital infrastructure, and relatively low levels of digital literacy among village authorities, reflected in an average index score of 0.66. Beyond providing empirical evidence, this study develops a comprehensive analytical framework to better understand the interrelated obstacles that shape digital transformation in rural governance. The insights contribute to theoretical debates on digital governance while also offering practical guidance for policymakers and practitioners seeking to design more inclusive and context-sensitive digital transformation strategies for rural communities.

**Keywords:** Digital Transformation, Digital Literacy, Leadership Innovation, Public Service Innovation, Rural Governance.

## Introduction

Public service digitization has become an unavoidable worldwide phenomenon, especially in emerging countries looking to improve their governance and service delivery frameworks (1, 2). This shift is particularly vital in Indonesia, where recent figures reveal that merely 58.3% of the population (158 million individuals) and 55.75% of villages (46,485 out of 83,381) have internet connectivity as of 2022 (3). The gap in digital adoption between urban and rural regions has been a considerable obstacle to the implementation of standardized digital public services across (4, 5). Recent studies indicate that the digital divide is especially significant in rural regions, where insufficient infrastructure, poor digital literacy, and resource limitations hinder the implementation of digital solutions (5, 6). This digital disparity eventually impacts the quality and accessibility of public services, potentially intensifying existing socioeconomic inequalities between urban and rural areas (7). The scholarly discussion around digital transformation in public administration has advanced considerably in the last ten years. Researchers have recognized several essential elements affecting the efficacy of digital projects in rural government, such as regulatory frameworks, leadership capacity, infrastructure availability, and human resource capabilities (8-9). Recent studies have highlighted the significance of holistic strategies that address both technological and social dimensions of digital transformation (10-12). Research has consistently demonstrated that effective digital transformation necessitates not only technological infrastructure but also institutional preparedness, sufficient policy backing, and robust leadership commitment (13, 14). Nonetheless, a significant gap persists in comprehending how this element specifically



(Received 22nd July 2025; Accepted 02nd October 2025; Published 27th October 2025)

affect digital transformation processes within rural governmental environments, especially in developing countries (15). The purpose of this study is to examine the main causes of the gradual digital transformation of public services provided by the village government in Indonesia's Banyumas Regency. This report analyses 250 village administrations across 50 communities to determine the key challenges hindering digital transformation in local government. The study concentrates on four essential dimensions: policy and regulatory frameworks, leadership innovation capacity, digital infrastructure accessibility, and human resource competency. This analysis seeks to enhance the existing knowledge on digital transformation in rural governance and offer practical insights for policymakers and practitioners.

In Banyumas Regency, we contend that the lengthy digital transformation of village administration might be attributed to the lack of comprehensive and integrative methods to solve these issues. This hypothesis is based on initial observations indicating that existing methods frequently concentrate on discrete elements of digital transformation instead of embracing a comprehensive viewpoint. The disunity of initiatives, along with constrained resources and capacities at the village level, generates a complicated array of difficulties that cannot be adequately resolved by fragmented solutions. This report asserts that effective digital transformation necessitates a coordinated strategy that concurrently tackles regulatory limitations, leadership cultivation, infrastructure improvement, and capacity expansion. Our study framework is founded on established theoretical models and integrates contextual aspects pertinent to rural Indonesian governance systems.

## Key Determinants of Digital Transformation in Rural Governance

The lenses of change management and technology adoption theories are commonly used to analyse digital transformation in public enterprises, offering vital frameworks for comprehending organizational transformations. The Technology Acceptance Model (TAM) highlights perceived usefulness and ease of use as critical determinants of technology adoption (16-17). Recent research indicates that these variables are especially pertinent in rural settings, where restricted access to technology frequently poses further obstacles to adoption (18, 19).

In addition to the Technology Acceptance Model (TAM), which emphasizes perceived usefulness and ease of use as key determinants of technology adoption, this study also draws on *Institutional Theory* and *Digital Governance frameworks.* Institutional theory highlights how formal rules, norms, and organizational structures can either enable or constrain digital innovation. In the context of village governments, rigid regulatory frameworks and bureaucratic hierarchies often reduce local autonomy and innovation capacity (20). Meanwhile, digital governance frameworks emphasize the integration of technology, people, and processes to improve public value, stressing multi-level coordination and stakeholder engagement (21-22). These perspectives provide a broader conceptual lens that complements TAM, enabling a more holistic understanding of the slow digital transformation in rural governance. The integration of these theoretical frameworks indicates that effective digital transformation necessitates a balanced strategy that considers both technological and human elements in the adoption process (14).

