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Analysis And Design of the Electronic-Based Tax Information System (SIPABETA) Architecture Using the TOGAF Architecture Development Method (ADM) at the Palu City Regional Revenue Agency

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Abstract

This study aims to analyze and design the architecture of the Electronic-Based Tax Information System (SIPABETA) at the Palu City Regional Revenue Agency (Bapenda) using the TOGAF Architecture Development Method (ADM). The study addresses data fragmentation, manual business processes, and limited system integration, which reduce the effectiveness of local tax administration and constrain the optimization of Locally Generated Revenue (PAD). A descriptive qualitative method was applied through a case-study approach involving interviews, direct observation, and document review. The analysis followed the TOGAF ADM phases, from the Preliminary Phase through Architecture Change Management. The study produced an enterprise architecture blueprint comprising an integrated business architecture, centralized data architecture, modular application architecture, and web-based technology architecture supported by application programming interfaces (APIs) and stronger data security. The proposed architecture is expected to improve operational efficiency, information accuracy, public service quality, and the transparency and sustainability of local tax governance in Palu City.

Keywords: TOGAF ADM, System Audit, Information System, Application Architecture, Bapenda Palu.

1 INTRODUCTION

Local tax administration is a central component of Locally Generated Revenue (Pendapatan Asli Daerah or PAD). Digital public services can improve the timeliness, traceability, and consistency of administrative transactions when business processes, data, applications, and infrastructure are designed as a coherent whole [1], [2]. Enterprise architecture provides the organizing mechanism for linking those layers to institutional objectives, while TOGAF ADM supplies an iterative method for developing and governing the architecture lifecycle [3].

At the Palu City Regional Revenue Agency (Bapenda Palu), preliminary evidence indicates that SIPABETA operates alongside manual activities and disconnected data stores. Taxpayer, tax-object, billing, and payment information is not yet consistently synchronized across tax categories and external payment channels. These conditions create duplicate work, delayed reconciliation, inconsistent records, limited cross-tax analysis, and weak management visibility. The problem is therefore not only an application-interface issue; it is an enterprise-wide alignment and integration problem.

Previous TOGAF-based studies have produced enterprise architecture plans for public health services, education, revenue agencies, and commercial organizations [4]-[8]. These studies establish the usefulness of ADM for structuring architecture artifacts, but many emphasize phase-by-phase deliverables without showing explicit traceability from field evidence to design decisions, stakeholder acceptance criteria, or a measurable post-implementation evaluation plan. Revenue-agency studies are also commonly organization-specific and do not address SIPABETA's combination of municipal tax silos, real-time bank reconciliation, digital tax documents, and staged governance in Palu City [6].

Research gap and contribution. This study addresses that gap by: (1) tailoring TOGAF ADM to the local-tax context of Bapenda Palu; (2) linking observed problems and stakeholder requirements to business, data, application, and technology decisions; (3) documenting

the rationale for major technology categories rather than presenting an unexplained product list; (4) defining architecture-review criteria and a requirement-to-design validation matrix; and (5) separating proposed benefits from empirically demonstrated results. The objective is to produce a validated and testable architecture blueprint, not to claim that implementation performance has already improved.

1 LITERATURE REVIEW

1.1 Information Systems and Enterprise Architecture

An information system combines people, processes, data, and technology to collect, process, store, and distribute information for operational and managerial purposes [1]. Enterprise architecture extends this systems view by describing how organizational capabilities, information, applications, and technology should be coordinated to achieve strategic outcomes [2], [3]. This perspective is appropriate for SIPABETA because fragmented tax administration cannot be resolved sustainably by changing a single application component.

1.2 Electronic Local-Tax Information System

Electronic tax services generally support registration, filing or self-assessment, billing, payment, proof of payment, and taxpayer communication. Indonesian studies report that online payment and self-service systems can improve accessibility and administrative effectiveness, although the result depends on integration, service quality, staff readiness, and taxpayer adoption [9]-[11]. In this article, SIPABETA is treated as a municipal digital-tax platform whose target state must support integrated taxpayer, tax-object, assessment, document, and payment data.

