DESIGNING MODULAR DIGITAL GOVERNANCE INFRASTRUCTURE FOR PUBLIC SECTOR FINANCIAL INTEGRATION: EVIDENCE FROM SMART SIPPP AT UNIVERSITAS TERBUKA

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ABSTRACT

Increased pressure has been applied on public universities to rationalise their financial management capacity. However, the shift has remained limited, with many still relying on decentralised systems supported by fragmented planning, budgeting, financial execution, procurement, and accountability frameworks. Such fragmented arrangements result in inefficient resource allocation, weak transaction traceability, and delays in coordination and compliance risks. This paper focuses on a qualitative single-case study of Smart SIPPP at Universitas Terbuka, an autonomous open university located in Indonesia. Based on the perspective of digital infrastructure and modular design, this study explores how an internally developed digital infrastructure can be designed to bind together fragmented financial processes with robust accountability. It draws from institutional documents, system observations, and records of implementation and operation. The data were thematically analysed to identify patterns corresponding to governance fragmentation, modular integration, embedded control mechanisms, audit traceability, and operational coordination. The results indicate that Smart SIPPP is built upon a shared digital architecture that integrates planning, budgeting, procurement, financial execution, and accountability. It integrates approval sequencing, validation controls, transaction records, and reporting visibility into financial workflows. Modular infrastructure decreases administrative fragmentation and supports audit readiness and regulatory alignment for autonomous public universities. By redirecting attention from technology adoption to infrastructure design, this study contributes to the literature on public sector digital transformation. The argument is that digital financial governance is not simply about adopting new technologies; it exists in the design of integrated infrastructures that make coordination, control, and accountability part of public organisations' everyday financial governance practices.

Keywords: Autonomous University, Digital Governance Infrastructure, Financial Integration, Modular Systems, Public Sector Accounting.

1.0 INTRODUCTION

Modernising financial governance is an immediate imperative for public universities functioning in increasingly sophisticated regulatory environments. Many institutions remain dependent on disconnected planning, budgeting, financial execution, procurement, and accountability processes. These fragmented arrangements often generate inefficiencies, redundant administrative tasks, weak audit traceability, delayed reporting, and heightened compliance risks. The problem becomes more serious in autonomous public universities,

where greater managerial flexibility is accompanied by stronger expectations for transparency, financial discipline, and institutional accountability.In particular, the literature agrees that public sector finance is a rapidly evolving digital context through approaches integrating digitalisation, automation, and data-driven governance. Prior studies have indicated that some public institutions can achieve organizational agility, operational efficiency, service effectiveness, digital transformation, and knowledge acquisition while replacing legacy systems (Atobishi et al., 2024; Haug et al., 2023; Ly, 2023; Saragih, 2025). However, many public institutions continue to face fragmented governance infrastructures that limit coordination, transparency, and real-time decision-making (Almulhim & Yigitcanlar, 2025; Merchán-Rodríguez & Juiz, 2024; Tumulak et al., 2024).

Despite this growing body of literature, much of the existing discussion still concentrates on technology adoption, digital readiness, or the performance outcomes of digital transformation. Less attention has been given to how digital infrastructure is intentionally designed to integrate fragmented financial processes and embed accountability into operational workflows.This research fills this gap by examining Smart SIPPP, an internally developed digital governance infrastructure at Universitas Terbuka. Because of its sizeable open and distance educational programs, geographically decentralised administrative configuration, and expanded operational autonomy from Government Regulation No. 39 of 2022, the institution provides a unique context for this investigation. This leads to significant coordination challenges and necessitates institutional requirements for integrated financial governance.Universitas Terbuka decided to build Smart SIPPP based on modular architecture that unifies all planning, budgeting, procurement, financial execution, and accountability processes within one integrated digital governance infrastructure. This makes the case analytically relevant, as it enables this study to investigate digital transformation, not simply as technology adoption, but rather as an infrastructure design process for overcoming governance fragmentation.

In this regard, this study examines the following research question: How can a modular digital governance infrastructure be designed to integrate fragmented financial processes while strengthening accountability in autonomous public universities?

This study adds to the literature by redirecting the analytical focus from technology adoption to public sector financial governance, with an emphasis on infrastructure design. This highlights how modular architecture enhances coordination, audit traceability, and accountability across complex financial governance ecosystems. In practice, this study provides takeaways for autonomous universities and other public-sector organisations looking to modernise their financial governance rather than digitising fragmented administrative processes.

2.0 LITERATURE REVIEW

2.1 Digital Transformation in Public Financial Governance

Digital transformation has enhanced different aspects of financial accountability, functional efficacy, and service responsiveness, which still need to mature in governance practices for public sector institutions. In the meantime, public organisations are increasingly required to improve legacy systems, enhance transparency and organisational efficiency, and strengthen their decision-making capabilities. Additionally, ongoing research indicates that digital capabilities foster the agility and performance of public organisations while enabling service innovation and legacy IT modernisation (Cosa & Torelli, 2024; Haug et al., 2023; Xu et al., 2024).This shift is especially critical in financial governance environments, where disconnected systems compromise operational coordination, duplicate administrative processes across departments, and weaken visibility over accountability markers. While many public organisations have implemented digital technologies, their integration into systems is challenging due to fragmented operational infrastructures, siloed workflows, and uneven organisational readiness (Aarab et al., 2025; Zhang & Kaur, 2024).Therefore, digital transformation should not be considered merely as adopting new digital tools. Digital

transformation in public financial governance also means rethinking institutional infrastructure so that planning, budgeting, procurement, financial execution, and accountability processes can work as an integrated governance system. Previous studies mainly view technology adoption, efficiency gains, and cases of emergence rather than how digital systems are purposefully constructed as governance infrastructure. This creates a need to find an approach to reconsider infrastructure design at the core of financial digitalisation in the public sector.