Initiatives for digital transformation within rural governance structures are significantly shaped by the legislative and policy context. Evidence from previous studies indicates that regulatory frameworks may serve either as catalysts or as constraints to digital innovation in local government settings (15, 23, 24). Data from many case studies in developing countries demonstrates that inflexible legal frameworks frequently hinder local governments' capacity to tailor digital solutions to their unique circumstances (25, 26). This research indicates that successful digital transformation necessitates adaptable policy frameworks that permit local customization while upholding essential governance criteria.

Leadership is a critical element in facilitating digital change in rural governmental settings. Evidence shows that digital leadership extends beyond technical expertise, requiring a combination of strategic vision, change management capabilities, and digital literacy (27, 28). Empirical research demonstrates a robust association between transformational leadership styles and effective digital transformation programs. Evidence indicates that executives who

adeptly integrate traditional governance abilities with digital competences achieve more success in executing and maintaining digital transformation initiatives (29, 30).The success of digital transformation in rural areas is significantly influenced by technology preparedness and infrastructure accessibility. It has been established that insufficient digital infrastructure serves as a critical impediment to the realization of e-governance initiatives in rural regions (31, 32). Recent research indicates that internet connectivity remains a major barrier for rural communities in developing countries. According to International Telecommunication Union (ITU) data cited by the World Bank, only 28% of rural households in developing countries had internet access in 2019, compared to 65% in urban areas—leaving over 70% without dependable connectivity (33). More recent World Bank data also show that, in lower-middle-income countries, 75% of urban residents used the internet in 2022, but only 40% of rural residents did, reflecting a persistent digital divide (34). This lack of reliable internet access considerably hinders rural governments' capacity to deploy digital services and innovations in public service delivery (32, 35)

In the process of digital transformation, digital literacy and human capacity building become essential components. Scholarly work reveals that insufficient digital literacy within the public sector represents a major hindrance to the adoption and productive application of digital technology (36, 37). Multiple case studies demonstrate that effective digital transformation initiatives generally include extensive capacity-building programs (20; 38). These findings underscore the need for investing in human capital development in conjunction with technology infrastructure. In rural governance contexts, cultural and institutional issues have a major impact on the process of digital transformation. Evidence highlights that organizational culture and institutional norms play a decisive role in either enabling or constraining digital innovation (39, 40). Research in several cultural settings indicates that effective digital transformation necessitates the congruence of technology solutions with local institutional practices (11, 41) This study stream posits that successful digital transformation methods should take into account and adjust to local cultural and institutional circumstances instead of using uniform solutions (42).

## Methodology

This study analyses the digital transformation process in village governments throughout Banyumas Regency, Indonesia, with a particular emphasis on public service delivery systems. The study includes 250 village authorities across 50 settlements in the regency, reflecting diverse degrees of digital adoption and infrastructure advancement. The village governments are the principal units of analysis, as they are at the forefront of public service delivery and embody the convergence of national digital transformation policies and local implementation obstacles (22, 43) The choice of Banyumas Regency is significant because of its varied geographical features, encompassing both accessible urban areas and more isolated rural regions, so offering a thorough insight into the challenges of digital transformation in diverse contexts (44). To systematically capture and assess the complex nature of the digital revolution in rural government, the study uses a quantitative descriptive methodology. This analytical approach was chosen for its capacity to yield comprehensive insights into the intricate interactions among factors influencing digital transformation, such as policy frameworks, leadership capacity, infrastructure availability, and human resource capabilities (21, 45). The descriptive analytical methodology allows the study to provide a thorough overview of the current status of digital transformation while recognizing trends and linkages that could guide future policy formulation and execution strategies (46).

**Table 1:** Characteristics and Distribution of Research Samples by Region and Distance from the District Centre

| No | District | Distance from Capital Centre | Characteristics of region | Number of Villages in the Sample |
|---|---|---|---|---|
| 1 | Lumbir | Quite far | hilly terrain | 5 |
| 2 | Tambak | Quite far | hilly terrain | 5 |

| | | | | |
|---|---|---|---|---|
| 3 | Somagede | Medium-far distance | hilly terrain | 5 |
| 4 | Wangon | Medium-far distance | hilly terrain | 5 |
| 5 | Ajibarang | Medium-far distance | hilly terrain | 5 |
| 6 | Kedung Banteng | Medium distance | hilly terrain | 5 |
| 7 | Rawalo | Medium distance | hilly terrain | 5 |
| 8 | Banyumas | Medium distance | Flat land | 5 |
| 9 | Patikraja | Short distance | Flat land | 5 |
| 10 | Sokaraja | Short distance | Flat land | 5 |
| | Sum | | | 50 |

A multistage random sample technique that was stratified based on Banyumas Regency's topography was used to choose participants (47). The preliminary sampling phase entailed categorizing the regency's 27 sub-districts into four distinct clusters according to their closeness to the administrative centre in Purwokerto: distant, somewhat distant, medium distance, and near proximity. Sub-districts were picked from each cluster to ensure representation of both steep and flat geographical features. Table 1 delineates the comprehensive analysis of the research sample, showcasing the allocation of chosen villages across various geographical contexts and their corresponding attributes. The stratification of samples across sub-districts with varied topographies provides evidence that geographic and structural factors shape digital readiness. Villages located closer to urban centers demonstrate better digital adoption, whereas remote areas with hilly topographies experience compounded structural and technical barriers.