1.3 TOGAF Architecture Development Method

The TOGAF Standard, 10th Edition describes ADM as the core method for developing and managing an enterprise architecture [3]. The method includes the Preliminary Phase, Requirements Management, Architecture Vision, Business Architecture, Information Systems Architecture, Technology Architecture, Opportunities and Solutions, Migration Planning, Implementation Governance, and Architecture Change Management. ADM is iterative and tailorable, allowing artifacts and governance controls to be adapted to organizational context rather than applied as a rigid checklist.

1.4 Architecture Validation and Technology Selection

Architecture quality should be reviewed against stakeholder concerns, requirements traceability, interoperability, security, operability, maintainability, and implementation feasibility. Quality models such as ISO/IEC 25010 provide useful evaluation categories, while zero-trust guidance emphasizes explicit verification, least privilege, and continuous monitoring [12], [13]. For SIPABETA, technology categories are therefore selected according to open standards, interoperability, local skills, total cost, security, supportability, scalability, auditability, and avoidance of unnecessary vendor lock-in.

2 RESEARCH METHODS

This research used a descriptive qualitative single-case study focused on SIPABETA at Bapenda Palu. A case-study approach is suitable when a contemporary system is examined in its organizational and operational context using multiple evidence sources [14]. The unit of analysis was the enterprise architecture of SIPABETA, including tax-service workflows, information entities, applications, integrations, infrastructure, and governance.

2.1 Participants and Sampling

Participants were selected purposively by role: personnel who administer SIPABETA, personnel who execute or supervise local-tax services, and personnel responsible for technical operation or integration. Selection required direct involvement in at least one of the following activities: taxpayer registration, assessment, billing-document issuance, payment reconciliation, reporting, user support, or system administration. The source manuscript available for this revision did not record the final number of interviewees or the calendar dates and duration of fieldwork. These details are therefore not fabricated and should be inserted from the original field log before publication. This reporting limitation does not alter the architecture artifacts but restricts assessment of sample adequacy and temporal transferability.

2.2 Data – Collection Protocol

Semi-structured interviews followed a common protocol covering: current tasks and actors; data created or consumed; recurrent errors and delays; interfaces with banks and other systems; authorization and audit requirements; service expectations; and priorities, constraints, and risks for migration. Observation used a workflow checklist to record handoffs, duplicate entry, manual verification, exception handling, and system-

response points. Document review examined available process descriptions, forms, reports, data structures, system screens, and policy or governance materials.

2.3 Analysis and Triangulation

Analysis proceeded in five steps: (1) coding evidence into business, data, application, technology, and governance themes; (2) reducing duplicate observations and retaining evidence relevant to the research questions; (3) comparing interview statements with observed workflows and documents; (4) mapping confirmed issues to baseline and target architecture artifacts; and (5) reviewing each proposed control against its originating requirement. A finding was treated as corroborated when supported by at least two evidence types or when a discrepancy was resolved through follow-up review. This triangulation strategy improves traceability and makes disagreements visible rather than averaging them away [15].

2.4 Architecture Development and Validation

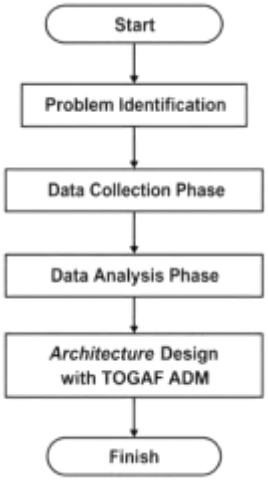

Figure 1. Research Stages

The ADM phases were used as an analysis and design sequence. Validation was structured as a walkthrough with representatives of business operations, system administration, management, and technical functions. Each reviewer assessed completeness, correctness, feasibility, security, interoperability, usability impact, and organizational readiness using a three-point disposition: accepted, accepted with revision, or unresolved. The revised blueprint should be approved only when no critical requirement remains unresolved. Because signed review forms were not included in the source file, this manuscript reports the validation procedure and criteria as the required governance mechanism, not as a completed quantitative acceptance result.

