

# Enterprise Architecture Design of SPBE Using TOGAF ADM for Improving Operational Efficiency: A Case Study of the Mining Sector at the West Java ESDM Agency

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**Abstract**— The Energy and Mineral Resources (ESDM) Agency of West Java, particularly its Mining Division, faces significant operational inefficiency challenges due to manual work processes, undocumented data management, and fragmented information systems. This condition hinders the achievement of strategic goals and compliance with the mandate of the Electronic-Based Government System (SPBE) as stipulated in Presidential Regulation No. 95 of 2018. This research aims to design an Enterprise Architecture (EA) to improve efficiency using the TOGAF ADM framework. The as-is analysis identified key problems in licensing, reporting, monitoring, and complaint services. As a solution, a to-be architecture was formulated based on the integrated E-Osmosys platform with a centralized database and API integration. Conceptual validation indicates the potential to eliminate data redundancy by up to 100% and achieve significant time efficiency improvements. The resulting blueprint provides a measurable strategic foundation for digital transformation to realize more efficient and reliable governance.

**Keywords**— Enterprise Architecture, TOGAF ADM, Electronic-Based Government, System (SPBE), Operational Efficiency, Business Architecture.

## I. INTRODUCTION

Digital transformation in the public sector has become a critical national priority under Presidential Regulation (Perpres) No. 95 of 2018 concerning the Electronic-Based Government System (SPBE). While countries like Singapore have successfully institutionalized centralized and highly coordinated e-government infrastructures, regional implementations in Indonesia remain severely bottlenecked by a lack of cross-agency integration, legacy infrastructural deficits, and suboptimal data synchronization. This regulation aims to realize clean, effective, transparent, and accountable governance, as well as high-quality and trustworthy public services through the integrated utilization of information and communication technology [1]. The goal of SPBE extends beyond mere digitization; it is a strategic approach to "optimize the use of technological devices. in modernizing governance. Through this, SPBE not only promotes administrative efficiency but also strengthens accountability and public information transparency" [2]. However, in the effort to realize this strategic vision, the

implementation of SPBE at the regional government level still faces various challenges, ranging from infrastructure limitations to a lack of cross-agency system integration [3].

The Energy and Mineral Resources (ESDM) Agency of West Java Province, as one of the Regional Government Organizations (OPD), holds a strategic responsibility for managing the energy and mining sector. Specifically, the Mining Division is tasked with a strategic objective articulated in the agency's Strategic Plan (Renstra), which is "To enhance the administrative and technical compliance of mining operations." However, the achievement of this objective is hindered by a series of fundamental operational inefficiencies. A preliminary analysis identifies an inefficiency paradox: despite the availability of several digital systems, such as the national Mineral Licensing system (Perizinan Minerba), the Online Single Submission (OSS) system, and the internal E-Osmosys system, work processes within the Mining Division still heavily rely on manual workflows, undocumented data management, and fragmented systems. This condition, where digital investment has not fully translated into process optimization, is not an isolated phenomenon. The operational inefficiencies at the agency level are not merely an internal issue but reflect a broader national challenge. As literature suggests, "the implementation of a clean, efficient, simple, and flexible bureaucracy, supported by responsive governance, will have a significant impact on improving the quality of public services," which in turn drives sustainable economic growth as a main pillar of the national development agenda [4].

Therefore, an Enterprise Architecture (EA) approach becomes crucial for analyzing the current conditions and strategically planning the implementation of SPBE. EA provides a methodology to realign information technology assets to ensure alignment between IT and the organization's business needs [5]. Although many studies have applied EA frameworks such as TOGAF ADM in government environments ([6]; [7]), a research gap remains in the provision of a robust validation mechanism to build a measurable business case. This research aims to fill that gap by not only designing an architectural blueprint but also presenting a metric-based conceptual validation that quantitatively proves the potential for efficiency

improvements. Thus, the primary contribution of this study is to provide a strategic plan supported by measurable evidence, serving as a foundation for the digital transformation of the Mining Division at the West Java ESDM Agency.

