Journal of Theoretical and Applied Information Technology

15th December 2023. Vol.101. No 23

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

SUPERVISION TRANSFORMATION IN GOVERNMENT INSTITUTIONS

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ABSTRACT

The supervision process in government starts from the planning, implementation, monitoring, and evaluation stages. Supervision is measured by how compliant an organization is in complying with statutory regulations. Currently checking data is only limited to data retrieval. Accelerated regulatory changes in government can create legal issues if organizations are unable to meet regulatory compliance. Limited Human Resources (HR) in analyzing the many regulations and limited inspection time result in less-than-optimal quality of supervision. Supervisors oversee complex problems and often have difficulty obtaining data and information to analyze to produce fast, efficient, and effective decisions. The current monitoring system runs on a computer-based system, but there are still many opportunities for improvement. Some opportunities that can be implemented include (1) end-to-end integration of all processes, (2) use of technology to check data validity, (3) reduction of approval processes, (4) early warning systems, and so on. The supervisory process of the Financial Services Authority (OJK, Otoritas Jasa Keuangan) has begun and the concept of implementing Regulatory Technology (RegTech) and Supervisory Technology (SupTech) has begun in an integrated manner on the supervisory and regulatory industry side. The results of the literature study have not answered the standard architectural solutions that can be used as a reference for monitoring solutions in government agencies. In this research, a similar solution is designed for monitoring processes in government agencies. In this research, a solution architecture artifact was designed for a monitoring system in government institutions. The chosen methodology is Design Science Research Methodology (DSRM). The designed solution is represented by adopting the 4-layer divisions used in Enterprise Architecture (EA), namely the business layer, data layer, application layer, and technology layer. Testing takes the form of measuring compliance with requirements and simulating business processes to predict the impact on the performance of the system being designed.

Keywords: *Architecture, RegTech, SupTech, Technology, Government*

1. INTRODUCTION

The introductory section consists of background, research questions, and objectives. according to the following discussion.

1.1 Background

Government organizations have monitoring systems in place to ensure that the organization's strategic goals are achieved. Supervision has an important role in an organization as a good organizational control system. The monitoring process aims to provide efforts to prevent potential losses as early as possible for stakeholders so that legal issues can be resolved more quickly and effectively. Finance is a determining factor in achieving measurement efficiency within the organization [1]. The government has an Electronic Based Government System (SPBE, Sistem Pemerintahan Berbasis Elektronik) by utilizing public services in the form of e-Government. Indonesia is ranked 77th out of 193 United Nations (UN) countries in the e-government ranking [2]. Indonesia still has a role to play in improving e-government rankings by leveraging technology. Technology continues to transform rapidly. The Indonesian government must be able to innovate in Industry 4.0 by continuing to transform, especially in the world of supervision which is still undergoing little transformation. The use of Internet of Things (IoT) technology, Artificial Intelligence (AI), Big Data, and so on is expected to improve e-government to be better in the future.

The acceleration of digital transformation according to President Joko Widodo on 3 August 2020 at the Merdeka Palace with 5 directions of

change. The 5 directions of change include (1) transformation to accelerate access expansion and improve digital infrastructure and internet service provision, (2) preparation of a digital transformation roadmap in strategic sectors, (3) acceleration of the integration of national data centers, (4) accelerate the preparation of HR needs digital talent and, (5) accelerating the preparation of regulations and financing. Supervision carries out a transformation according to President Joko Widodo's direction to improve supervisory performance in a better direction for Indonesia going forward.

Fintech is a financial technology solution followed by the development of RegTech (Regulatory Technology) and SupTech (Supervisory Technology) evolution in the financial industry [3]. RegTech is a technology that has a monitoring, reporting, and compliance context [3]. SupTech is a technology that is part of a supervisory system that helps regulatory agencies, usually in the form of government agencies or institutions authorized to carry out supervision [4].

The Financial Services Authority of Indonesia (OJK, Otoritas Jasa Keuangan) as the Financial Services Supervisory Agency in Indonesia uses RegTech and SupTech technology. RegTech is mostly applied to internal institutions to ensure their activities comply with the rules set by the regulators. OJK uses SupTech to ensure industry compliance with regulations and measure the risk level of each Financial Services Institution.

The supervision process has the same stages in carrying out inspections. The stages of supervision include the stages of inspection planning, data and information collection, inspection, analysis, and reporting [5]. Supervision in Government Agencies still uses semi-traditional methods with the help of computers. Semi-traditional methods experience constraints in fast monitoring mechanisms, fraud prevention, data collection, data analysis, and complex regulations. The increasing number of regulations also makes it difficult to supervise supervised entities, so the business processes have the potential to violate legal compliance. The human resources needed to conduct audits are still limited in dealing with complex supervisory issues. RegTech and SupTech solutions that have been used by OJK can be used as a reference for government agencies. Based on existing research, no research discusses architectural references that can be used as architectural standards for supervision in government. The above problems become research gaps to increase opportunities for supervisory transformation innovation in the form of architectural designs for supervisory solutions in government agencies.

1.2 Research Question

From the existing background, RegTech has a regulatory compliance function in carrying out business process activities and SupTech has a supervisory function that integrates automation from data collection, data processing, and data analysis as well as generating compliance and audit reports automatically. Semi-traditional control problems try to adopt RegTech and SupTech as transformation suggestions, so this research problem includes:

1. How to get a “solution architecture” that can have an impact on improving the aspects that have been stated in the background?
2. What transformations must be carried out in government supervision business processes so that the basic concepts of RegTech and SupTech can be applied in government supervision processes?