3 RESULTS AND DISCUSSION

3.1 Preliminary Phase and Architecture Principles

The Preliminary Phase prepares the organization and establishes the fundamental principles for architecture design. The findings indicate that SIPABETA development is intended to improve the effectiveness of local tax services, transparency, and administrative digitalization. The architecture principles serve as decision-making guidelines, as presented in the Principles Catalog.

Table 1 SIPABETA Principles Catalog

No.	Principle	Decision Rule
1	Business-IT Alignment	Every architecture work package must support a defined tax-service capability or PAD-management need.
2	Integrated Data	Taxpayer, tax-object, assessment, document, and payment records use governed master identifiers and controlled synchronization.
3	Seccurity and Privacy	Access is role-based, auditable, encrypted in transit, and limited to the minimum data needed.
4	Interoperability	Internal and external exchanges use documented APIs, versioning, validation, and error-handling rules.
5	Availability and recoverability	Critical services have monitoring, backup, recovery objectives, and tested restoration procedures.
6	Technology Independence	Open standards and portable components are preferred where they meet capability and support requirements.
7	Evidence – Based Change	Architecture changes require traceability to a requirement, risk, incident, regulation, or measured service need.

3.2 Requirements Management and Traceability

This phase identified the principal user requirements for SIPABETA: ease of access, service speed, and information transparency. Immediate priorities include improving the user interface (UI) and providing online payment facilities. Functions that remain unavailable include automated notifications and integrated digital payments.

Table 2. Development Issues and Architectural Solutions

ID.	Observed Issue	Architecture Response	Acceptance Indicator
R1	Delayed payment synchronization	API gateway, idempotent transaction handling, automated reconciliation, and exception queue	At least 95% of successful payments reflected within 5 minutes during pilot; no duplicate posting in test cases.

ID.	Observed Issue	Architecture Response	Acceptance Indicator
R2	Fragmented taxpayer and tax-object data	Governed master identifiers, canonical data model, migration rules, and data-quality checks	Duplicate-rate and mandatory-field completeness reported; agreed thresholds achieved before cutover.
R3	Manual verification and document issuance.	Workflow rules, role-based approval, e-SPPT/e-SKPD generation, and audit trail	End-to-end test passes for normal and exception scenarios; every decision has user and timestamp.
R4	Limited management visibility	Operational dashboard and governed analytical layer	Daily totals reconcile with transaction records; dashboard freshness and access controls verified.
R5	Access errors and weak user experience	Separated front end and service layer, responsive interface, usability testing	Task-completion rate and error rate measured with representative users before release.
R6	Weak architecture governance	Architecture board, compliance review, change log, and periodic risk review	All releases include architecture-compliance and security-review records.

3.3 Phase A: Architecture Vision

The primary vision for SIPABETA is to deliver fast, accurate, and transparent digital local tax services. The system is designed to address service delays, long queues at tax offices, and limited taxpayer access to information. Expected benefits include easier service access, improved tax-data accuracy, and optimized PAD. The system covers local tax categories under the authority of the municipal government, including hotel, restaurant, and advertising taxes.

3.4 Phase B: Business Architecture

The business architecture analysis indicates a significant transition from manual to digital processes. Business processes were modeled using Business Process Model and Notation (BPMN) diagrams for four core processes: registration, tax assessment, tax payment, and reporting and recommendations.