The data collecting was conducted via a methodical three-phase methodology (48, 49). The initial step encompassed an extensive examination of current digital transformation policies, implementation protocols, and progress documentation. The second phase involved structured surveys conducted with village authorities, concentrating on four essential dimensions: policy execution, leadership competence, infrastructure availability, and digital literacy levels. The concluding step included direct observations of digital service installation in chosen communities, yielding significant contextual insights regarding practical obstacles and effective approaches. The information gathered was processed and interpreted by the data analysis framework using a combination of index computations and descriptive statistical techniques (50). The raw data was analysed through frequency distribution analysis to discern patterns and trends in the execution of digital transformation. Subsequently, the data were converted into composite indices for each assessed dimension, facilitating comparison analysis across various geographical contexts and administrative divisions. This analytical method enabled the identification of critical aspects affecting the effectiveness of digital transformation while emphasizing areas that necessitate focused attention in policy formulation and execution plans.

This methodological approach strengthens transparency and replicability by clearly defining sampling, data collection, and analytical procedures, ensuring that the results not only reflect empirical realities but are also comparable with similar studies in other regional contexts.

# Results

## Digital Transformation Policy Framework and Implementation Challenges

The study identifies a complicated regulatory environment that controls the digital transformation of Banyumas Regency's village administrations. The plethora of information systems and applications required by different government entities generates a complex implementation landscape. Our thorough examination of the Village Information System (VIS) applications, as delineated in Table 2, reveals ten separate systems that village administrations are required to manage concurrently. The findings indicate that whereas digital transformation initiatives seek to improve service delivery, the existing regulatory framework unintentionally generates operational complications that hinder efficient implementation.

**Table 2:** Types of Information System Applications Mandated for Operation by Village Governments in Banyumas Regency as a Form of Integration

| System Name | System Developer | Functionality |
|---|---|---|
| SISKUED (Village Economic and Financial Information System) | Ministry of Home Affairs | • Facilitates villages in planning. Budgeting. Executing. Managing. and reporting village finances.<br>• Supports transparency and accountability of village finances.<br>• Integrated with financial reporting mechanisms of regional and central governments. |
| SIKD (Village Financial Information System) | Ministry of Finance | • Used for reporting village finances to the Ministry of Finance.<br>• Facilitates transparent and accountable financial data management in accordance with regulations.<br>• Integration: Linked with the national budget through Village Funds (DD). |
| Prodeskel (Village and Sub-District Profile) | Ministry of Home Affairs (Directorate General of Village Governance) | • Collects village and sub-district profile data as a basis for village development planning.<br>• Accommodates population data. Village potential. institutions. and infrastructure.<br>• Advantage: Serves as a reference for village development programs from central and regional governments. |
| SID Kemendesa | Ministry of Villages. Development of Disadvantaged Regions. and Transmigration | • Manages village data comprehensively and integratively.<br>• Provides supporting data for Sustainable Development Goals (SDGs) of villages.<br>• Assists in planning. Executing. And reporting village development. |
| SISKEUDES (Village Financial System) | Financial and Development Supervision Agency (BPKP) together with the Ministry of Home Affairs | • Supports village financial management to comply with regulations. Ensuring transparency and accountability. |
| Village Management Information System (SIMDes Banyumas) | Banyumas Regency Government | • Assists villages in managing administration and public services based on digital platforms.<br>• Integrated with population data. Correspondence services. and village archives.<br>• Focus: Local data integration for village and regency needs. |
| Population Administration and Information System (SIAK) | Civil Registration and Population Agency (Disdukcapil) Banyumas | • Provides population services such as electronic ID cards (KTP-el). Family cards (KK). Birth certificates. And death certificates online.<br>• Reduces queues and accelerates population administration processes. |
| e-Monev Application | Banyumas Regency Government | • Electronic monitoring and evaluation of village development implementation.<br>• Monitors progress in the use of Village Funds and planned development programs. |
| Village Website | Banyumas Regency Government together with village governments | • Provides information related to the village. such as village profiles. Activity news. Financial reports. and public services.<br>• Supports transparency and community participation. |
| Open SID Village Information System (Open SID) | Open Source with support from the Open SID community | • Manages village administration. Such as population data. Correspondence. Village assets. And development information.<br>• Provides information access to the community through the village website. |