1.3 Objective

This research will design a solution architecture to support the transformation of supervisory processes in government institutions. The architectural proposal is represented in a layering concept following the EA (Enterprise Architecture) architectural vision concept, then continued with the design of business process architecture, data architecture, application architecture, and technology architecture.

1.4 Research Limitations

Considering the various limitations of time, resources, and access to various related parties, several actions were taken in this research as follows.

1. The layers designed in this research do not include security solutions?
2. The testing and evaluation process is only carried out using simulation, not implemented in real government organizations?
3. The business process that is used as a reference is the business supervision process in the Indonesian government?

1.5 Novelty and Contribution

Based on the literature search that has been carried out and explained above, research for this development is still very rarely carried out. It is hoped that the results of this research can provide a scientific contribution in the form of proposals for alternative architectural solutions to support the monitoring process in government institutions.

2. LITERATURE REVIEW

2.1 E-Government

Modern innovations in Information and Communication Technology (ICT) are developing rapidly. The government continues to strive to improve public services that can be utilized by the community. Public services provide equal opportunity to the public in accessing government services to assist the government in improving its performance. Weaknesses using traditional methods have begun to be abandoned to streamline resources. Governments around the world are launching e-government systems to provide fast services to their citizens [6]. There are 4 (four) e-government models according to [7]:

1. G2G (Government to Government) is an online public service that allows the exchange of data between Government Agencies through an integrated database.
2. G2B (Government to Business) is an online public service that allows the exchange of data between Government Agencies and business people.
3. G2C (Government to Citizen) is an online public service that allows the exchange of data between Government Agencies and the public.
4. G2E (Government to Employee) is an online public service that allows the exchange of data between Government Agencies and employees in their environment.

2.2 Supporting Technology for Supervision

Supervision is the process of supervising activities and evaluating the implementation of activities to ensure that these activities are by the plan [1]. Adoption of supervisory technology needs to be carried out to carry out supervisory transformation in Government Agencies. Supervision must be increased towards increasing efficiency and effectiveness of performance. Some of the existing transformation concepts are as follows.

2.2.1 Regulatory Technology (RegTech)

RegTech is a subset of FinTechs whose function is to facilitate more efficient and effective regulatory requirements [3]. Regulatory technology helps with compliance management and reduces compliance risk. Traditional technology not only requires a lot of human and financial investment but also carries a certain degree of technical risk [8]. The main feature of RegTech is regulatory compliance and automated data reporting [8]. RegTech is a subset of Fintech whose touch facilitates regulatory requirements more efficiently and effectively [9]. The term RegTech is used in terms of information technology and law to assist the financial world in meeting regulatory audit material requirements in regulatory compliance assistance [10]. Utilization of digital technology that can meet the demands of the regulatory compliance process consists of big data Analytics, Natural language Processing, Robotic Process Automation, Distributed ledger Technology, Artificial Intelligence, Cloud Computing, Machine Learning, and Application programming interface [11].

2.2.2 Supervisory Technology (SupTech)

SupTech is used for financial supervision in security systems which is completely dematerialized as a main requirement and pillar of SupTech [12]. SupTech differs from RegTech in that it is not focused on assisting with compliance with laws and regulations but supports oversight agencies in compliance assessments [4]. SupTech can also assist Supervisory Authorities in properly accessing enterprise systems so that they can not only monitor performance in real-time but also carry out investigations efficiently with AI and ML [13].

2.2.3 Continuous Audit (CA)

The public and private sectors, in improving their business processes, conduct internal audits to achieve strategic goals. Continuous Audit relies on continuously high data frequency and automated processes as an alternative to conducting audits which are usually carried out once a year. CA is a procedure for collecting and evaluating evidence to detect the output and effectiveness of real-time accounting systems in protecting assets, data integrity, and data analysis with audit techniques [14]. Data analysis tools and techniques will be better analyzed in data warehouses and audit processes run based on CA technology infrastructure using data analytics, AI, and blockchain [14].

2.2.4 Big Data

Big data is a technological innovation that can manage large amounts of data originating from various structured, semi-structured, and unstructured sources at high speed to produce insights in analytics [15].

2.2.5 Data Lakehouse

Data Lakehouse is a low-cost data management system with directly accessible storage and also provides Database Management System (DBMS) management and traditional analytical performance features such as Atomicity, Consistency, Isolation, and Durability (ACID) transactions, data versioning, auditing, indexing, caching, and clearing queries by combining data lake and data warehouse [16]

2.2.6 AI and Machine Learning

AI is an intelligent machine that can perform tasks performed by humans which include

reasoning, thinking, learning, and solving problems. AI studies the ability of human thought processes to understand intelligence and duplicate it in machines [15].

2.2.7 Cloud Computing

Cloud computing is a model of providing computing services that allow access over a network on demand, which can be done conveniently with a variety of configurable computing resources (network, servers, storage, applications, and services) that can be released quickly [17]. Cloud computing characteristics include.

1. On-demand, self-service services that enable users to leverage computing capabilities.
2. Wide network access, which is a capability that is available through the network and can be accessed through standard mechanisms for using the platform.
3. Multi-tenancy and resource pooling allow the combining of heterogeneous computing resources that can serve many consumers.
4. Fast elasticity and scalability allow functionality and resources to be scaled quickly, elastically, and automatically.
5. Measurable provisions to control and optimize resource allocation and provide measurement capabilities to determine use for collection purposes, enabling easy monitoring, control, and reporting.