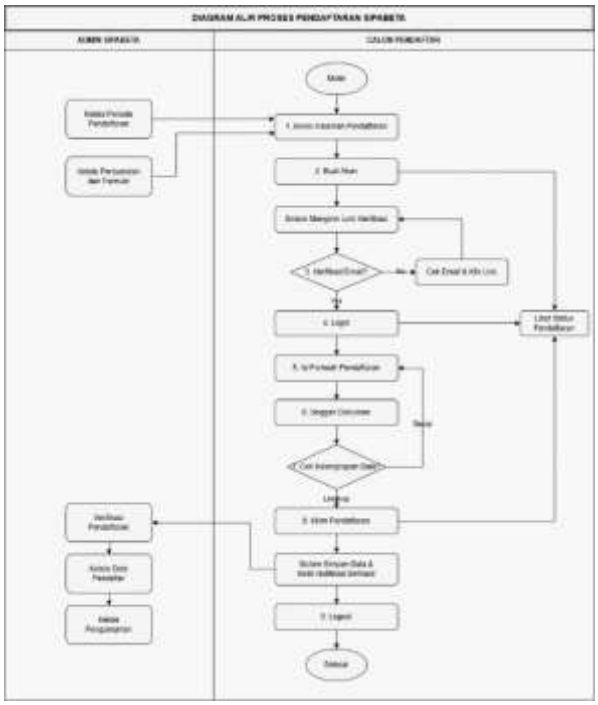

Figure 2. SIPABETA Registration Process Diagram

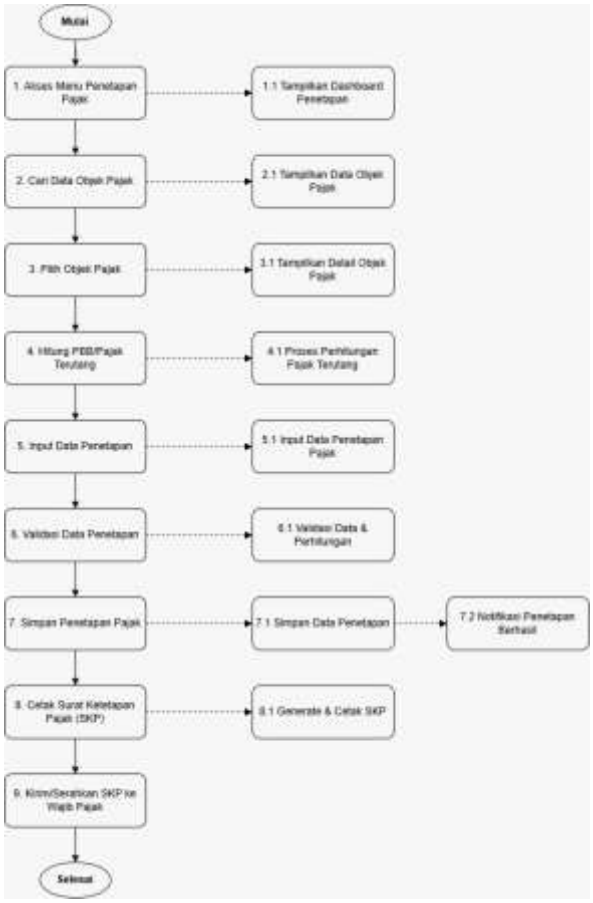

Figure 3. Tax Assessment Process Diagram

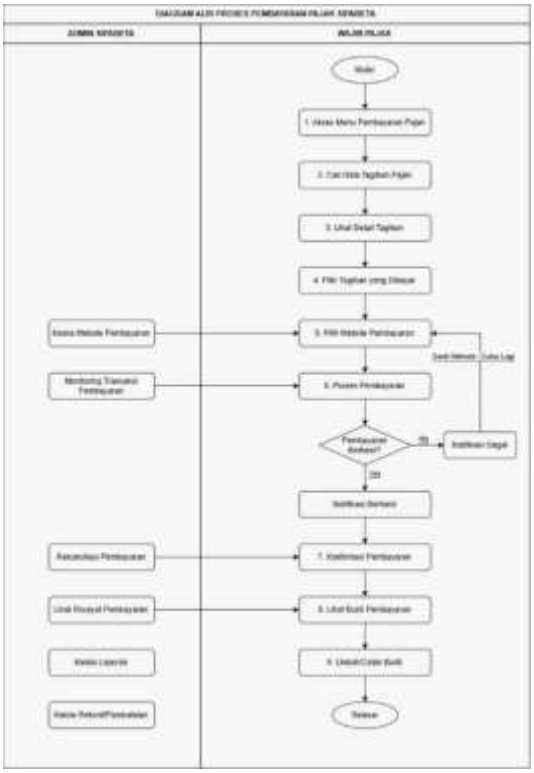

Figure 4. SIPABETA Tax Payment Process Diagram

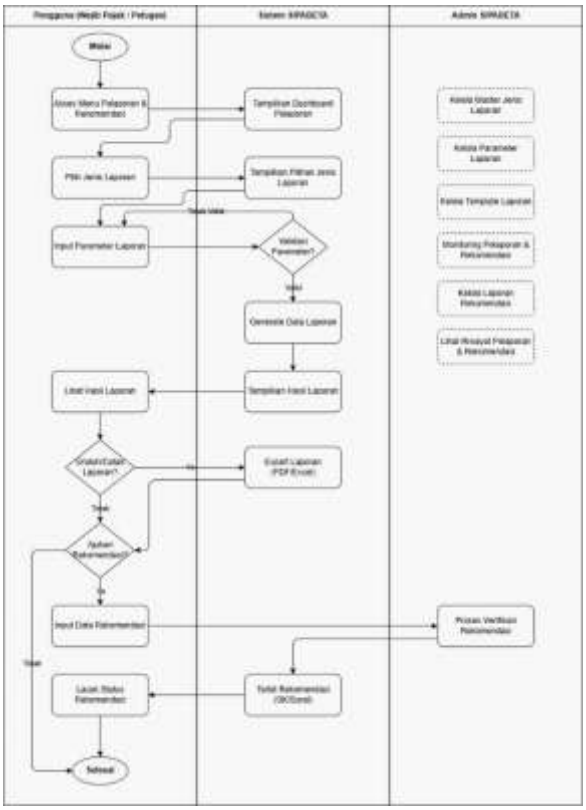

Figure 5. SIPABETA Reporting and Recommendation Process Diagram

The gap analysis between the current (as-is) and intended (to-be) conditions is summarized in the following tables.

Table 3. As-Is and To-Be Gap Analysis

No.	Aspect	As-Is	To-Be
1	Registration Process	Semi-manual	Online and integrated
2	Data Validation	Manual officer verification	Automated digital verification
3	SPPT Issuance	Printed/physical	Digital (e-SPPT)
4	Payment	Separate with manual reconciliation	Real-time integration
5	Reporting	Periodic	Real-time dashboard

Table 4. Business Gap Analysis

Activity	Baseline Condition	Target Condition	Status
Taxpayer registration	Manual (paper form)	Digital (web form)	Replace
Tax assessment	Manual/Excel calculation	Automated system calculation	Replace
SKPD issuance	Bulk printing and manual distribution	Self-service issuance (e-SKPD)	Replace
Payment	Cash at the service counter	Cashless/online	Replace
PAD monitoring	Monthly recapitulation	Real-time dashboard	New

Compared with previous TOGAF studies [4]-[8], the main difference is the emphasis on transaction reconciliation and cross-tax master data. The design does not simply digitize existing steps; it removes duplicate entry, makes exceptions explicit, and links each process outcome to an auditable data record. The practical implication is that process redesign, data governance, and integration contracts must be implemented together.

3.5 Phase C: Information Systems Architecture

This phase covers the design of the data and application architectures.

Data Architecture: SIPABETA manages key data entities represented in an Entity Relationship Diagram (ERD). The ERD models relationships among taxpayers, tax objects, Tax Due Notification Letters (SPPT), and payment transactions to maintain data integrity and consistency.