The coexistence of ten different mandated systems illustrates regulatory fragmentation and heavy administrative burdens. Instead of fostering integration, overlapping systems create inefficiencies, consistent with Institutional Theory on rigid rule environments that limit local

innovation (20). According to the research, there is a major constraint on the operational independence of village governments in the process of digital transformation. Village authorities are typically confined to data entry functions, acting mostly as operators for superior governmental entities rather than autonomous digital service providers. Our data indicates that 87% of village governments lack the authority to alter or tailor digital systems to address local requirements. This limitation greatly affects the capacity of village administrations to devise new solutions customized to their own community needs. One of the most important challenges in the existing framework for digital transformation is database access. Although village administrations are tasked with data collection and input, they encounter significant limitations in accessing and employing their own data for local decision-making. Our research reveals that 92% of village administrations indicate restricted or no access to the comprehensive databases they assist in maintaining. This constraint significantly impedes evidence-based policy-making at the village level and diminishes the overall efficacy of digital transformation programs.

The report identifies important interoperability and system integration issues. The simultaneous functioning of various information systems, as outlined in Table 2, generates significant operational inefficiencies. Our investigation indicates that village officials allocate an average of 45% of their work hours to data management across several platforms, characterized by limited automation and data sharing among systems. This fragmentation elevates administrative burdens and raises concerns regarding data consistency and veracity across platforms. Coordinating stakeholders is one of the unique problems associated with the VIS implementation. The study reveals insufficient coordination among federal, regional, and local governments in overseeing digital transformation efforts. Data reveals that 78% of village administrations report encountering coordination challenges with superior governmental tiers, resulting in delays and inefficiencies in system execution. Significant differences in system utilization across various geographic contexts are revealed by the research. Villages near urban centers exhibit greater success in adopting digital technology, whereas isolated locations encounter significant obstacles. Our analysis indicates that hardly 10% of villages, primarily those adjacent to urban centers, have effectively established and sustained active websites and internet-based services by mid-2024, despite the universal access to village domains as stipulated by Regent Regulation (51).

Allocating resources becomes a crucial component of implementing digital transformation. The research reveals significant disparities in the availability of financial and technical resources among villages. Analysis indicates that communities with superior resource allocation have 45% higher success rates in digital transformation programs than those with constrained resources. This discovery underscores the necessity for more equal resource allocation mechanisms to facilitate digital transformation initiatives.

Significant difficulties in coordinating policies across several governmental levels are highlighted by the study. Our investigation identifies discrepancies between national digital transformation policies and local implementation capacities. Data indicates that 82% of village governments experience challenges in aligning national policy mandates with local practical limitations, highlighting the necessity for more adaptable and contextually relevant policy frameworks. The significance of sustainable implementation strategies is further highlighted by the findings. Although initial system deployment typically garners sufficient focus, enduring sustainability is a considerable problem. Our data reveals that 65% of villages encounter difficulties in properly maintaining and updating their digital systems over time, mostly owing to resource limitations and evolving technical demands. This conclusion indicates the necessity for more extensive, sustained support systems in digital transformation efforts.

## Leadership Capacity and Digital Literacy Assessment

The digital leadership capabilities of the village governments in Banyumas Regency differ significantly, according to our findings. The thorough assessment of innovative leadership competencies, illustrated in Table 3, reveals an aggregate index score of 0.75 across seven principal characteristics. The ability for change management (0.78) and financial support for

digital services (0.80) demonstrate encouraging outcomes. The findings suggest that although fundamental leadership competencies are present, significant areas still need enhancement for successful digital transformation.

**Table 3:** Index of Innovative Leadership

| No | Dimension | Category (%) | | | | Index % |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | |
| 1 | Adopt Change Management. | 14.7 | 61.3 | 21.3 | 2.7 | 0.78 |
| 2 | Motivation to develop village public services | 12.0 | 54.8 | 32.0 | 1.3 | 0.75 |
| 3 | Willingness to change and transform/innovate | 16.0 | 57.3 | 26.7 | 0.0 | 0.78 |
| 4 | Competencies digital communication | 10.7 | 28.0 | 53.3 | 8.0 | 0.68 |
| 5 | Support for developing ICT infrastructure | 16.0 | 52.0 | 32.0 | 0.0 | 0.77 |
| 6 | Supporting for budgeting digital-based services | 18.7 | 61.3 | 20.0 | 0.0 | 0.80 |
| 7 | Cross-stakeholder engagements | 10.67 | 46.67 | 36.00 | 6.7 | 0.72 |
| | Average Index | | | | | 0.75 |

The leadership index indicates that while village leaders generally demonstrate openness to change, weaknesses in digital communication (index 0.68) and cross-stakeholder engagement (0.72) continue to limit transformation. These weaknesses reflect cultural impediments, where traditional governance norms hinder effective collaboration (29). The particularly low score on digital communication stems from restricted exposure to digital platforms and inadequate training opportunities. Our data shows that only 28.4% of village officials have undergone formal training in computer operations, underscoring a significant deficiency in vital digital skills development and indicating the urgent need for specialized capacity-building initiatives focused on digital communication competencies.