2.2 Digital Infrastructure Perspective and Modular Design

This study is based on a digital infrastructure perspective as its core theoretical lens. Instead of being seen as an independent information system, it views digital systems as socio-technical infrastructures that link actors, organizational units, workflows, data flows, and accountability mechanisms. Digital infrastructure differs from stand-alone applications because it spans organisational boundaries, facilitates coordination among many actors, and changes over time as institutional practices.In information systems research, these digital and information infrastructures are conceptualised as circular, heterogeneous, modular (in the sense of open architecture), interoperable, scalable, and evolving arrangements embedded in organisational routines and shaped by standards, installed bases, path dependence, and distributed control (Tilson et al., 2010). In contrast, these features differentiate digital infrastructures from standalone applications because they have value not only through technical functionality but also as enablers of coordination, integration, and adaptability across organisational processes.

One of the principal architectural features of digital infrastructure is its modularity. This modular design enables organisations to develop, change, or expand relevant system tasks as required without overhauling the entire infrastructure. This especially applies to complex public institutions where planning, budgeting, procurement, financial execution, and accountability functions might need their own workflows but also need to function within a shared governance architecture.Based on recent research, modularity can help improve organisational agility and allow institutions to respond relatively quickly to evolving operational demand (Lee et al., 2024; Zhang et al., 2025). Modular architectures are correlated with improved coordination, service delivery, and legacy infrastructure modernisation in the public sector (Fávero et al., 2025).However, modularity does not automatically ensure smooth integration. Modular systems have less well-defined integration mechanisms and are therefore likely to carry coordination problems via poorly connected modules, disconnected data flows, and fragile interoperability (Donmez & Norheim-Hansen, 2024; Putrama & Martinek, 2024). In financial governance, this risk is even higher, where planning, budgeting, and execution functions related to procurement and accountability must be integrated using reliable data sequencing and control mechanisms.

This study conceptualises Smart SIPPP from a digital infrastructure perspective, not as a standalone software application, but rather as a modular governance infrastructure to bridge fragmented financial processes and enhance institutional accountability (Firman et al., 2022).It analyses the infrastructure based on four dimensions:modularity, interoperability, scalability, and evolvability. These dimensions formthe basis for examining Smart SIPPP as connected processes in financial governance integrated via linked modules, shared data flows and controls, and traceable accountability.

2.3 Digital Governance and Accountability Infrastructure

Traditional financial governance frameworks are process-oriented and rely on extensive manual documentation, linear checks, and disconnected administrative coordination. These mechanisms are designed for accountability but may slow down the pace of decision-making in the field, lead to duplication of administrative efforts, and impose greater limitations on real-time financial operations.Digital governance infrastructure effectively re-engineer's accountability systems, with control embedded in the operational

workflows themselves. Such mechanisms can be built into workflows, approval structures, and some may have automated validation processes, maintain transaction records, enable traceability, integrated documentation, and real-time reporting. Previous research suggests that public organisations are progressing towards digitally enabled transparency and accountability (Ahearn et al., 2025; Xanthopoulou et al., 2023).However, it is not the digital nature of a system that creates accountability. This most definitely depends on whether this digital infrastructure is based on making the transaction visible, traceable, verifiable, and reportable across organisational units.This positions Smart SIPPP as more than just an operational system. It acts as a governance infrastructure by embedding coordination, control, and accountability mechanisms into financial workflows.

2.4 Regulatory Pressures and Public Accountability

Modernising financial governance is supported by regulatory frameworks in the following ways. ISAK 35 also offers intellectual triggers for public sector institutions in Indonesia to do better and concentrate on improving the quality of financial reporting, transparency, and accountability.Inadequate resources and technical readiness have been shown to lead to poor implementation of digital financial governance reforms in multiple studies (Damayanti et al., 2025; Michelotto & Joia, 2024). Failure to comply puts institutional legitimacy and stakeholders' confidence at risk (Dowling & Legrand, 2023; Khamzina et al., 2025).Simultaneously, regulatory pressure can stimulate innovation when institutions have sufficient internal resources to convert compliance requirements into redesigning their infrastructure (Mady et al., 2024; Wu & Tham, 2023).Therefore, regulation is not just a limit on innovation. It could also provoke a re-examination of how these financial governance systems need to be integrated, overseen, and made accountable.

2.5 Conceptual Framework

This study develops a theoretical framework that connects the fragmentation of governance, design of modular digital infrastructure, integration mechanisms, and governance outcomes based on the literature review highlighted above. The first institutional problem is the fragmentation of governance within the framework. Fragmentation results from planning, budgeting, and procurement processes, as well as financial execution and accountability being exercised through siloed systems, manual workflows, and separate administrative routines. This leads to inefficiencies, slow coordination, poor transparency, traceability gaps, and compliance risks. The second element is the modular design of the digital infrastructure. From the standpoint of digital infrastructure, modular infrastructure is understood to mean an interconnected system architecture that enables specialised financial functions to operate through shared modules while remaining connected through a network of data, workflow rules, and interoperability mechanisms. The third is governance integration mechanisms. These mechanisms provide pathways for explaining improvements in governance, which is a key outcome of functional modular infrastructure. The core Smart SIPPP mechanisms include workflow sequencing, approval hierarchy, automated validation, transaction traceability, documentation control, role-based access, and time-based reporting. The fourth is an outcome related to governance. Employing well-designed integration mechanisms in support of modular infrastructure can help reduce administrative fragmentation, facilitate operational coordination, reinforce audit readiness, and enhance regulatory alignment and accountability. Smart SIPPP represents a case of public-sector digital transformation, from technology adoption to infrastructure-based governance integration within this framework. This is shown by the following conceptual relationship:

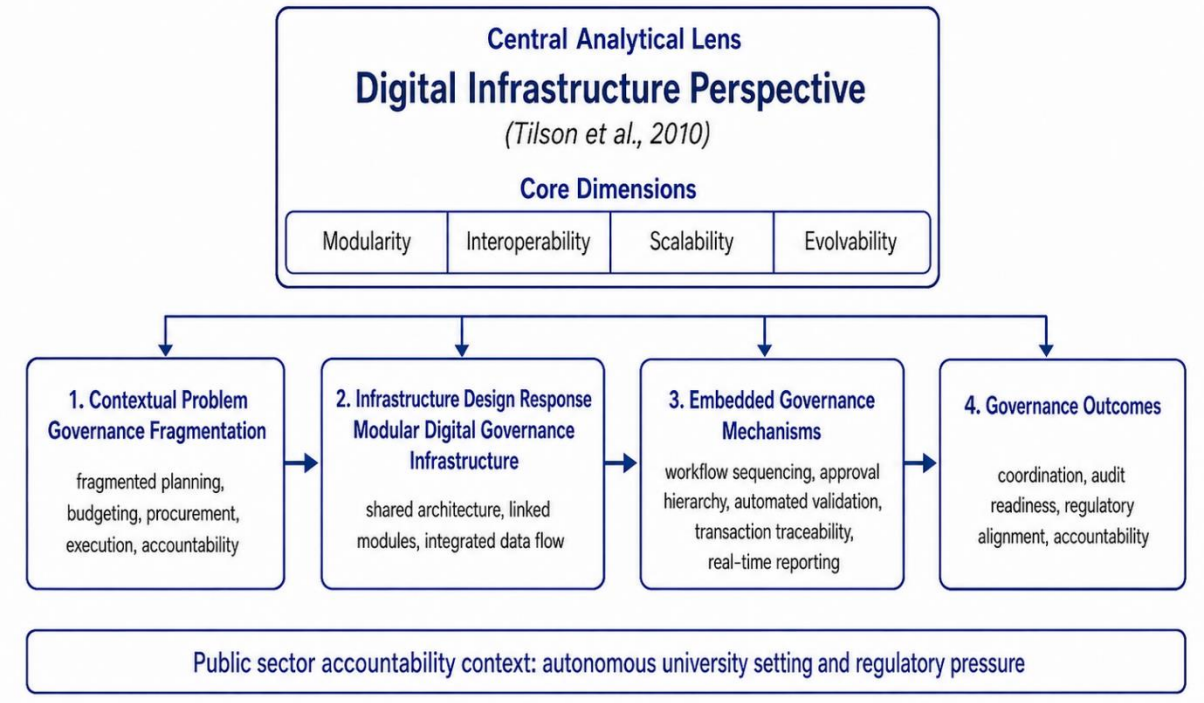


Fig. 1 *Conceptual Framework Informed by the Digital Infrastructure Perspective*

The key to the proposed framework is that modular digital infrastructure does not lead to accountability on its own. Instead, it is made more robust when modular architecture embeds governance mechanisms into financial workflows and ties previously siloed systems into an integrated network.

3.0 METHODOLOGY

3.1 Research Design

This study employed a qualitative single-case study design to examine the development and implementation of Smart SIPPP as a modular digital governance infrastructure at Universitas Terbuka. The case study approach was appropriate because the study aimed to understand how digital infrastructure was designed, implemented, and embedded within the financial governance processes of a real institutional setting.The analytical focus of this study was not on individual technology adoption behaviour, but on the design logic, integration mechanisms, and governance outcomes of an internally developed digital infrastructure. This focus is consistent with the study's conceptual framework, which uses the digital infrastructure perspective as an analytical lens for explaining how modularity, interoperability, scalability, and evolvability support governance integration.

Universitas Terbuka was selected as the case because it represents a relevant and information-rich setting for examining digital financial governance. The institution operates as a large-scale open and distance learning university with geographically dispersed administrative units and increased accountability demands following its status as an autonomous university under Government Regulation No. 39 of 2022.

3.2 Data Sources

This study used multiple sources of evidence to investigate the design, implementation, and governance outcomes of Smart SIPPP. Triangulation was reinforced using these multiple data sources, as it permitted the study to compare types of evidence across different documents, system observations, and operational records. The data sources

included institutional documents, system observations, and operational records pertaining to the development and use of Smart SIPPP from 2020 to 2022.

Table 1Data Sources and Analytical Purpose

Data source	Examples	Analytical purpose
Institutional documents	Planning documents, workflow records, implementation reports, financial reports, audit-related records, governance documents	To identify the governance problems, system development rationale, and institutional logic behind Smart SIPPP
System observations	Observation of planning, budgeting, procurement, financial execution, approval, reporting, and accountability workflows	To examine modular integration, workflow sequencing, approval structures, validation controls, and transaction traceability
Operational records	Audit outcomes, workflow efficiency evidence, paperless process records, real-time reporting outputs, implementation records	To assess governance outcomes, operational coordination, audit readiness, and accountability improvements

These sources were selected as ideal types of central components of the conceptual framework: fragmentation between governance regimes and design modularity, embeddedness in mechanisms governing infrastructure use, and the measurement of wider governance outcomes.

3.3 Document Analysis

A document review analysis of related internal institutional documents was used to inform the Smart SIPPP's development logic, governance rationale, and operational structure. These records illustrate the business and institutional imperatives that led to its design, the system's modular architecture, and the governance targets established during its creation. Document analysis uncovered references to fragmented workflows, coordination mechanisms, and approval procedures that did not meet reporting requirements and control mechanisms designed specifically to ensure accountability. This documentary data was also interpreted with respect to a comparison of pre-integration governance conditions and post-integration design logic of the Smart SIPPP.