2.3 Enterprise Architecture (EA)

Enterprise Architecture is the highest-level architecture type and highest strategy in the form of principles, policies, and business rules implemented by the organization [18]. EA also defines, manages, and updates the entire range of information technology within established standards, policies, principles, and directions [19]. EA has the main idea of determining the needs of an organization in an information system that connects and aligns data, processes, people, infrastructure, time, and motivation in achieving an organization's business goals [20].

2.3.1 TOGAF (The Open Group Architecture Framework)

TOGAF is one of the most widely used Enterprise Architectures as a methodology or framework to improve company business efficiency. Architecture according to the TOGAF context is a structure of interconnected components and has principles and guidelines that govern the design and evolution over time [21]. TOGAF has 4 (four) architectural domains which are part of the Enterprise Architecture [21]:

6. Business Architecture defines the business strategy, governance, organization, and key business processes.
7. Data Architecture describes the logical and physical structure of the organization to data assets and data management resources.
8. Application Architecture provides a blueprint for each application that will be created, deployed, and interacts with and relates to the main business processes of an organization.
9. Technology Architecture describes the software and hardware needed to support business services, data, and applications including IT infrastructure, middleware, network, communication, processing, and standards.

2.3.2 TOGAF- Architecture Development Method (ADM)

The TOGAF architecture development (ADM) method provides a tested and repeatable process for building architecture. ADM includes building an architectural framework, developing it, transitioning, and realizing it. The ADM cycle is carried out on an ongoing basis so that the organization in making changes is more controlled in achieving goals and business opportunities. The stages of ADM are as follows [21].

1. The Preliminary Phase
2. Phase A: Architecture Vision.
3. Phase B: Business Architecture.
4. Phase C: Information System Architecture
5. Phase D: Technology Architecture
6. Phase E: Opportunities & Solution
7. Phase F: Migration Planning
8. Phase G: Implementation of Governance
9. Phase H: Architecture Charge Management
10. Requirement management

2.3.3 Solution Architecture, Solution Design, and Other IT Architectures

Architecture is a solution to solving problems by looking at the problem in the big picture including the solution contextually, solving problems to create components that are used as interaction models logically in solving problems, and detailing the physical changes needed to complete the solution step by step [18]. Enterprise Architecture can be divided into 4 (four) subdomains [18].

1. Business architecture is everything related to business, products and services, business processes, organizational structure, etc.
2. Data or information architecture is everything about information and data in an organization in conveying its business operations.

3. Application architecture is a software application that supports businesses in managing data and information.
4. Infrastructure architecture or technology architecture is an overview of the infrastructure and technology that supports the operation of software, data management, and other aspects of an organization's business operations.

Solution architecture largely considers the fact that solutions depend on people, organizational structure, processes, information, and IT as shown in Figure 1.

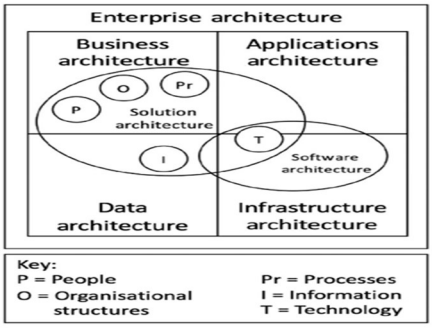

Figure 1: Architectural Details [18]

3. METHODOLOGY

This research uses Design Science Research Methodology (DSRM). DSRM is a research method that presents each stage easily so that it helps research related to information technology [22]. This method can be used to understand and evaluate. DSRM consists of six stages of the method starting from identify Problem and Motivate, Define Objective of a solution, Design and Development, Demonstration, Evaluation, and Communication. The DSRM stages are shown in Figure 2.

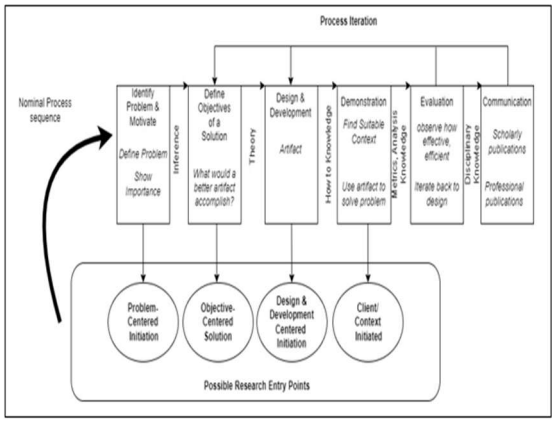

Figure 2: Design Science Research Methodology [22]

3.1 Identify Problem and Motivate Phase

This stage discusses problems that develop in supervision in government institutions. Identify problems using qualitative methods and supporting literature studies to determine important problems that will be discussed in this research so that solutions can be found easily.

3.2 Define objective of a solution Phase

The next stage defines the objectives of a solution to the problem at hand. The motivation for this stage is to produce solutions that can be considered in solving the problems faced. Researchers conducted a review of the literature to obtain the right solution, namely a supervisory solution in the form of a supervisory solution architecture for government institutions.

3.3 Design and Development Phase

The Identification of these problems becomes a list of system requirements or requirements. Next, the researcher used the Systematic Literature Review (SLR) method from a research perspective to find a solution that was the motivation for this research that could answer the supervision problem. In addition, researchers used the snowball sampling method to facilitate the literature review. Based on the SLR, a solution for designing artifacts in the form of a supervisory solution architecture for government institutions is obtained so that this solution can become an initial proposal that can be adopted by supervision at government institutions. The design stage uses the TOGAF ADM method because the results of this research artifact are architecture. TOGAF ADM is adopted not on a full cycle. The EA layer is adopted only in the business, data, application, and technology layer models. Apart from that, solutions are also proposed for formulating organizational change proposals, job analysis, and regulatory changes. TOGAF ADM Cycle.