Figure 6. SIPABETA ERD Data Object Catalog

Figure 7. Entity Relationship Diagram

Application Architecture: SIPABETA is designed with an interface that facilitates user access. The user flow begins with application download and continues through sign-in, security verification, data management, and payment

Figure 8. Palu City SIPABETA Application

An API Gateway architecture pattern is used to integrate internal modules with external systems.

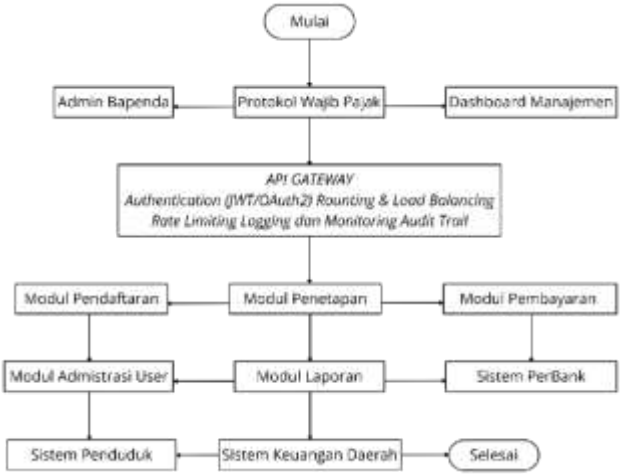

Figure 9. API Gateway Architecture Diagram

3.6 Phase D: Technology Architecture

The technology architecture defines the infrastructure standards required to support the system. The Technology Standards Catalog provides guidance for selecting appropriate technologies.

Table 5 Technology Standards Catalog

Capability	Preferred Standard or Option	Technical and Organizational Rationale
Server Platform	Supported Linux distribution; retain Windows only for justified dependencies	Linux offers broad support for web, database, and observability tooling. A mixed estate is acceptable only when lifecycle, patching, and staff support are defined.
Relational database	PostgreSQL; MySQL as an evaluated alternative	Both support transactional integrity and mature tooling. PostgreSQL is preferred when advanced constraints, extensibility, and standards-oriented SQL are priorities [16].
Web delivery	Nginx or Apache HTTP Server	Mature reverse-proxy and TLS termination capabilities; selection depends on existing skills, support, and benchmark results.
Identity and access	OIDC/OAuth 2.0 compatible identity provider, such as Keycloak	Centralizes SSO, role mapping, session policy, and integration with multifactor authentication. OAuth 2.0 is an authorization framework and should be paired with OIDC for authentication [17], [18].
API management	Standards-based gateway with OpenAPI documentation	Supports contract governance, throttling, authentication enforcement, versioning, and partner isolation.
Logging	Centralized searchable log platform, such as Elastic Stack or equivalent	Enables audit investigation and correlation across applications; retention and sensitive-data masking must be configured.

Capability	Preferred Standard or Option	Technical and Organizational Rationale
Monitoring	Prometheus-compatible metrics or Zabbix, with alerting	Provides measurable availability, latency, saturation, and error indicators. Choice depends on existing operational practice and integration effort.
Backup and recovery	Encrypted backup, off-site copy, replication where justified, and restoration testing	A backup is not accepted until restoration is tested against documented recovery-time and recovery-point objectives.

Figure 10. Technology Standards Catalog SIPABETA

3.7 Phase E: Opportunities and Solutions

This phase identifies development opportunities, including QRIS-based digital payment integration, an AI-enabled tax-service chatbot, and a real-time analytics dashboard. Recommended strategic measures include strengthening staff competencies, establishing an architecture management team, developing standard operating procedures, and securing budgetary support.

3.8 Phase F: Migration Planning

Migration planning is structured in stages to ensure a controlled transition. The migration and implementation roadmap comprises short-, medium-, and long-term phases.