3.4 System Observation

A system-level observation of how Smart SIPPP operates with respect to planning, budgeting, procurement, financial execution, and accountability workflows was conducted. The observation looked at details such as workflow structure, approval sequencing, validation points, user roles, transaction recordkeeping, documentation attachment, and reporting. This insight allowed the study to assess how governance mechanisms were inscribed directly into the digital infrastructure. Specifically, whether the system integrated disparate processes, enabled role-based approval with a clear audit trail, surfaced transaction visibility, and provided traceability across financial workflows.

3.5 Operational Evaluation

Operational records were assessed to determine how the Smart SIPPP addressed governance weaknesses within the pre-integration environment, supporting more structured governance after system integration. Integration with existing workflows, transaction traceability, operational efficiency, audit readiness, regulatory alignment, and reporting visibility were assessed. This study views operational outcomes as less performance metrics

than governance outputs enabled through the design of modular infrastructure along with embedded governance mechanisms. This ensured alignment between the conceptual model, data analysis, and results.

3.6 Data Analysis

The data were analysed thematically, and patterns were identified in relation to infrastructure design, governance mechanisms, and institutional outcomes. The analysis was performed in several steps. In the initial stage, the researcher became well acquainted with the data through institutional documents, observation notes, and operational records. First, initial codes were created based on recurring data regarding fragmented governance processes, modular design features, workflow integration, approval mechanisms, validation controls, transaction traceability, reporting visibility, and accountability outcomes. Third, similar codes were combined into meaningful analytical categories based on the conceptual framework. These include governance fragmentation, modular infrastructure design with digital capabilities, embedded mechanisms for governance, and governance outcomes. Finally, the themes were further refined through a cross-comparison of the evidence across documents, observations, and operational records. Finally, the themes were interpreted through digital infrastructure lenses to understand how modularity, interoperability, scalability, and evolvability dictate Smart SIPPP's design and governance role.

3.7 Trustworthiness and Credibility

Various strategies were employed to enhance the trustworthiness of this study. The first is the triangulation of data based on comparing evidence from institutional documents, system observations, and operational records. Second, the application of a conceptual framework reinforced analytical consistency by guiding the interpretation of the evidence across data sources. Third, to ensure an audit trail, institutional documents, system observations, and operational records were traced to the findings, governance mechanisms, and analytical interpretations. Appendix A provides an audit trail of the evidence for the themes. Fourth, researcher reflexivity was exercised by acknowledging that this case constituted an internally developed institutional system and thus required careful separation of descriptive system features from the analytical governance implications. These strategies would make the results more credible and reduce the risk of false claims, where descriptions of the systems are mistakenly seen as supported analyses.

4.0 FINDINGS

To clarify, the evidence is reported using the following codes: institutional documents (D1-D4), system and workflow observations (O1-O10), and operational or implementation records(R1-R3). The interpretation of the codes can be found in Appendix A. Table 2 presents a summary of the evidence supporting each sub-theme, governance mechanism, and analytical interpretation. Appendix A and Table 2 jointly allow for stronger traceability between the empirical evidence and the study findings.

4.1 Governance Fragmentation as the Initial Design Problem

Smart SIPPP was created to solve the fragmentation in financial governance processes at Universitas Terbuka. Prior to the integration, planning, budgeting, performance execution, and accountability activities were supported by standalone systems, isolated administrative routines, and document-based coordination across organizational units. All these scattered systems led to duplication of administration, increased approval time, limited data visibility, and a lack of traceability of transactions.

The analysis indicated that all financial processes redundantly involved numerous handovers of paper forms and repetitive checks across various units (D1-D4; O1-O3). Below

are some practices that lead to coordination costs and delays in the flow of financial information from the managerial decision-making system to the financial execution system. Fragmentation also constrains institutions' ability to monitor financial performance in real time because information is scattered across distinct workflows and system environments.These weaknesses became increasingly apparent as Universitas Terbuka grew in scale and became independent of the government. An integrated governance infrastructure that connects financial functions within the organisation, with a focus on assurance and accountability, compliance, and audit readiness is needed. Technical evidence of system heterogeneity in the legacy environment is shown in Figure 2.

Kriteria	Appel	Mataku	manisku, mapan	Mesra	SIPPAN	ProMISe	SIAIS	SIMPEG	Integrator (ideal)
Arsitektur	Monolitik	Monolitik	Monolitik	Monolitik	Microservice	Microservice	Monolitik	Monolitik	Microservice
Repositori	-	-	-	-	Gitlab	Gitlab	-	-	Gitlab
Framework	CI	CI	CI	CI	Laravel	Laravel	CI	Drupal	Laravel/CI
Database	MySQL	MySQL	MySQL	MySQL	MySQL	MySQL	MySQL	MySQL	Postgre, Mysql, MariaDB
UI/UX	NR	NR	NR	Responsive	Responsive	Responsive	NR	Responsive	Responsive
SSL	-	-	-	-	1.3	1.3	-	-	TLS 1.2 <
SSO									

Fig. 2 Legacy Fragmented Financial System

Fig. 2 shows the variation across legacy systems in terms of architecture, repository, framework, databases, interface responsiveness, security layer, and single sign-on readiness. This indicates that the pre-integration problem was not that the institution lacked a special way of conducting digital business. However, the real problem was the lack of integration between systems and financial governance workflows. This heterogeneity reinforces the need for financial integration on a common modular backbone rather than through external applications.From an analytical standpoint, this finding corroborates the first part of the conceptual framework: governance fragmentation acts as a contextual problem that requires modular digital infrastructure. Therefore, the issue was not only technical. It was a governance issue of disjointed workflows, various technology stacks across functions, and limited integration between financial processes.