3.4 Demonstration Phase

This phase shows the oversight architecture of the Regional Financial Agency and Assets (BKAD, Badan Keuangan dan Aset Daerah). The demonstration was carried out by simulating business processes using the Bizagi Modeler and measuring time.

3.5 Evaluation Phase

Evaluation of the implementation of the supervisory architecture in government agencies is carried out using logical scenarios and a literature

review. Evaluation based on artifact design requirements and needs.

3.6 Communication Phase

This phase is the communication stage, which can document everything related to the results of architectural design supervision in government agencies. The results of this phase are in the form of this paper.

4. RESULT AND ANALYSIS

4.1 Requirement Analysis

Supervision, which is still manual, has advantages and disadvantages so there are still problems that must be resolved. The following problems can be seen in Table 1.

Table 1: Supervision Strengths and Weaknesses.

Strength	Weakness
1. Supervision is independent 2. Supervision as a consultant in Supervision 3. Supervision is objective 4. Monitoring results are needed to determine the policy direction	1. Lack of HR auditors under supervision 2. Difficult to control reporting in real-time 3. The difficulty of detecting fraud as early as possible 4. Lack of fraud prevention because it cannot be controlled quickly 5. It is difficult to control regulation management in real-time 6. The difficulty of collecting large amounts of data, efficiently and effectively 7. Architectural solutions that are considered necessary to apply surveillance technology to government agencies that are fast and effective do not yet exist.

Based on these weaknesses, it can be designed the need to change in the supervisory transformation process in government institutions. Artifact requirements can be seen in Table 2.

Table 2: Requirements Artifacts.

NO	Requirements	Description
1	Improving Compliance with Regulations and Policies	Architecture can increase regulatory compliance
2	Resource efficiency	Architecture can improve resource efficiency
3	Data Accuracy	Architecture can improve data accuracy
4	On-time	Architecture can perform timely report collection
5	Real-time	Architecture can be monitored on an ongoing basis in real-time
6	Transparency	The architecture can provide a transparent exchange of data
7	Integrated supervision	Integrated architecture with multiple entities
8	Reduce risk	Architecture can reduce risk
9	Fraud detection	Architecture can reduce process fraud
10	Scalability	The architecture has data storage scalability

The results of the architectural design can meet the design needs that are designed according to the stages in each business architecture, data architecture, and application architecture as the second stage of evaluation.

4.1.1 Business Architecture Requirement Analysis

Business process weaknesses in the Government Oversight Agency are now included in the list of initiatives to be changed as shown in Table 3.

Table 3: Requirements Business Architecture.

NO	Initiative List
1	Automated regulatory business process changes solutions
2	Business process change solutions that can replace human work
3	Business process change solutions that can collect, process, analyze, and process decisions automatically
4	Business process change solutions that can send reports in real-time, and batch
5	Business process change solutions that can monitor business processes on an ongoing basis in real-time
6	Solutions for changing business processes for data collection in one data repository
7	Integrated supervisory business process change solutions in all supervised areas
8	Business process change solutions that can mitigate risks earlier
9	Business process change solutions that can detect fraud quickly
10	Business process change solutions capable of storing large amounts of data

4.1.2 Data Architecture Requirement Analysis

Government Oversight Agency Data Architecture Weaknesses are now included in the list of initiatives to be changed as shown in Table 4.

Table 4: Requirements Data Architecture.

NO	Initiative List
1	The required data solutions are in the form of regulatory data, external government data, other supporting data, operational data, models, compliance report assessment analysis data, and audit report data.
2	Structured, unstructured, and semi-structured data storage solutions.
3	A good data storage management solution.
4	A well-accessible data storage solution for analytic tools.
5	A data storage solution that has the scalability of adding large amounts of data.
6	A data repository solution that has a schema real-time, batch, and hybrid.
7	data storage solution capable of retrieving data historical quickly

4.1.3 Application Architecture Requirement Analysis

Weaknesses The current Government Oversight Agency application architecture is included in the list of initiatives to be changed as shown in Table 5.

Table 5: Requirements Application Architecture.

NO	Initiative List
1	Application solutions that can collect data online, in real-time, batch, and hybrid
2	Application Solutions that can perform good automatic data processing in real-time, batch, and hybrid
3	Application solutions that can perform data analysis automatically are good real-time, batch, and hybrid
4	Application Solutions that support data analysis using NLP
5	Application Solutions that support data analysis using AI/ML
6	Application Solutions that support building models using ML
7	Supporting Application Solutions data analytics audits
8	Application Solutions that support data management for metadata
9	System management compliance application solutions
10	Application Solutions that support sending reports automatically
11	Application Solutions that support Visualization BI Dashboard, real-time monitoring, warning alert system, and automatic reports.

4.1.4 Technology Architecture Requirement Analysis

Weaknesses The current Government Oversight Agency technology architecture is included in the list of initiatives to be changed as shown in Table 6.

Table 6: Requirements Technology Architecture.