While these studies successfully established foundational conceptual blueprints, they treated government agencies as closed, isolated systems. They stopped short of presenting data-driven validation mechanisms to quantitatively justify the digital intervention. Furthermore, none of these models address the unique regulatory friction of the mining sector, which operates under rigid, dual-tier federal-state mandates requiring regional compliance with centralized national systems. The novelty of this research lies in filling this exact gap. It provides a customized TOGAF ADM blueprint designed for vertical regulatory environments, supported by a quantitative, metric-based validation framework tailored to a bureaucratic ecosystem. By introducing automated API middleware directly into the internal E-Osmosys platform, this study shifts regional governance from a reactive state to an integrated, data-driven framework.

## II. METHOD

This research adopts a descriptive qualitative approach using the case study method. This approach was chosen to obtain an in-depth understanding of the phenomena of operational inefficiency and architectural needs within the specific context of the Mining Division of the West Java Energy and Mineral Resources Agency. Data collection was conducted through the triangulation of three main sources to ensure the validity and richness of the information. First, a document study was performed by analyzing internal organizational documents such as the Strategic Plan (Renstra) and Standard Operating Procedures (SOPs) to understand the formal framework and strategic objectives. Second, semi-structured interviews were conducted with internal informants from the Mining Division and information system managers to gather in-depth information regarding existing conditions, manual work processes, and user needs; and third, a literature review of journals, books, and related research was used to build a strong theoretical foundation.

The architecture analysis and planning process utilizes the TOGAF ADM framework as its primary method. This framework was chosen because, as stated in the literature, "TOGAF provides detailed guidance on how to plan, design, develop, and implement an enterprise architecture and information system, which is known as the Architecture Development Method (ADM)" [8]. Furthermore, the chosen method is inherently structured and continuous, as the "ADM is TOGAF's logical methodology consisting of primary phases for the development and maintenance of an organization's technical architecture. This method is iterative, dynamic, and sustainable" [9]. To apply this structured methodology effectively within the scope of the research, and in accordance with the research limitations, the application of TOGAF ADM is focused on several phases: the Preliminary Phase (establishing architectural principles); Phase A (Architecture Vision); Phase B (Business Architecture); Phase C (Information Systems Architectures: data and application); Phase D (Technology Architecture); and Phase E (Opportunities and Solutions, including gap analysis and solution formulation).

To ensure that the proposed architecture is not only theoretically robust but also holds practical and strategic relevance, this study employs a conceptual model validation conducted through three approaches.

### 1. Comparison of Efficiency Metrics

This validation measures the potential for efficiency improvement by comparing the As-Is and To-Be architectures using three specific metrics: Time Efficiency, Manual Step Reduction, and Data Redundancy Reduction. These calculations are based on established formulas to provide a measurable projection of the impact

#### a. Time Efficiency

BeforeTime represents the average operational duration stipulated by current SOP guidelines or reported by informants during legacy execution. AfterTime represents the simulated execution time within an integrated environment.

$$\text{Time Efficiency (\%)} = \frac{(\text{Before Time} - \text{After Time})}{\text{Time Before}} \times 100 \quad (1)$$

#### b. Step reduction

Steps are counted strictly as human-initiated manual transactions, hand-offs, or escalations mapped within the corresponding BPMN models. Automated backend operations executed by the system do not count as active steps. For instance, handling a citizen complaint requires 4 distinct manual routing steps via WhatsApp.

$$\text{Step Reduction (\%)} = \frac{(\text{Before Time} - \text{After Time})}{\text{Number of Steps Before}} \times 100 \quad (2)$$

#### c. Data Redundancy Reduction

The structural elimination of duplicated data storage fields is quantified via the following display formula:

$$\text{DRR (\%)} = \frac{(\text{Before Time} - \text{After Time})}{\text{Number of Steps Before}} \times 100 \quad (3)$$

### 2. Stakeholder Validation

Discussion sessions were conducted with representatives from the Mining Division to confirm the accuracy of the problem analysis and to ensure that the recommended solutions address real-world needs.

### 3. Expert Judgment

The resulting design was validated by an Enterprise Architecture consultant to test the architectural solution and the logic of the quantitative projections, thereby providing a "reality check" for the research findings.

## III. RESULT AND DISCUSSION

This section presents the results of the architecture analysis and planning, which were conducted systematically using the TOGAF ADM framework. The objective is to produce a blueprint that can address operational efficiency issues within the Mining Division of the West Java Energy and Mineral Resources Agency.

### A. Preliminary Phase

In this phase, a Principles Catalog is developed to identify the principles that will guide the subsequent design process. These principles are presented in a tabular Principles Catalog, which details the principles to be adopted by the Mining Division of the West Java Energy and Mineral Resources Agency and outlines the expected outcomes of each.