4.2 Modular Architecture Design of Smart SIPPP

In response to these challenges, Universitas Terbuka constructed Smart SIPPP as a modular e-governance system. The intention was to create an integrated digital architecture combining planning, budgeting, procurement, financial execution, reporting, and accountability functionalities into one system. Smart SIPPP decentralises and interconnects financial functions using modular design principles that allow specific processes or functionalities to be linked through integrated data flows, rather than replacing all the functioning parts of an institution with one large monolithic system.The design covers the main dimensions that normally come to mind when considering the Digital Infrastructure Perspective. Modularity appears as interconnected modular components that disaggregate specific financial tasks. When used together in each workflow, the modules demonstrated interoperability by sending and receiving financial data. Scalability means that you can grow and use more reporting, monitoring, and integration when required. Evolvability refers to a system's ability to make incremental improvements during implementation.

The architecture achieved this by constructing the Smart SIPPP as connected functional components (D2–D4, R1–R3) instead of isolated applications. This study was able to share information defining planning, accountability, and enabling adaptive management, where specialised units operate at a flexible level within the more stable context of a comprehensive governance framework. Figure 3 shows the modular architectural design of the Smart SIPPP.

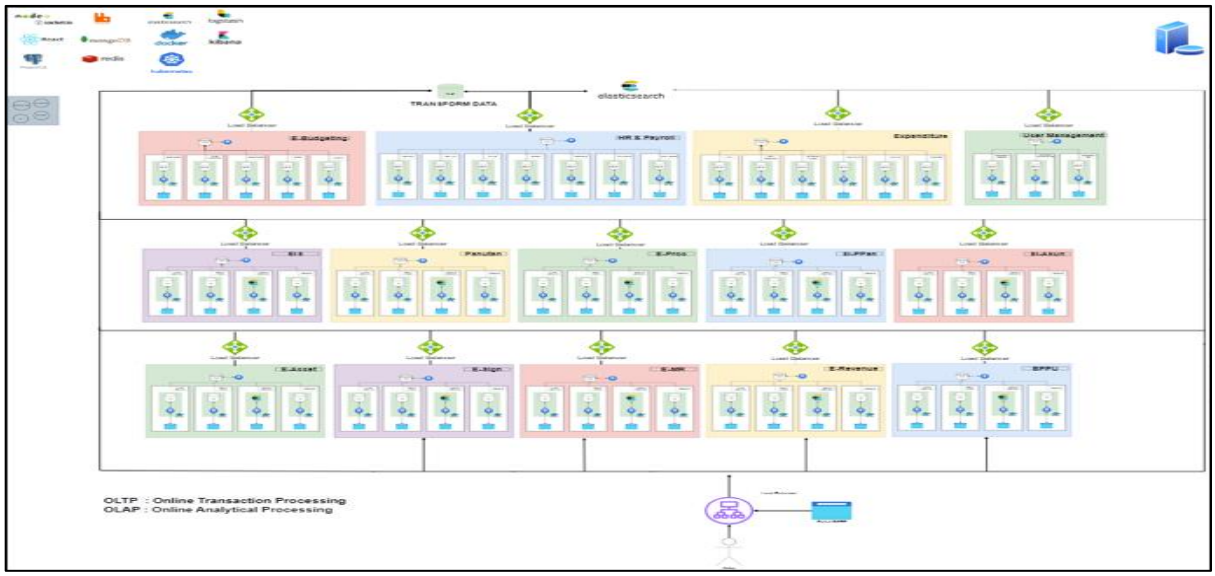


Fig. 3 Modular Architecture of SMART SIPPP

This study presents the Smart SIPPP, and Figure 3 shows how it connects several functional components in an architecture. This figure affirms the interpretation of Smart SIPPP not just as an operating application. It serves as an infrastructural design that responds to fragmented governance. This result aligns with the conceptual guidance of showing how a theoretical construct of digital infrastructure, specifically its core dimensions (modularity, interoperability, scalability, and evolvability), is translated into an institutional financial governance system.Organisational adjustments are also necessary after the implementation phase. Traditional administrative routines have been altered by new workflow disciplines, process dependencies, and inter-system coordination. Implementation records suggested that iterative refinement was needed before stabilising operations (R1–R3). This illustrates that building modular infrastructure is not only a technical task. It was also a process of institutional change in which coordination and control over financial governance were continuously adapted.

4.3 Governance Integration Through Digital Infrastructure

Smart SIPPP enhances governance integration by embedding mechanisms for accountability and monitoring in the financial workflow. Workflows consist of a series of sequential mechanisms, such as approval hierarchy, automated validation, transaction traceability, integrated documentation records, role-based access, and real-time reporting.As a result of these observations, financial activities were no longer regarded as isolated administrative steps (O4–O7). All planning, budgeting, procurement, execution, and accountability functions are linked to sequential workflows and approvals. By facilitating financial transactions through designated control points, it increased visibility into the nature of responsibilities, approval status, supporting documents, and transaction history.

Traditional financial governance mechanisms rely heavily on manual checking, operational document flow, and ex-post audits. In this context, these types of controls are at least partly part of the system architecture with Smart SIPPP. This was facilitated not only by human oversight but also by digital workflow rules, validation controls, documentation trails,

and reporting visibility, all of which support accountability.This finding explains how modular infrastructure produces governance value. Governance mechanisms are directly built into financial workflows, thereby facilitating accountability. This reaffirms the conceptual framework by placing embedded governance mechanisms as the analytical link between the modular infrastructure design and governance outcomes.