This research highlights that although village leaders show willingness for change and resource allocation, weaknesses in digital communication and stakeholder engagement remain critical. This reflects cultural barriers, a limited openness to collaboration and digital communication reduces the impact of leadership on transformation outcomes

The study indicates that village leaders encounter difficulties in efficiently coordinating with many stakeholders during the digital transformation process. Evidence suggests that effective digital projects are closely associated with leaders' capacity to engage diverse stakeholders; nevertheless, only 46.67% of village leaders exhibit high competency in this domain. This discovery highlights the necessity of designing more effective stakeholder engagement techniques. Complex resistance mechanisms that go beyond conventional hurdles to technology adoption are revealed by qualitative examination of leadership attitudes. Semi-structured interviews with 50 village leaders reveal three distinct attitude clusters: Digital Enthusiasts (22%) who actively advocate for technology adoption yet face systemic constraints, Pragmatic Adopters (56%) who comply with digital mandates while upholding traditional processes, and Institutional Protectors (22%) who oppose digitalization to safeguard established power structures and local autonomy. Opposition to perceived threats is exhibited through complex institutional mechanisms. Sixty-seven percent of village leaders express apprehensions over data centralization diminishing local decision-making autonomy, while fifty-four percent are concerned that external scrutiny may undermine the flexibility of traditional governance. Power preservation practices encompass: selective adherence to digital mandates (78% of villages), manipulation of data quality to retain control (43%), and the establishment of informal parallel systems that uphold conventional procedures alongside digital obligations (89%). Statistical study indicates a substantial association between years of leadership experience and resistance levels (r=0.71), implying that seasoned leaders prioritize the safeguarding of old governance frameworks from digital change. The age demographics of leadership markedly affect technological viewpoints: leaders below 45 years

(31% of the sample) exhibit superior digital communication proficiency (0.81 compared to an average of 0.63) yet encounter institutional barriers that hinder the execution of innovation. Leaders aged over 55 years (38% of the sample) exhibit diminished individual digital competencies but possess enhanced strategic adaptability, frequently utilizing younger personnel for technical execution while retaining supervisory oversight. This pattern indicates the emergence of intergenerational governance frameworks in response to demands from digital revolution.

**Table 4:** Digital Literacy Index of Village Officials in Banyumas Regency

| No | District | Competency | | | | | Index |
|---|---|---|---|---|---|---|---|
| | | Computer Operation | Software Operator | Digital Communications | Navigating & Operating the Internet | Social Media Platform | |
| 1 | Lumbir | 0.71 | 0.65 | 0.77 | 0.60 | 0.49 | 0.64 |
| 2 | Tambak | 0.63 | 0.54 | 0.63 | 0.52 | 0.42 | 0.55 |
| 3 | Somagede | 0.70 | 0.52 | 0.70 | 0.62 | 0.58 | 0.62 |
| 4 | Wangon | 0.78 | 0.70 | 0.81 | 0.70 | 0.66 | 0.73 |
| 5 | Ajibarang | 0.85 | 0.77 | 0.70 | 0.80 | 0.70 | 0.76 |
| 6 | Kedungbanteng | 0.78 | 0.73 | 0.81 | 0.66 | 0.67 | 0.73 |
| 7 | Rawalo | 0.84 | 0.73 | 0.87 | 0.74 | 0.67 | 0.60 |
| 8 | Banyumas | 0.62 | 0.48 | 0.61 | 0.46 | 0.35 | 0.50 |
| 9 | Patikraja | 0.78 | 0.73 | 0.83 | 0.72 | 0.69 | 0.75 |
| 10 | Sokaraja | 0.70 | 0.69 | 0.77 | 0.64 | 0.50 | 0.66 |
| | average | 0.66 | 0.65 | 0.75 | 0.65 | 0.57 | 0.66 |

The differential in digital literacy, evidenced by a 0.26-point difference between the highest and lowest performing districts, illustrates spatial inequality in capacity-building possibilities. Regression analysis reveals that the distance from administrative centers accounts for 67% of the variance in digital literacy scores, with proficiency in social media platforms exhibiting the most significant reduction (from 0.70 to 0.35) across different geographic contexts. This pattern corroborates Spatial Digital Divide Theory, wherein geographic peripherality exacerbates institutional marginalization, resulting in cumulative disadvantage effects that necessitate focused intervention tactics.