TABEL I. PRINCIPLES CATALOG

Principle	Result	Description
Business Principles	The designed architecture must be aligned with the organization's goals, activities, primary tasks, and functions.	Ensuring that every proposed technology solution directly supports the achievement of the agency's strategic objective, namely "administrative and technical order."
Application Principles	Applications must be managed with strong commitment to deliver services that meet user needs and are easily accessible. Furthermore, the developed applications must provide specific web services and Application Programming Interfaces (APIs) to enable integration with other applications.	This addresses the problem of fragmented systems. This principle mandates the use of APIs for integration, prevents the future development of siloed applications, and ensures a unified user experience.
Data Principles	Data must be managed optimally by ensuring that its storage, accuracy, timeliness (real-time), and confidentiality are maintained. Information technology management at the West Java Provincial ESDM Agency must include the identification of master data management to guarantee data consistency and quality across all application systems, for both internal and external purposes, in accordance with applicable regulations.	This directly addresses the issue of scattered and redundant data. This principle prohibits the creation of new, isolated databases and requires all modules to interact with a single, centralized database.
Technology Principles	The required technology infrastructure will be provided by the Communication and Informatics Agency.	This optimizes existing resources and ensures compliance with the national SPBE (Electronic-Based Government System) policy.

**B. Phase A: Architectural Vision**

The Architecture Vision phase is the initial step in the architectural design process, serving to establish a strategic vision and a general overview of the solution. This ensures that all stakeholders share a common perception of the project's direction.

The vision adopted is from the SPBE (Electronic-Based Government System), which is "To realize quality public services based on Information and Communication Technology." This vision supports the achievement of the West Java provincial development vision, "JABAR ISTIMEWA" (Special West Java), which emphasizes excellent, innovative, and technology-based public services.

To realize this vision, the SPBE mission was established, which includes: (1) strengthening electronic-based organizational governance; (2) developing integrated and

inclusive digital public services; (3) building an integrated, secure, and reliable ICT foundation; and (4) enhancing human resource competencies based on information and communication technology.

Subsequently, a mapping of work processes was conducted using a value chain diagram (Fig. 2) to identify primary activities (licensing, reporting, evaluation, result dissemination, supervision, and complaints) and their supporting activities.

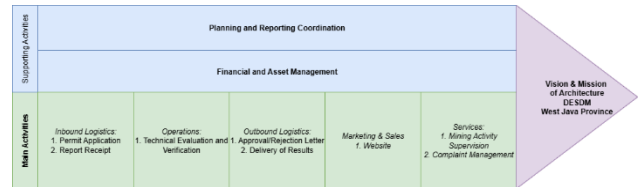


Fig. 1 Value Chain Analysis.

**C. Phase B: Business Architecture**

This phase analyzes the current (as-is) business processes to identify inefficiencies and formulate recommendations for the improved (to-be) state.

**a. Analysis of Current Business Architecture (As-Is)**

The current state analysis identifies four main problems: (1) a fragmented licensing system that requires manual recapitulation; (2) a redundant data entry process for RKAB reports; (3) a supervision process that is not digitally documented; and (4) a complaint service that relies on informal platforms. These inefficiencies are visualized through the following BPMN modeling.

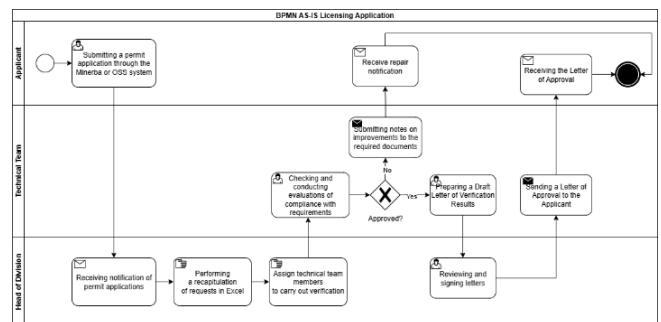


Fig. 2. BPMN Permit Application Process (As-Is)

This process demonstrates inefficiency due to the manual recapitulation of data from national systems (OSS/Minerba) into Excel files, which slows down processing and is prone to errors

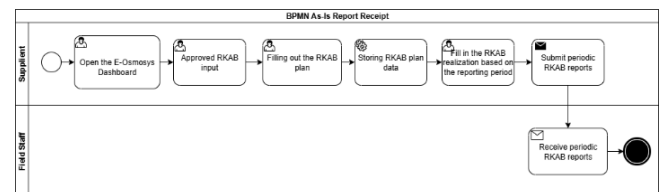


Fig. 3. BPMN Report Receipt Process (As-Is)

This workflow reveals redundancy, as applicants are required to re-enter licensing data when submitting RKAB reports in E-Osmosys.