4.4 Operational Efficiency and Process Integration

Smart SIPPP integrates financial workflows for operational efficiency, workflow, and end-to-end document circulation, requiring far less manual document sharing, approval documentation, and reporting within the same environment. The system helps in paperless administration by processing and storing documents, approval records, and transaction details electronically.Operational records and system observational data suggested that integrated workflows facilitated better coordination across units because financial data were more easily retrieved within the system (O6-O10; R1-R3). By enabling management to monitor their finances on a near real-time basis, real-time reporting functionality can also help support faster monitoring than what is possible through continued reliance on manual, standalone reports.

These changes strengthened the integration of processes by closing the space between financial planning, budget execution, procurement, and accountability reporting. These processes are now more interconnected via common system architecture and workflow-based coordination rather than functioning as siloed administrative routines.Operational efficiency is an analytical point, not a technical performance claim. Here, governance output is illustrated from the connections of infrastructure. Less dependence on paper-based document circulation, better visibility on reporting, and enhanced coordination are tangible benefits, each of which speaks to the wider institutional value of modular digital governance infrastructure.

4.5 Audit Traceability and Regulatory Alignment

Smart SIPPP showed how audit visibility is enhanced through transaction traceability across the entire financial workflow. The system integrates processes for planning, budgeting, procurement, financial execution, and accountability to track transactions through many steps in the financial governance cycle.Transaction history, approval records, supporting documents, and accountability records became more readily accessible in the workspace (O7–O10;R2–R3), as revealed by system- and audit-related records. To illustrate, a finance transaction can have an entire thread from planning approval to budget distribution, procurement, or project execution events (with supporting documents), approval history, and accountability reporting.

The traceability function facilitates audit readiness by minimising reliance on fragmented document searches and increasing an institution's potential to establish compliance with both internal governance processes and external reporting obligations, including financial reporting expectations and accountability expectations associated with ISAK 35.This finding shows that the embedded governance mechanisms create accountability. Audit traceability was not created by digitisation. The concept grew from integrating transaction logs, approval schemes, documentation standards, and reporting transparency into the digital workflow environment.

4.6 Future Scalability of Governance Infrastructure

Although originally designed to streamline siloed financial governance, Smart SIPPP, built with a modular architecture, allows future scalability. The modular structure allows the institution to scale up the system by adding reporting capabilities, monitoring features, data integration tools, and connections with other institutional platforms, as necessary. Implementation records suggest that the installed modular framework should support

subsequent iterations and other integration needs (R1-R3). This scalability aligns with the digital infrastructure perspective that recognises digital infrastructure as a living system in perpetual maturity rather than a finished application as an immutable system. Scalability and evolvability are consequently key components of the Smart SIPPP, as it can be expected that some governance characteristics (institutional autonomy, regulatory expectations, audit demands, and technology capabilities) will evolve over time. Nonetheless, these future options should be understood with caution. These data represent developmental potential, as opposed to realisations. Financial integration and institutional accountability through modular governance infrastructure are the greatest contributions of Smart SIPPPs. This finding indicates that a modular digital governance infrastructure may lay the groundwork for viable and sustainable institutional reform. However, future effectiveness will be contingent upon the ongoing maintenance of systems, adaptation by users and supportive leadership, and institutional capacity to refresh this framework as governance requirements change over time.

Table 2 Evidence Trail Linking Findings, Mechanisms, and Governance Outcomes

Finding theme	Evidence source	Evidence basis	Governance mechanism	Analytical interpretation
Governance fragmentation	D1–D4, O1–O3, Figure 2	Legacy systems showed differences in architecture, repository, framework, database, UI/UX, SSL, and SSO readiness.	Identification of disconnected system environments and duplicated verification points	Fragmentation reflected weak integration across financial governance processes, not merely the absence of digital tools.
Modular infrastructure design	D2–D4, R1–R3, Figure 3	Smart SIPPP architecture showed linked functional modules and integrated system components.	Modular architecture, shared data structure, interoperability, and integrated data flow.	Smart SIPPP functioned as an infrastructure design response to fragmented governance.
Workflow-based governance control	O4–O7	Observed approval sequencing, validation points, role-based access, documentation records, and transaction movement across workflows	Approval hierarchy, automated validation, workflow sequencing, documentation trail, and role-based control	Governance controls were embedded into daily financial workflows rather than applied only through manual or ex-post control.
Process integration	O6–O10, R1–R3	Evidence of digital document processing, integrated workflow access, and reporting visibility	Workflow integration, reduced duplicated verification, digital documentation, and reporting access	Efficiency is interpreted as a governance outcome of integration, not as an unsupported time-saving claim.
Audit traceability	O7–O10, R2–R3	Transaction history, approval records, supporting documents, and accountability records were	Transaction traceability, documentation trail, approval history, and reporting visibility	Audit readiness improved because transactions became more visible, traceable,

Finding theme	Evidence source	Evidence basis	Governance mechanism	Analytical interpretation
		accessible within the workflow environment.		and verifiable across the financial governance cycle.
Scalability and future development	R1–R3	Modular design allowed future reporting, monitoring, and system integration extensions.	Scalability and evolvability of digital infrastructure	Smart SIPPP provides a foundation for future governance integration, but this remains potential rather than a fully realised outcome

5.0 DISCUSSION

This study examined Smart SIPPP as a digital governance infrastructure and an application platform that integrates fragmented financial processes by providing accountability in autonomous university environments. The results found that the core challenge in governance was not just a lack of digital technology, but rather an ongoing history of siloed financial workflows across planning, budgeting, procurement, financial execution, and accountability. This study shows how modularity, interoperability, scalability, and evolvability came together to reshape Smart SIPPP into an infrastructure-based response aimed at mitigating the fragmentation of financial governance through the lens of the digital infrastructure perspective.