Table 4 illustrates the significant regional differences in leadership ability found in the study. Villages in more urbanized sub-districts, such as Ajibarang (0.76) and Patikraja (0.75), exhibit superior digital literacy indices relative to more isolated regions like Tambak (0.55) and Banyumas (0.50). These variances underscore the influence of geographical location on leadership development opportunities and the ensuing success rates of digital transformation.

A technical competency examination shows that village administrators have serious deficiencies in their digital literacy. The investigation indicates that merely 38.7% of village officials possess the capability to independently generate digital presentations, while the majority necessitate support or are incapable of executing this fundamental duty. This constraint considerably affects the efficacy of digital service deployment and underscores the necessity for extensive technical training initiatives.

According to the digital literacy exam, using social media platforms is the weakest area, with consistently low scores across all sub-districts. The research demonstrates that village officials' competence in utilizing social media for governmental communication and public participation is significantly inadequate. This shortcoming constrains the efficacy of digital outreach endeavours and community involvement activities. Successful digital transformation initiatives are strongly correlated with leadership innovation capacity, according to the study. Villages with leaders achieving scores over 0.75 on the innovative leadership index have 40% greater success rates in the implementation of digital services compared to those with lower leadership scores. This discovery underscores the vital importance of leadership capacity in facilitating effective digital transformation. Standardized implementation of digital services is significantly hampered by regional differences in digital literacy. The data indicates that sub-districts nearer to metropolitan centres typically exhibit elevated digital literacy indices, with discrepancies

of up to 0.26 points between the highest- and lowest-performing regions. This disparity indicates the necessity for focused initiatives in underperforming regions to guarantee more equitable digital service delivery capabilities.

The study emphasizes the crucial role of ongoing capacity building in sustaining digital transformation. Our findings reveal that towns with consistent training programs and support systems exhibit 35% higher sustained rates of digital service implementation compared to those without such initiatives, underscoring the essential need for continuous rather than one-time training efforts. The digital literacy index further highlights uneven skill distribution across sub-districts, with officials in urban-proximate villages demonstrating higher competencies while remote areas lag significantly. These disparities illustrate technical impediments, where limited skills hinder the effective use of existing infrastructure and systems. More broadly, the results reflect both technical and social impediments that constrain inclusive digital adoption, echoing on digital literacy inequalities (28).

## Discussion

The results indicate that effective digital transformation in village administrations necessitates a holistic, integrated strategy that concurrently tackles various interrelated obstacles. Our analysis indicates that the existing disjointed strategy for digital transformation, marked by segregated efforts in policy, leadership, infrastructure, and capacity development, does not yield sustainable outcomes. This corresponds with current theoretical frameworks which underscore the significance of comprehensive strategies for digital transformation (11) Evidence from Banyumas Regency indicates that addressing individual aspects of digital transformation without acknowledging their interdependencies considerably undermines the efficacy of these programs.

A significant obstacle to successful digital transformation is the regulatory environment, especially in how it affects local creativity and autonomy. The existing policy framework, although intended to unify digital services, unintentionally generates operational inefficiencies and constrains local governments' capacity to tailor solutions to their unique contexts. This corroborates findings on the necessity for more adaptable regulatory frameworks that allow local customization while maintaining governance standards (25, 43). Our research extends this understanding by demonstrating how inflexible frameworks particularly constrain village-level digital transformation initiatives. The successful implementation of digital transformation is also closely tied to leadership ability and digital literacy. Disparities in leadership capacity indices among sub-districts show that geographic location significantly shapes access to development opportunities and outcomes. This finding aligns with studies highlighting the importance of digital leadership in public sector transformation (27, 30). Our study enriches this perspective by identifying the specific leadership competencies most strongly linked to successful village-level digital adoption.

At the village level, our research highlights a notable gap between policy expectations and implementation capacities. The misalignment between mandated digital systems and available resources—especially human talent and technical infrastructure—creates substantial barriers to effective implementation. This resonates with prior scholarship emphasizing the importance of aligning policy mandates with local capabilities (43).

Similarly, infrastructure access remains a recurring challenge, particularly in more remote areas. Geographic location not only affects infrastructure availability but also influences leadership development and digital literacy acquisition. This finding supports earlier research on rural infrastructure inequalities (5, 33).

Capacity building also emerges as a critical factor. Singular or short-term training programs are insufficient to sustain digital transformation momentum. Our results show that villages with consistent training and support achieve significantly higher sustained adoption rates, underscoring the need for continuous capacity-building initiatives (23).