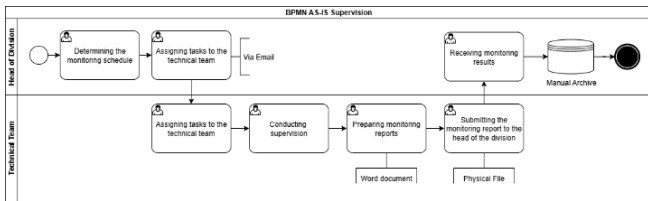


Fig. 4. BPMN Supervision Process (As-Is)

The supervision process is entirely manual, making the data difficult to track and analyze.

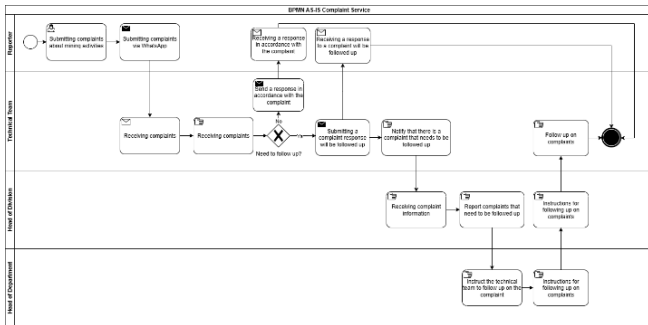


Fig. 5. BPMN Complaint Service Process

The use of WhatsApp for this process means that data is not systematically documented and is difficult to monitor.

*b. Target Business Architecture Recommendations (To-Be)*

As a solution, a target architecture is recommended that automates and integrates business processes into the E-Osmosys system. The recommended-to-be business processes are designed to re-establish strategic alignment. This focus on process redesign is a core activity in establishing the new Business Architecture, where, according to theory, "Business Architecture describes the general information related to the organization needed to ensure alignment between the company's strategic vision and mission and its operational policies" [10].

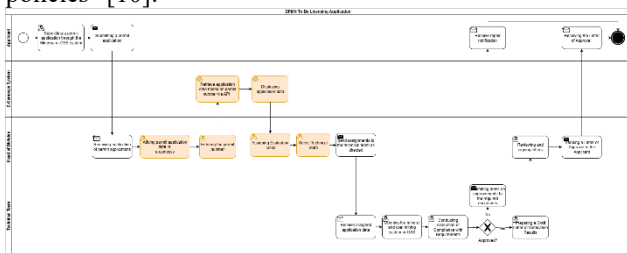


Fig. 6. BPMN Permit Application Process (To-Be)

Manual processes are eliminated through API integration, allowing the E-Osmosys system to automatically pull application data from the national systems.

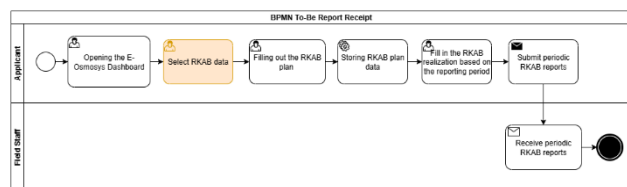


Fig. 7. BPMN Report Receipt Process (To-Be)

Data redundancy is eliminated by enabling the E-Osmosys system to retrieve existing licensing data.

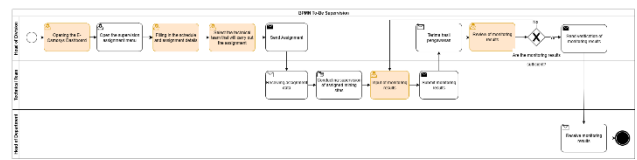


Fig. 8. BPMN Supervision Process (To-Be)

The entire supervision workflow is digitized, with all data stored in a centralized database for easy tracking and analysis.