The discussion is structured around five key points. First, it shifts the discourse from technology adoption to the design of infrastructure. Second, it shows how modular infrastructure provides governance coordination. Third, it demonstrates how embedded governance mechanisms convey accountability from digital infrastructure. Fourth, it identifies regulatory pressure as a foundation and catalyst for public sector infrastructure innovation. Fifth, this highlights the risks of fragmented digitalisation in public sector governance infrastructure.

5.1 From Technology Adoption to Infrastructure Design

The findings directly address the research question of the study as they empirically reveal that it is not only the adoption of technology in public financial governance that produces digital transformation. Essentially, the problem with Smart SIPPP is its fragmented governance architecture. At this point, Universitas Terbuka had already implemented digital tools and several administrative systems. However, the Planning, Budgeting, Procurement, Execution, and Accountability processes remain poorly integrated.

Prior studies have focused predominantly on various aspects of interest, such as adoption readiness, digital transformation outcomes, organisational agility, legacy modernisation, and digital service delivery (Atobishi et al., 2024; Haug et al., 2023; Ly, 2023; Saragih, 2025). However, these studies do not fully explain how infrastructure design operates as a mechanism for integrating financial governance.The Smart SIPPP case challenges the assumption that digitalisation automatically results in governance integration. Public institutions can adopt digital tools while maintaining siloed workflows, redundant verification, and disjointed accountability systems. Thus, digital transformation can replicate digital fragmentation rather than solving it.Therefore, this study contributes to the literature on digital transformation by demonstrating that infrastructure design is a fundamental prerequisite for governance integration. Smart SIPPP offers value in the shape of a digital

platform and its modular infrastructure that absorbs financial workflows, data flows, approval structures, and accountability records. From this perspective, the stabilisation of digital finance depends on the extent to which systems are designed to organise and interconnect institutional processes in a manageable manner.

5.2 Governance Coordination Through Infrastructure Integration

The study further shows increased coordination in public sector financial governance through modular digital infrastructure. Smart SIPPP connects these traditionally siloed functions through a shared management architecture, planning, budgeting, procurement, financial execution, and accountability.This is consistent with the core attributes regularly emphasised in the digital infrastructure literature. Modularity refers to the structuring of financial functions into manageable components. Interoperability enables the transfer of data and workflows among these components. Scalability allows the infrastructure to grow, while evolvability permits refinement whenever institutional needs change.

The theoretical dimensions of the Smart SIPPP case were illustrated through a secure connected architecture comprising interdependent modules, synchronised data flows, and feedback loops that iteratively refined the system performance. It makes it easier to avoid relying too heavily on siloed point solutions, allowing a much more traceable line between planning and accountability reporting.This is important because the behaviour of an organisation is shaped not only by its culture but also by the design of its infrastructure. Coordination in fragmented systems depends on manual follow-up, document circulation, and informal ad-hoc activities. As infrastructure is embedded, it enhances coordination along the workflow architecture, approval sequencing, and visibility of reporting.

5.3 Embedded Governance Mechanisms as the Link Between Design and Outcomes

An important takeaway from the case study is that, although modular infrastructure can provide a pathway for institutionalising accountability, it only does so if effective governance mechanisms are embedded in its regular operational processes. Specifically, for Smart SIPPP, the embedded governance features consisted of workflow sequence, approval hierarchy, automated validation, transaction traceability and integrated documentation, role-based access, and real-time report generation.These mechanisms illustrate how modular infrastructure design produces governance results. The digitalisation of transactions has led to better accountability and increased visibility, traceability, verifiability, and reportability of all financial activities across organisational units. These findings offer an investigation of the analytical gap between system design and governance outcomes.

The sense that embedded governance mechanisms act as a lens to link infrastructure design and governance value enters into how this study is designed. This is important because public-sector digital transformation research tends to focus on outcomes such as transparency, efficiency, and accountability without unpacking the mechanisms through which they occur.Smart SIPPP illustrates how control, which can strengthen accountability, is embedded in the very infrastructure. Approval hierarchies identify responsibilities, validation rules minimise discrepancies or non-compliance within processes, transaction records maintain traceability, and real-time reporting enhances monitoring visibility. Together, these mechanisms transform modular infrastructures into governance systems.

5.4 Regulatory Pressure as Both Constraint and Catalyst

The findings also reveal that regulatory pressure may serve as a barrier or an accelerant to public-sector infrastructure innovation. Autonomous public universities face more accountability for the flexibility they are granted. This emphasises the need for better financial reporting, compliance, visibility, audit readiness, and institutional transparency.The literature often argues that compliance burden and restrictive institutional environments can

constrain innovation (Bagherifam et al., 2025; Park et al., 2025). At the same time, recent research indicates that institutional capabilities can enable organisations to respond to regulatory pressure through innovation and strategic adaptation (Lee et al., 2024; Sankaran et al., 2023).

Smart SIPPP case supports this balanced viewpoint. In Indonesia, regulatory requirements and subsequent financial accountability pressures (such as ISAK 35) have advocated for institutional modernisation. However, this pressure will also justify the reform of the financial governance architecture. Instead of treating regulation merely as a compliance burden, Universitas Terbuka used it to link the planning, budgeting, procurement, execution, and accountability processes.This relationship must not be generalised. Innovation in organisations can be stimulated by regulatory pressure only when an organisation has been endowed with leadership support, technical capabilities, financial resources, and organisational readiness. In the absence of these conditions, regulation may become a source of administrative burden rather than an element that reforms infrastructure. This interpretation avoids technological determinism. Digital infrastructure, in principle, may enable accountability; however, it is contingent on institutional capacity and governance commitment, with the ability to integrate compliance pressure into system design.