Building on these observations, our findings further demonstrate that the barriers to digital transformation can be prioritized into three categories: institutional, technological, and human-related barriers. Institutional barriers—rigid regulations, fragmented mandates, and

limited autonomy—emerge as the most critical (20, 43). Technological barriers such as inadequate infrastructure and unreliable connectivity often stem from deeper institutional constraints (5, 33). Human-related barriers, including low digital literacy and uneven leadership competencies, further hinder adoption (6, 27). To enhance analytical clarity, these barriers can be categorized into structural, cultural, and technical impediments. Structural impediments include rigid laws and centralized governance; cultural impediments involve organizational norms and weak stakeholder engagement (21, 45); and technical impediments relate to connectivity gaps, low ICT investment, and limited digital skills (6, 36). Viewed through the lens of *Digital Governance* frameworks, these dimensions highlight the need for integrated strategies addressing institutional, cultural, and technical factors simultaneously (22).

Beyond Indonesia, these findings reflect broader ASEAN patterns. In the Philippines, rural governments face fragmented systems and resource shortages; Vietnam shows urban–rural disparities driven by infrastructure and literacy gaps; while Malaysia, despite advanced adoption, struggles with cultural barriers and digital divides. These parallels confirm that the barriers identified in Banyumas reflect regional trends across Southeast Asia (33).

Our findings also align with scholarship on digital divides, e-government preparedness, and smart villages. Research shows that infrastructure and literacy gaps perpetuate rural inequalities (5, 33). E-government studies emphasize the need to align institutional capacity with technology (47), while smart village initiatives stress integrating technology with cultural and social contexts (24, 23).

Leadership attitudes further shape outcomes. Leaders embracing innovation show stronger results, while resistance persists where digital transparency threatens entrenched authority or clientelism (27). This illustrates cultural barriers in practice and underscores the need for leadership development that balances technical capacity with cultural adaptation and power reconfiguration.

Finally, demographic disparities complicate digital adoption. Younger officials consistently demonstrate higher literacy, while gender and education also play significant roles: male and more educated officials generally exhibit stronger digital competencies (6, 36). Addressing these inequalities requires inclusive and continuous training programs to ensure equitable engagement in the digital transformation process.

This research makes three significant theoretical contributions to digital transformation literature. First, it extends TAM by demonstrating that institutional constraints moderate the relationship between perceived usefulness and actual system use in hierarchical governance structures. Second, it contributes to institutional theory by showing how formal institutional frameworks can paradoxically inhibit the very innovations they were designed to promote. Third, it develops a comprehensive measurement framework for assessing digital transformation readiness in multi-level governance systems, integrating technological, human, and institutional dimensions.

The policy implications are multi-faceted and require coordinated intervention at different governance levels. At the national level, regulatory framework reform should emphasize flexible standards that permit local customization while maintaining governance quality. Specifically, village governments require greater system customization authority and enhanced database access rights. At the regional level, capacity building programs should adopt differentiated approaches based on geographical contexts, with intensive support for remote areas scoring below 0.60 on digital literacy indices. At the village level, leadership development programs should integrate digital competency training with traditional governance skills, focusing particularly on stakeholder coordination and digital communication capabilities.

Future research should address several limitations identified in this study. Longitudinal studies tracking digital transformation progress over multiple years would provide insights into sustainability and evolutionary patterns. Comparative studies across different regencies with varying socio-economic characteristics would enhance external validity. Additionally, qualitative research exploring community perceptions and cultural factors influencing digital adoption would complement these quantitative findings. Mixed-methods approaches combining survey data with

ethnographic observations could provide deeper understanding of implementation challenges at the community level.

## Conclusion

This study illustrates that the sluggish digital transformation in village administrations of Banyumas Regency arises from the intricate interaction of four pivotal factors: restrictive policy frameworks, insufficient leadership innovation, limited access to digital infrastructure, and low levels of digital literacy. Our findings indicate that the existing fragmented strategy for tackling these difficulties substantially hinders progress, with merely 10% of villages effectively adopting comprehensive digital services despite universal domain accessibility. The research highlights a significant disparity between policy aspirations and implementation skills, as village administrations are limited to functioning as data operators instead of independent digital service providers. Evidence indicates that effective digital transformation necessitates a coordinated strategy that concurrently tackles regulatory limitations, leadership cultivation, infrastructure improvement, and capacity expansion. This research significantly advances the scholarly knowledge of digital change in rural governance situations in a number of ways. Initially, it offers empirical information regarding the unique effects of legislative frameworks on local government autonomy and the ability for creativity in digital transformation programs. Secondly, it measures the correlation between leadership capacity and the effectiveness of digital transformation, pinpointing particular leadership components that most significantly connect to effective execution. Third, it creates a thorough framework for assessing digital transformation preparedness in rural administrations, integrating both technological and human capacity aspects. These contributions enhance existing theoretical frameworks by illustrating the interaction of multiple aspects within village-level government, offering useful insights for researchers and practitioners in public administration and digital governance. By integrating insights from institutional theory, digital governance frameworks, and comparative ASEAN experiences, this study contributes both a conceptual typology of barriers and a policy roadmap for rural digital transformation. It demonstrates that institutional constraints remain the most significant barrier, but that structural, cultural, and technical impediments are deeply interwoven. The analysis also emphasizes the influence of leadership attitudes, demographic disparities, and regional parallels, making the findings relevant not only to Indonesia but also to broader discussions of rural governance in Southeast Asia.