NO	Initiative List
1	Data Center infrastructure solutions
2	Compute and storage infrastructure solutions
3	Container infrastructure solutions
4	Network infrastructure solutions (Network)
5	Edge Computing infrastructure solutions
6	API infrastructure solutions
7	RPA infrastructure solutions
8	Cloud Technology infrastructure solutions
9	Big Data Analytics infrastructure solutions
10	AI/ML infrastructure solutions
11	NLP infrastructure solutions

4.1.5 Supporting Factors

The actors involved must be by the job requirements analysis which is adjusted from the business process transformation that fulfills the process of collecting, processing, analyzing, and visualizing data automatically. Regulations must also follow in terms of architecture adapted to Electronic-Based Government Systems, supervision, and data security.

4.2 Design Result

4.2.1 Business Architecture Design

The concept of supervision in government agencies is still semi-traditional, starting from the data collection process, data processing, and analysis to the preparation of audit reports. This process is considered inefficient, so a business change process is needed in the future. Report data for each agency are still collected in a format that cannot be read and

analyzed directly, so this method is less efficient and there are still weaknesses. Business changes to the supervisory business architecture need to be made as shown in Figure 4.

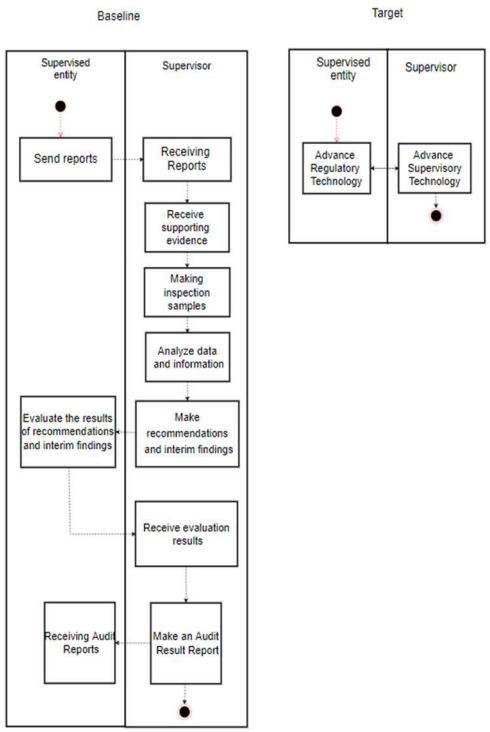

Figure 4: Supervision Process Baseline and Target

the concept of monitoring solutions will be seen from the modeling of the stages of supervision [5] and based on the study of literature [11] having the same pattern of supervision that the monitoring process includes the process of collecting data and information, managing data and information, analyzing data and information, and producing an analysis conclusion report that can be visualized as shown in Figure 5.

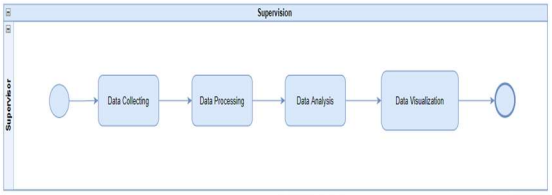

Figure 5: Process Business Supervision

4.2.2 Data Architecture Design

The data architecture before adopting technology regulation and technology supervision is shown in Figure 6.

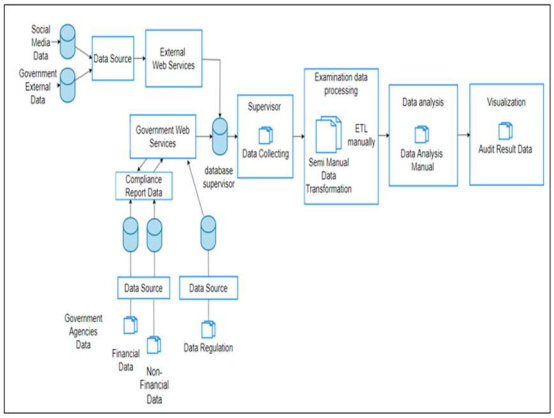

Figure 6: Data Architecture Baseline

The data architecture after adopting technology regulation and technology supervision is shown in Figure 7.

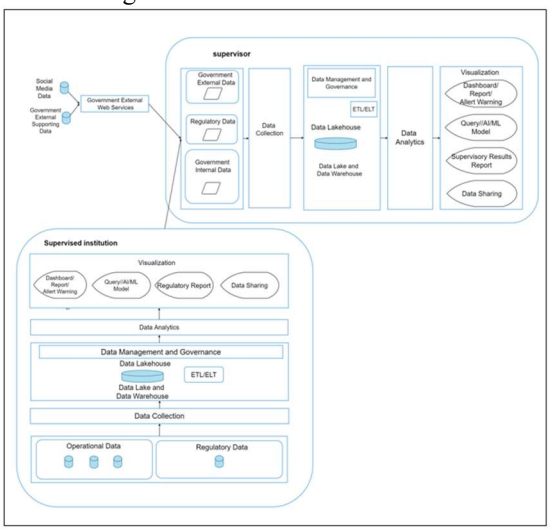

Figure 7: Data Architecture Target

4.2.3 Application Architecture Design

The application architecture before adopting technology regulation and technology supervision is shown in Figure 8.

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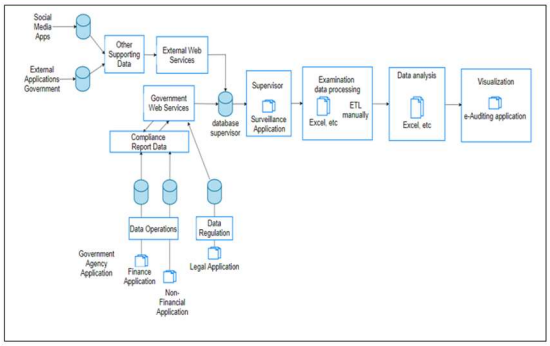

Figure 8: Application Architecture Baseline

The application architecture after adopting technology regulation and technology supervision is shown in Figure 9.