5.5 The Risks of Fragmented Digitalization

One of the most significant takeaways from this study is that fragmented digitalisation may replicate old inefficiencies in a manageable digital format. Public institutions may adopt separate applications for procurement, finance, planning, reporting, and administration without ensuring interoperability across systems. These findings challenge overly optimistic views of digital transformation. Technology alone does not resolve governance fragmentation unless digital systems are designed to connect workflows, data, control points, and accountability records (Helbing & Ienca, 2024; Zwitter, 2024). The lack of connectivity and recognition of data causes new forms of fragmentation between institutions, inconsistent and duplicative inputs, unclear accountability for approval, and limited audit visibility.The Smart SIPPP case illustrates that the value of digital transformation relies on its integration logic. Digital transformation discussions should not only start but also end with the integration of governance problems. At the core of public financial governance is the ability to link financial processes to achieve better coordination, control, traceability, and accountability.

5.6 Implications for Future Public Sector Governance Infrastructure

The findings are relevant for autonomous universities and other public sector institutions which are modernising their financial governance. Future modernisation of the public sector should first focus on basic integration rather than frontline technologies such as AI, predictive analytics, or continuous auditing. Advanced technologies may offer limited value if the underlying governance infrastructure remains fragmented (Bagherifam et al., 2025; Helbing & Ienca, 2024). Hence, digital infrastructure should be treated as a governance project, not an information technology project for public institutions. Thus, financial governance actors, internal auditors, policy units, operational users, and technology developers should be part of the system design. This involvement is required to define control, accountability, and reporting requirements directly into the system design.

This modular design may be beneficial to public institutions that require modernisation without completely overwriting existing systems. However, modularity must be accompanied by interoperability and the same data architecture. Otherwise, modular systems risk becoming disjointed. Audit traceability must be designed rather than being an afterthought. To ensure this, public-sector financial systems should be proactive in capturing traceability across the entire financial governance cycle, from transaction to approval to document trail and accountability records.In summary, the practical implications are simple: public institutions should not digitise existing routines. They need to redesign the financial

governance infrastructure so that coordination, control, reporting, and accountability are part of daily work processes.

5.7 Theoretical Contribution

This study provides empirical evidence of the operation of these core dimensions in contemporary public sector financial governance, thereby contributing to the digital infrastructure literature. Modularity, interoperability, scalability, and evolvability are not only technical traits, but they also have governance implications. These dimensions influenced how financial processes were connected, accountability mechanisms were embedded, and institutional coordination was enhanced in the Smart SIPPP.This study also responds to the need for a larger public-sector digital transformation literature by developing an infrastructure design perspective. This study finds that treating digital transformation as adoption or implementation alone is inadequate to explain governance outcomes, which are contingent on the architecture of integration and the mechanisms embedded within that architecture.Finally, this study advances public-sector accounting and accountability by showing how digital infrastructure can make coordination, control, traceability, and reporting visible in evidence-based financial workflows. Instead of digital tools as administrative support systems, this shifts attention to digital infrastructure as a governance mechanism for public service delivery.

6.0 CONCLUSION

This study examined Smart SIPPP as a modular digital governance infrastructure to integrate fragmented financial processes and support accountability at Universitas Terbuka. The study emerged from the common public sector governance challenge faced by governments: how planning, budgeting, procurement, financial execution, and accountability functions often exist in silos, and administrative routines undermine effective coordination and auditability, thereby inhibiting reporting and compliance.Focusing on the digital infrastructure perspective as an analytic core, our findings illustrate the relevance of modularity, interoperability, scalability, and evolvability in explaining how digital infrastructure influences public financial governance. Smart SIPPP case demonstrates where the modular infrastructure connects specialised financial functions through shared architecture, interconnected modules, and data flows embedded in their capabilities, underpinned by safeguards (sequencing, approvals, validation, traceability, reporting, etc).

The results imply that Smart SIPPP did not just digitise processes to enhance financial governance, but also embedded coordination, control, and accountability into the operational workflows. Such integration enhances governance visibility, audit readiness, regulatory alignment, and accountability throughout the financial governance cycle.This study adds to the literature by redirecting the focus from technology adoption issues to infrastructure design in public sector digital transformation. This study argues that digital financial governance involves not only adopting digital tools but also creating a comprehensive infrastructure capable of linking workflows, data, control points, and accountability records.Therefore, this study has a practical component that presents lessons for autonomous universities and other public-sector entities that aim to modernise financial governance. This is because the underlying governance infrastructure will remain weak, potentially reproducing fragmentation with more advanced technologies (e.g. artificial intelligence, predictive analytics, or continuous auditing) piloted or attempted in institutions that have not integrated foundational elements.

The limitations of this study include its single-case design and focus on the original design and operational characteristics of Smart SIPPP versus long-term longitudinal outcomes. Future research could be conducted in comparative cases, longitudinal analysis, and investigating how leadership, organisational readiness, user capability, and regulatory environments affect the sustainability of modular digital infrastructure.In conclusion, the successful digital transformation of public finances does not only mean the adoption of

technology. This calls for the intentional design of infrastructure that links disparate processes together, integrating accountability into the everyday routines of institutions.

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

CO-AUTHOR CONTRIBUTION

Author 1 completed the study design and document analysis, system observations, case evidence analysis, and manuscript draft. Co-author 2 was involved in the conceptual development, methodological refinement, and critical review of the manuscript. Co-author 3 and Co-author 4 provided academic supervision, contributed to the interpretation of the findings, and reviewed the manuscript for intellectual content. All the authors have reviewed and approved the final version of the manuscript.

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DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

Generative AI tools were used only to help refine the language of a few sections for larger meaning, correct grammar, and check readability before manuscript preparation by the authors. The authors were solely responsible for the study design, data collection, system observation, analysis and interpretation of the findings, and the final scholarly decisions. The authors undertook a thorough review of all outputs generated during the editing process and take full responsibility for the accuracy, originality, and integrity of this manuscript.

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