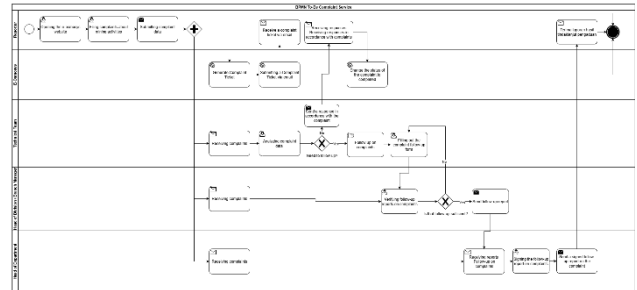


Fig. 9. BPMN Complaint Process (To-Be)

A structured complaint system is introduced in E-Osmosys, which provides tracking ticket numbers and ensures every complaint is recorded and followed up on transparently.

*D. Phase C: Information System Architecture*

This phase focuses on designing the data and application architecture to support the recommended business processes. This is a critical step where the previously defined business needs are translated into technical specifications, directly addressing the core purpose of an enterprise architecture, which is to provide "a set of models that guide the decision-making process to achieve alignment between expected business goals and the information technology resources within a company" [11]. The as-is analysis reveals a significant lack of this alignment, primarily due to system fragmentation.

*a. Analysis of Current Business Architecture (As-Is)*

The current state reveals that data is scattered across various disconnected systems, causing redundancy and unstructured data (Fig. 10). This fragmentation represents a fundamental architectural flaw, as literature defines that "enterprise architecture serves as the primary foundation for developing information systems at the enterprise level, which demands optimal integration through the use of information technology" [12]. The failure to achieve this required integration is not confined to the data layer, as the application architecture is similarly fragmented, forcing staff to act as manual liaisons between systems (Fig. 11).

Fig. 10 visualizes the fragmented data flow, which relies on manual processes such as recapitulation into Excel. Fig. 11 shows agency staff positioned in the middle, manually bridging the gap between national systems and informal platforms.

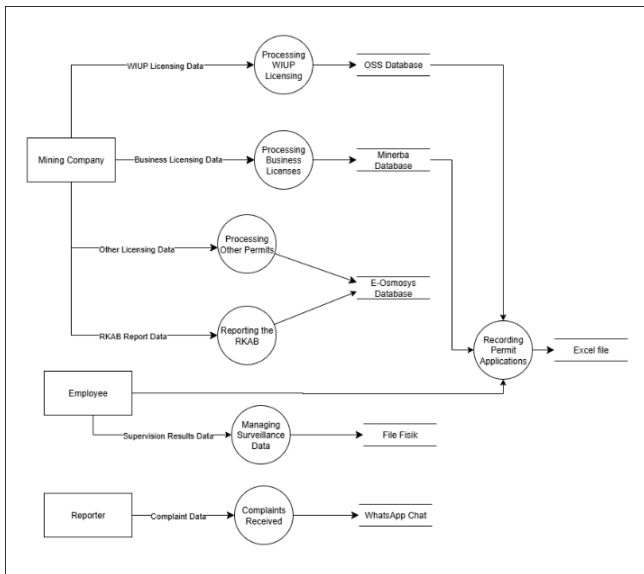


Fig. 10. Baseline Data Architecture

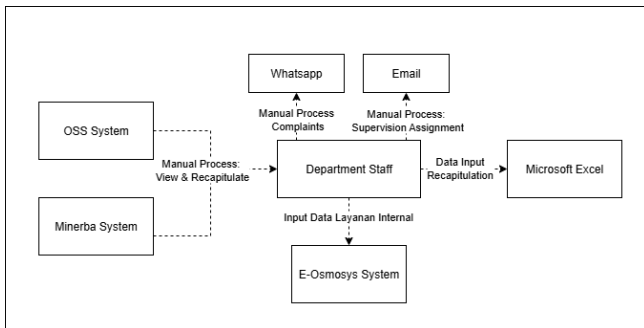


Fig. 11. Application Architecture Block Diagram (As-Is)

*b. Target Information System Architecture Recommendation (To-Be)*

As a solution, a centralized data architecture with a single database in E-Osmosys is recommended. This strategy creates a single source of truth, thereby enforcing a clear separation of the data layer from other architectural components. This aligns with the core theory that "the concept of enterprise architecture aims to build information systems by separating data, processes, technological infrastructure, users, time, and motivation within an enterprise architecture framework" [13]. To complement this unified data foundation, the proposed application architecture positions E-Osmosys as an operational hub, integrated with external systems through an API Gateway (Fig. 12).