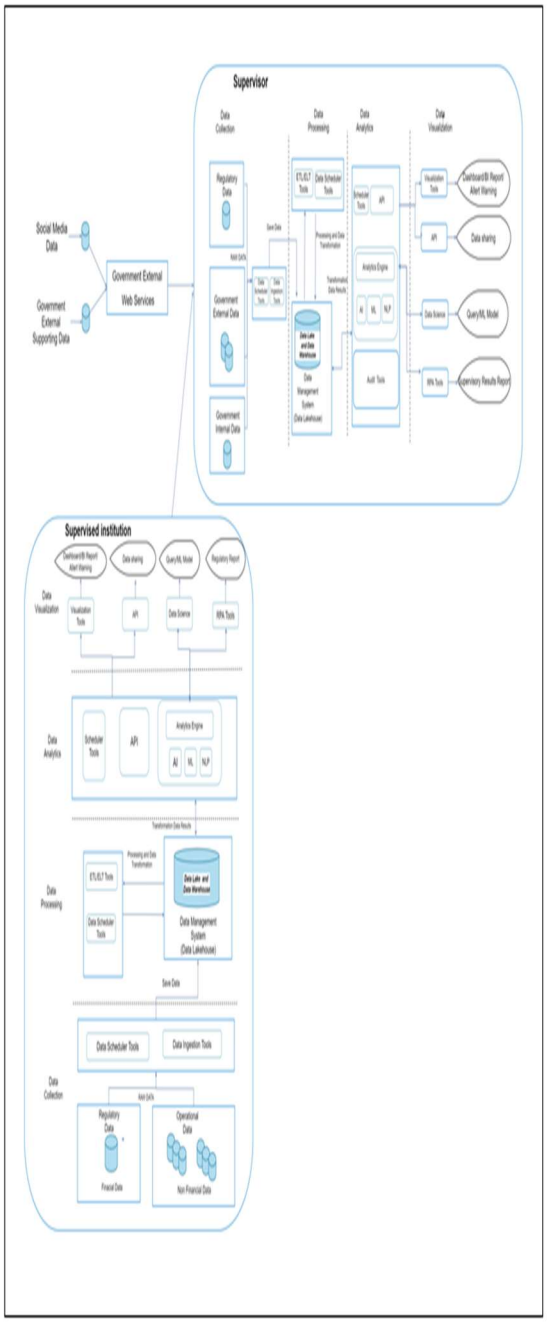

Figure 9: Application Architecture Target

4.2.4 Technology Architecture Design

The technology architecture before adopting technology regulation and technology supervision is shown in Figure 10.

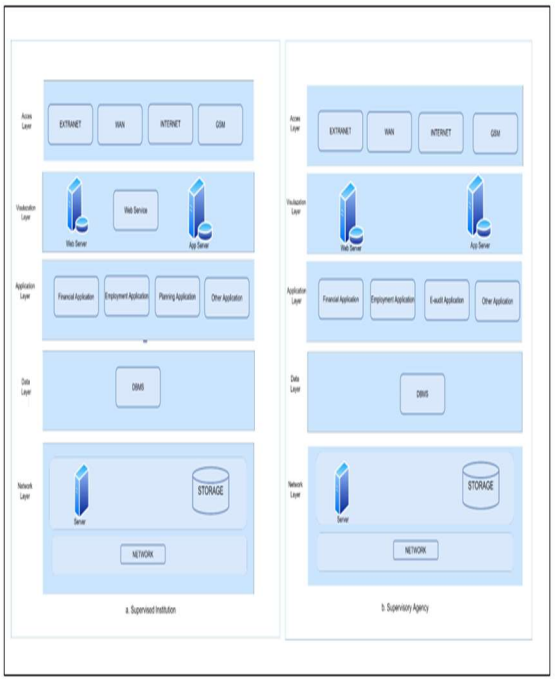

Figure 9: Technology Architecture Baseline

The technology architecture after adopting technology regulation and technology supervision is shown in Figure 11.

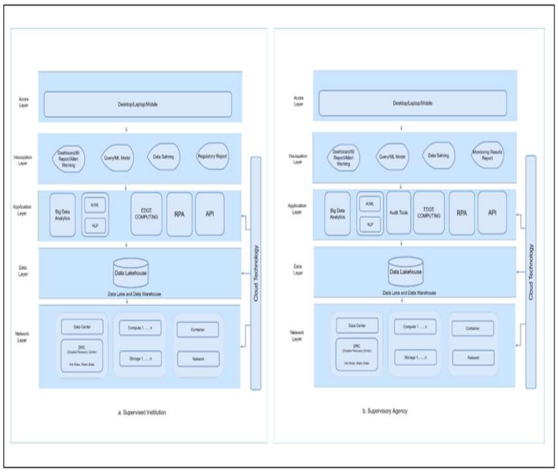

Figure 10: Technology Architecture Target

4.2.5 Supporting Factors Design

Supervision transformation requires other preparations that are supporting factors for transformation, including the preparation of human resources, organization, and governance, as well as supporting factors that must be prepared. Analysis of the needs of the actor's role, among others, can be seen in Table 7.