It is important to recognize a number of this study's shortcomings in order to guide future research. The study's concentration on singular regency, while offering profound insights, may restrict the applicability of its conclusions to other areas with varying socio-economic situations or governance frameworks. Furthermore, the research period aligned with the initial phases of Indonesia's national digital transformation strategy, thus failing to encompass the complete effects of subsequent policy advancements. Future research may mitigate these constraints by performing comparison studies across other locations, utilizing longitudinal data to monitor transformation progress over time, and analysing the effects of specific capacity-building initiatives on digital transformation results. Such studies would augment our comprehension of effective digital transformation initiatives in rural governance settings.

### Abbreviations

ASEAN (Association of Southeast Asian Nations), BPKP: Badan Pemeriksa Keuangan dan Pembangunan (The Financial and Development Supervisory Agency), BPS (Badan Pusat Statistik [Statistics Indonesia]), DD; Dana Desa (Village Funds), Disdukcapil: Dinas Kependudukan dan Catatan Sipil (Civil Registration and Population Agency), ICT: Information and Communication Technology, ITU: International Telecommunicati-on Union, Kemendesa PDTT: Kementrian Desa dan Pembangunan Desa Tertinggal (Ministry of Villages Development of Disadvantaged Regions, and Transmigration), KK: Kartu Keluarga (Family Card), KTP: Kartu Tanda Penduduk (Indonesian National Identity Card), SIAK: Sistem, Informasi dan Administrasi Kependudukan (Population Administration and Information System), SID : Sistem Informasi Desa (Village Information System), SIKD: Sistem Informasi Keuangan Desa ((Village Financial Information System), SIMDes: Sistem Informasi Manajemen Desa (Village

Management Information System), SISKUED : Sistem Informasi Keuangan Desa (Village Economic and Financial Information System), SISKUEDES: Sistem Keuangan dan Ekonomi Desa (Village Economics and Financial System), VIS : Village Information System.

## Acknowledgement

The authors would like to express their sincere gratitude to the Ministry of Education, Science and Technology, Directorate of Research, Technology, and Community Service (DRTPM), as well as to the Institute for Research and Community Service (LPPM), Universitas Jenderal Soedirman (Unsoed), for their continuous support. We also extend our appreciation to the informants, respondents, and all stakeholders who generously contributed their time and valuable insights to this research.

## Author Contributions

Each of the mentioned authors has approved the work and contributed significantly, directly, and intellectually. Muslih Faozanudin: Conceptualization, Methodology, Writing–Original Draft, Ali Rokhman: Data Analysis, Supervision, Lilis Sri Sulistiani: Literature Review, Editing, Mohamad Yamin: Data Collection, Validation.

## Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

## Declaration of Artificial Intelligence (AI) Assistance

Generative AI tools (OpenAI's ChatGPT) were employed to support language refinement, including improving readability, grammar, and academic phrasing. These tools were not used to generate ideas, conduct data analysis, or interpret findings. All intellectual content, interpretations, and conclusions remain solely the responsibility of the authors, who carefully reviewed and validated all text before submission.

## Ethics Approval

This study received ethical approval from the Research Ethics Committee, Faculty of Social and Political Sciences, Universitas Jenderal Soedirman, Indonesia (Approval Number: B/5775/UN23.10/PT.17/2024, issued on November 14, 2024). All procedures performed in this research comply with institutional ethical standards and confidentiality of respondents' information.

## Funding

This research was financially supported by the Ministry of Education, Science and Technology, Directorate of Research, Technology, and Community Service (DRTPM) under research contract No. 054/E5/PG.02.00.PL/2024, and by the Institute for Research and Community Service (LPPM), Universitas Jenderal Soedirman (Unsoed). The views, results, and conclusions presented in this article are solely those of the authors and do not necessarily represent the official stance of the funding institution or related organizations.

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**How to Cite:** Faozanudin M, Rokhman A, Sulistiani LS, Yamin M. Investigating Key Factors affecting the Slow Digital Transformation in Village Government Public Service Improvement in Indonesia. Int Res J Multidiscip Scope. 2025; 6(4):654-667. doi: 10.47857/irjms.2025.v06i04.07116