This ERD serves as the blueprint for the centralized database, ensuring that master data is entered only once and shared across all modules.

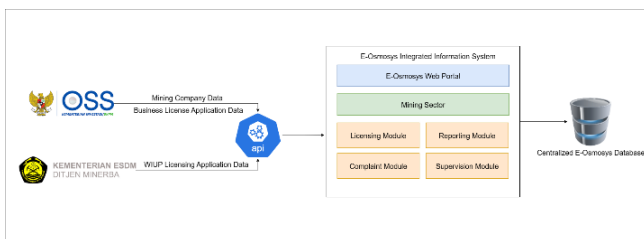


Fig. 12. Application Architecture Recommendations

This new architecture integrates all functions into E-Osmosys, eliminating manual processes and informal platforms.

*E. Phase D: Technology Architecture*

The recommended technology architecture utilizes the shared infrastructure managed by the West Java Provincial Communication and Informatics Agency (Diskominfo), in accordance with the mandate of the SPBE Presidential Regulation. The E-Osmosys system will be hosted on Diskominfo servers with the implementation of a Load Balancer to ensure system availability (Fig. 13). Security aspects will be strengthened through physical, technical (firewall, encryption), and administrative controls in line with the ISO/IEC 27001:2013 standard (Fig. 14).

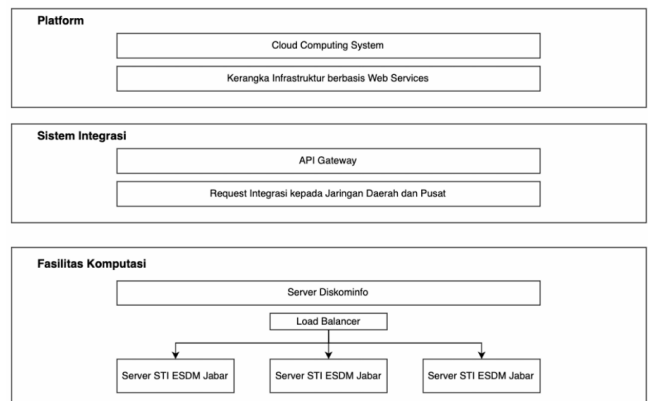


Fig. 13. West Java DESDM Infrastructure Domain

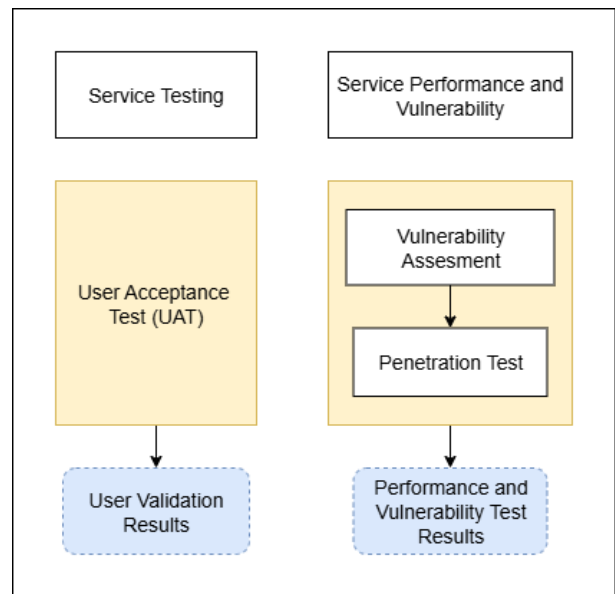


Fig. 14. West Java DESDM Security Domain

*F. Phase E: Opportunities and Solutions*

This phase analyzes the gap between the as-is and to-be architectures to validate the potential for efficiency improvements. Table 3 summarizes the comparison of metrics between these two states.