Table 7: Analyze The Needs Of Actors And Roles.

Activities/Roles	ACTORS IN BUSINESS PROCESS					
	Legal Specialist/Analys	Functional Auditors	Data Engineer	Database Administrators	Data Analyst	Data Scientist
Supervision Division						
Data Collector		A	R	C	I	I
Data Processing		A	C	I	R	I
Data analysis		A	I	I	R	C
Data Presentation		A	I	I	C	R
Supervised Entity Division						
Data Collector	A		R	C	I	I
Data Processing	A		C	I	R	I
Data analysis	A		I	I	R	C
Data Presentation	A		I	I	C	R

Analysis of organizational needs based on role requirements can change the organizational structure of one of the oversight institutions, as exemplified by the Regional Inspectorate organization as shown in Figure 12.

Figure 12: Structure Organization Target

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Governance transformation such as regulations must also be considered as shown in Table 8.

Table 8: Regulations That Affect The Transformation.

No	Regulation	Regulation Description	Comment
1	PP No. 39 of 2019	One Indonesian Data	that to obtain data that is accurate, up to date, integrated, accountable, easily accessible, and shared, it is necessary to improve the governance of data produced by the Government through the implementation of One Data Indonesia to be realized and properly implemented to realize data collection in the process of regulatory technology and Supervision technology.
2	Law No. 27 of 2022	Personal Data Protection	Indonesia already has a personal data protection law so all access and processing rights relating to the protection of personal data in the processing of regulatory technology and supervision technology must comply with the provisions of this law.
3	PP No. 95 of 2018	Electronic-Based Government System	All government systems must comply with the rules of SPBE so that it is easy to develop regulatory technology and supervision technology.
4	PP No. 132 of 2022	National Electronic-Based Government System Architecture	The SPBE architecture serves as a guide in developing architectural solutions for supervision technology and regulatory technology.
5	Law No. 8 of 2010	Prevention and Eradication of Money Laundering Crimes	Laws on the prevention and eradication of money laundering will be better if supervision technology and regulatory technology are used so that the process becomes more transparent and faster.
6	Law No 11 of 2008	Information and Electronic Transactions	Electronic transaction laws become the foundation for transaction processes that can be read by Supervision Technology in the analysis process.
7	Law No. 19 of 2016	Amendments to Law Number 11 of 2008 concerning electronic information and transactions	Electronic transaction laws become the foundation of the transaction process that can be read by Supervision Technology in the analysis process and become the foundation of e-KYC.
8	PP No 8 of 2006	Financial Reporting and Performance of Government Agencies	This regulation can serve as a guideline in the government's financial and performance reporting process, with the help of regulatory technology and supervision technology later reporting can be done in real-time so that additional consideration is needed for articles on financial and performance reports that can be reported in real-time, quarterly or periodically one year after the budget has been used.

5. DISCUSSION

5.1 Demonstration

The design results in the form of business architecture, data architecture, and application architecture are tested through government agency case study scenarios. The test case study uses a logical scenario business process at the Regional Financial and Asset Management Agency (BKAD, Badan Keuangan dan Aset Daerah). Researchers try to simulate the results of architectural designs that have been produced in the Regional Development Information System (SIPD, Sistem Informasi Pembangunan Daerah). Regulatory bodies issue new regulations that are read by regulatory technology. Regulatory technology helps SIPD in the process of changing regulations to fulfill the business process of making Regional Financial Reports (LKPD, Laporan Keuangan Perangkat Daerah). Financial reports are automatically reported to the inspectorate for review and sent to BPK RI automatically. The Supreme Audit Agency (BPK RI, Badan Pemeriksa Keuangan Republik Indonesia) can check LKPD automatically. Surveillance Technology can absorb data and information directly. BPK RI conducts data processing and in-depth review to produce recommendations and follow-up on Audit Result Reports.

5.1.1 Business Architecture Simulations

The Implementation of business architecture artifacts for LKPD supervision is the adoption of business architecture process artifacts that have been designed at the business architecture design stage. The results of the baseline business process simulation are shown in Figure 13.

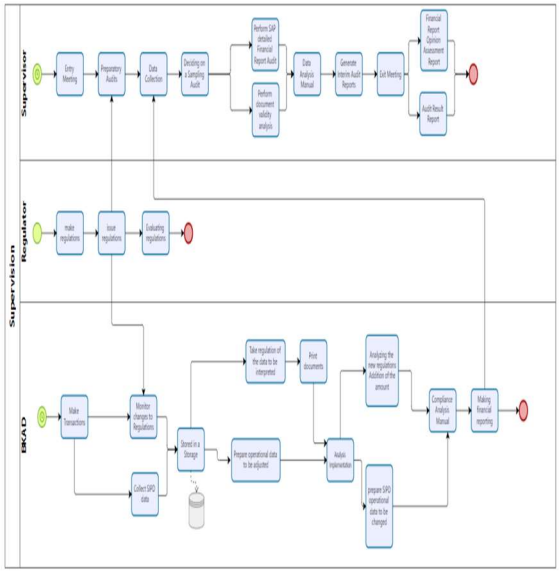

Figure 13: LKPD Baseline Business Process Simulation Results

The target business process simulation results using Bizagi are shown in Figure 12.