Table 6 Roadmap Migration Plan

Time Horizon	Strategic Focus	Key Programs/ Activities	Expected Outputs	Organizational Outputs
Short Term (0–6 Months)	System Stabilization and Standardization	1. IT infrastructure audit 2. Integration of taxpayer and tax-object databases 3. Development of IT governance policies 4. Improved system security and data backup	Documented and standardized IT infrastructure, integrated databases, and established governance policies	Greater system stability, lower disruption risk, and an established foundation for digital transformation
Medium Term (6–12 Months)	Service Development and Integration	1. Development of the e-SPPT module 2. Online payment integration (banks/electronic channels) 3. Real-time monitoring dashboard 4. Implementation of risk management and internal controls	Integrated electronic tax services, available performance monitoring, and more automated business processes	Improved operational efficiency, transparent data, and faster public services
Long Term (1–3 Years)	Optimization and Digital Transformation	1. Interoperability with local-government systems 2. Implementation of Business Intelligence (BI) 3. Development of mobile and cloud systems 4. KPI evaluation and continuous improvement	An analytics-based system, available mobile services, and continuous performance evaluation	More effective local tax collection, stronger accountability, and continuous innovation

3.9 Phase G: Implementation Governance

Implementation governance ensures that execution remains aligned with the approved plan. The governance structure involves the Head of Bapenda, Head of the Information Technology Division, Technical Team, Audit Team, and Service Unit. Oversight is conducted through dashboard monitoring, periodic reports, and weekly coordination meetings.

Table 7 SIPABETA Implementation Governance

Governance Component	Mechanism	Role	Evidence
Strategic oversight	Approve scope, priorities, risk appetite, and funding	Head of Bapenda	Decision record and benefit owner
Architecture compliance	Review solution designs and deviations against principles	Architecture/IT governance team	Compliance checklist and waiver log

Governance Component	Mechanism	Role	Evidence
Technical assurance	Security, integration, performance, backup, and recovery tests	Technical team with internal control	Test report and remediation record
Operational readiness	SOPs, training, support, monitoring, and escalation rehearsal	Service and IT operations leads	Readiness sign-off
Data governance	Data owner assignment, quality rules, access classification, retention	Business data owners	Data dictionary and quality dashboard
Change control	Monthly review plus urgent security and regulatory path	Architecture board	Change register and versioned blueprint

3.10 Phase H: Architecture Change Management

The final phase ensures that the architecture remains relevant as requirements evolve. Change is managed through a monthly evaluation forum and complaint handling through the help desk.

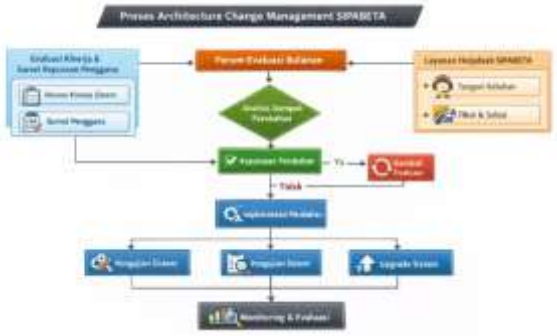

Figure 11 Architecture Change Management Process

3.11 Architecture Design Evaluation

Recent government-sector TOGAF ADM studies provide a more appropriate basis for evaluating the proposed SIPABETA architecture. Andrea et al. applied TOGAF ADM 9.2 to village e-government and assessed the resulting design using an Enterprise Architecture Scorecard, reporting 82.27% alignment with organizational objectives and implementation readiness [19]. Junirianto et al. designed an SPBE architecture for an Indonesian regional government agency and used a focused group discussion with five key stakeholders to examine contextual suitability and technical feasibility [20]. Both studies show that an architecture proposal can be evaluated before implementation, provided that design-level validation is clearly separated from operational performance measurement.