TABEL II. COMPARISON OF AS-IS AND TO-BE EFFICIENCY METRICS

Business Process	Metrics	As-Is Conditions (Estimates)	To-Be Recommendations (Estimates)	Potential Improvements
Recapitulation of Licensing Applications and Task Disposition	Time Efficiency	1-2 Days	<1 Day	±66.7%
	Reduction in Manual Steps	2 Steps	0 Steps	100%
	Reduction in Data Redundancy	5 Data Columns	0 Data Columns	100%
RKAB Data Input	Time Efficiency	5 Minutes	3 Minutes	60%
	Reduction in Manual Steps	Not Relevant (N/A)	Not Relevant (N/A)	(N/A)
	Reduction in Data Redundancy	3 Data Columns	0 Data Columns	100%
Complaint Service (Excluding follow-up procedures in the field)	Time Efficiency	1-2 Days	<1 Day	±66.7%
	Reduction in Manual Steps	4 Steps	1 Step (Verification)	75%
	Reduction in Data Redundancy	Not Relevant (N/A)	Not Relevant (N/A)	(N/A)
Supervision (excluding on-site supervision)	Time Efficiency	2-4 Hours (Administration & Reporting)	< 1 Hour	±80%
	Reduction in Manual Steps	3 Steps	1 Step (Review)	67%
	Reduction in Data Redundancy	Not Relevant (T/R)	Not Relevant (T/R)	(T/R)

The significant potential improvements shown in the table align with the theoretical principle that "the achievement of operational efficiency can be realized through the utilization of technological innovation, which plays a role in accelerating business process execution" [14].

The validation results indicate significant potential improvements, such as a 100% elimination of data redundancy and up to a 100% reduction in manual steps for the license recapitulation process. Qualitative validation with stakeholders confirmed the accuracy of the problem analysis and the relevance of the proposed solution. Furthermore, validation from an Enterprise Architecture expert reinforced the robustness of the solution, while also providing input to refine the efficiency projections to be more realistic within a bureaucratic context.

### G. Public Sector Comparison Matrix

Based on the presented efficiency metric simulation results, integrating technological components into the business architecture is logically proven to provide a significant performance leap across all primary business processes in the Mining Division. However, when placed into a broader academic context through a comparison with several previous public-sector Enterprise Architecture (EA) studies in Indonesia, unique structural characteristics emerge that fundamentally distinguish this research. For instance, the study conducted by Yustisiawandana et al. (2024) in Tasikmalaya Regency focused on a macro-level EA design to optimize the regional SPBE index generally to meet the medium-term targets of the RPJMD planning document. On the other hand, the study by Wulandari et al. (2021) within the Sukabumi Regency government placed its standardization emphasis on the aspect of front-end public service delivery through the formulation of an electronic-based government administrative service catalog. Both previous studies generally operate within the domain of horizontal integration, specifically bridging the isolation of system functional modules (silo applications) across different departments or working units situated at an equivalent level of local government hierarchical authority.

The fundamental difference in this research regarding the Mining Division of the West Java ESDM Agency lies in the exceptionally strict demand for vertical integration. The regional Mining Division does not possess absolute technical or regulatory autonomy, as its daily operations are bound by centralized mandates where the core master licensing databases are fully controlled by the central government through the national OSS system and the Minerba portal of the Directorate General of Mineral and Coal. This operational reality creates an architectural challenge that is far more complex than simply unifying internal local government applications. Consequently, as revealed during the qualitative stakeholder validation sessions, the main bottleneck in live implementation shifts from technological infrastructure readiness to formal bureaucratic and policy constraints. The process of requesting access permissions and opening data-sharing channels via an API Gateway with central government ministries is recognized as requiring extensive coordination time and rigid bureaucratic prerequisites.

Therefore, this comparative analysis confirms that the resulting EA blueprint should not be viewed merely as a software engineering project, but rather as a strategic and formal instrument to guide data interoperability policy negotiations across different levels of government hierarchical authority.

### IV. CONCLUSION

This research successfully formulated an Enterprise Architecture blueprint to address operational inefficiencies at the Mining Division of the West Java Energy and Mineral Resources Agency. The analysis of the current state identified key issues in manual workflows and system fragmentation across licensing, reporting, supervision, and complaint processes. As a solution, an integrated target architecture is recommended, centered on the E-Osmosys platform with a centralized database and API integration. This conceptually validated strategic plan demonstrates the potential to

eliminate data redundancy by up to 100% and to significantly reduce administrative processing times, thereby providing a measurable foundation for a digital transformation towards more efficient and reliable governance.

For future work, it is recommended that the West Java ESDM Agency act on this plan by developing a detailed

implementation roadmap (TOGAF ADM Phase F) and prioritizing the development of functional modules within E-Osmosys. Furthermore, subsequent researchers are advised to conduct an empirical validation post-implementation to measure the actual on-the-ground efficiency impact and compare it with the projections from this study.

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