Following these cases, the SIPABETA blueprint was evaluated at the design level through architecture-artifact consistency and requirement coverage. The assessment examined whether the proposed business processes, data entities, application services, technology standards, migration activities, and governance controls addressed the six requirements identified in Table 2. The review showed complete conceptual coverage: delayed payment synchronization is addressed by the API gateway and automated reconciliation; fragmented taxpayer and tax-object records are addressed by governed master identifiers and a centralized data model; manual verification is addressed by workflow rules and auditable digital documents; limited management visibility is addressed by the operational dashboard; accessibility issues are addressed by separation of the presentation and service layers; and weak governance is addressed by architecture-compliance and change-control mechanisms.

The comparison also clarifies the contribution of this study. Similar to the Simpang Pasir e-government case [19], the SIPABETA architecture aligns business, data, application, and technology domains with public-service objectives. Similar to the SPBE case [20], the proposed design emphasizes organizational feasibility and staged implementation. However, SIPABETA adds requirements that are specific to municipal tax administration, particularly cross-tax master-data governance, near-real-time bank reconciliation, digital tax-document issuance, transaction auditability, and exception handling. These elements make the architecture more directly suited to revenue-administration risks than a general-purpose e-government blueprint.

This evaluation supports the internal coherence and implementation readiness of the proposed architecture, but it does not demonstrate improved production performance. After deployment, the expected benefits must be verified using the acceptance indicators in Table 2, including payment-update latency, duplicate-record rate, mandatory-field completeness, task-completion rate, transaction error rate, dashboard reconciliation accuracy, system availability, and architecture-compliance records. Accordingly, the present result is a design-level enterprise architecture blueprint whose operational effectiveness remains subject to pilot implementation and before-and-after measurement.

4 CONCLUSION

This study developed an enterprise architecture blueprint for SIPABETA by applying TOGAF ADM to the business, data, application, technology, migration, and governance requirements of the Palu City Regional Revenue Agency. The proposed architecture consolidates taxpayer, tax-object, assessment, tax-

document, and payment information through governed master data; restructures registration, assessment, payment, and reporting as integrated digital workflows; and introduces API-mediated payment reconciliation, role-based access control, operational monitoring, backup and recovery controls, and phased implementation governance. The requirement-to-architecture mapping shows that each principal problem identified in the current environment is addressed by a corresponding target capability and acceptance indicator.

Compared with general e-government TOGAF implementations, the SIPABETA blueprint places greater emphasis on requirements that are specific to municipal revenue administration, including cross-tax data consistency, near-real-time bank reconciliation, digital tax-document issuance, transaction traceability, and controlled exception handling. The design-level evaluation indicates that the proposed artifacts are internally consistent and aligned with the service and governance objectives of Bapenda Palu. These findings support the suitability of the architecture as an implementation guide, while improvements in processing time, data quality, service availability, user acceptance, and PAD monitoring remain outcomes to be verified during pilot deployment.

Implementation should begin with data cleansing and master-data governance, followed by payment integration, identity and access management, logging, monitoring, and tested backup restoration. A controlled pilot should then measure payment-update latency, duplicate-record rates, mandatory-field completeness, transaction errors, task-completion rates, dashboard reconciliation accuracy, and system availability against the indicators defined in this study. Subsequent development, including business intelligence, mobile services, cloud deployment, and an AI-assisted service channel, should proceed only after the foundational controls and pilot targets have been achieved. Periodic architecture reviews and staff and taxpayer training should accompany each migration stage to maintain alignment with regulatory changes and operational needs.

5 RECOMMENDATIONS

1. Staff Training. Conduct regular training for personnel to support effective use of SIPABETA.
2. System Integration. Strengthen integration across SIPABETA and real-time monitoring modules to consolidate data.
3. Architecture Evaluation. Conduct periodic reviews through the TOGAF ADM cycle to keep the system aligned with regulations and public needs.
4. Taxpayer Outreach. Expand information and educational activities to increase taxpayer participation and compliance.
5. Digital Service Improvement. Develop additional features to simplify transactions and improve taxpayer access to information.

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