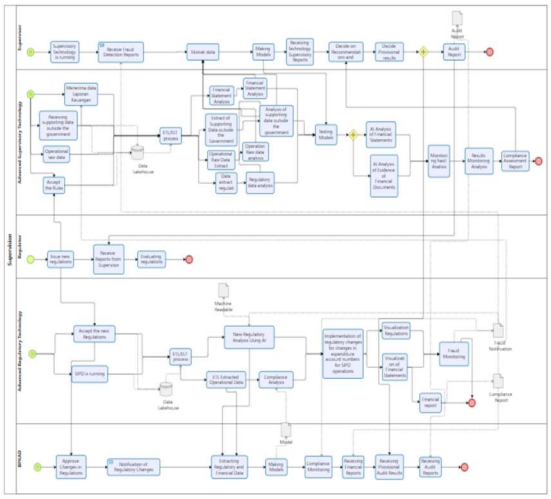

Figure 14: LKPD Target Business Process Simulation Results

The simulation using Bizagi produces a baseline audit business process simulation that takes approximately 60 working days, namely the Unaudited financial statement stage and the Audited financial statement stage. The target business process simulation results produce a faster inspection process simulation with a total inspection time of 3 working days. The target process has an alert warning system for fraud prevention by generating conclusions from Audit Reports. The results of the total time required before and after the transformation of the supervisory process can be seen in Figure 14.

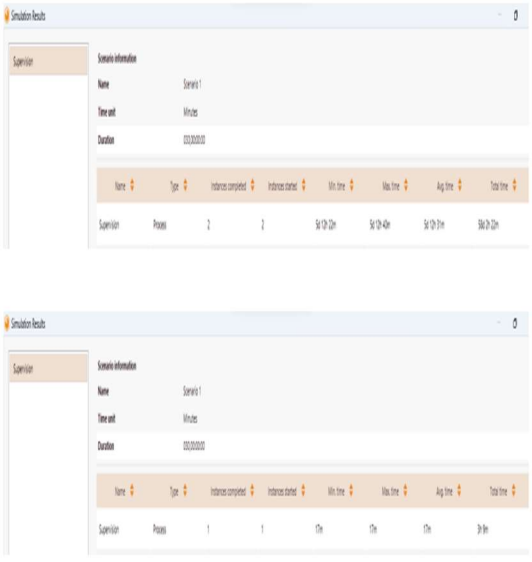

Figure 14: Comparison of LKPD Simulation Results

5.1.2 Data Architecture Simulations

Implementation of the data architecture is the adoption of the data architecture that has been designed at the design stage. The baseline simulation is carried out by adopting the artifacts that have been designed as shown in Figure 15.

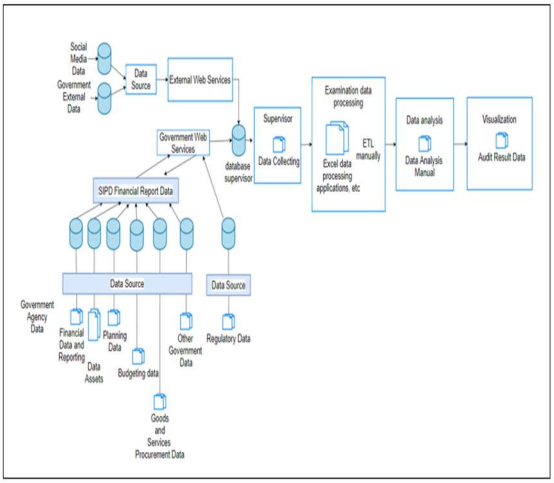

Figure 15: SIPD Data Architecture Baseline

The target simulation is carried out by adopting the artifacts that have been designed, the results are shown in Figure 16.

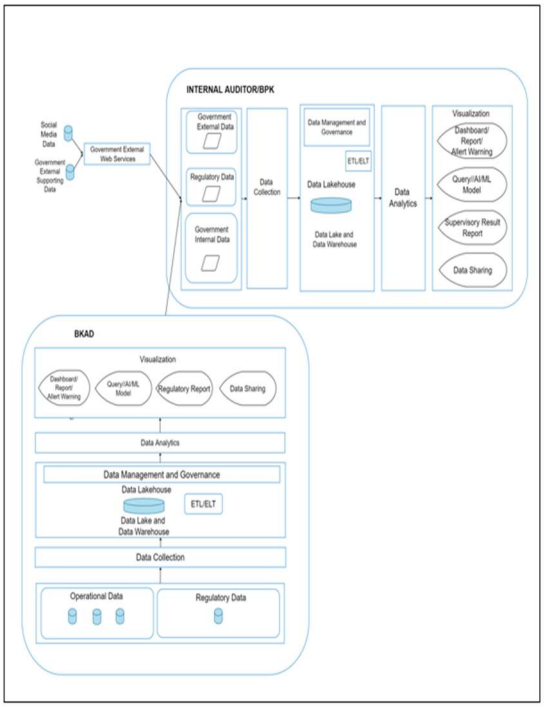

Figure 16: SIPD Data Architecture Target

The data architecture above can be applied to Government Agencies. In the demonstration at BKAD, the data collected comes from the database of each different agency. Data is collected and stored automatically in storage that can accommodate structured, unstructured, and semi-structured data with the help of an API. BKAD automatically recognizes regulatory change notifications and can retrieve new regulatory data from the legal department. Regulatory data is in the ETL/ELT along with operational data. Changes in regulations regarding changes to spending account numbers are read automatically using AI. The regulatory change data is then analyzed together with operational data and adjusted for compliance and produces Financial Reports that meet compliance standards so that the SIPD business process automatically changes. Compliance reports are submitted automatically to the Supervisor. Supervisors absorb data and process it again to analyze and examine financial reports to make decisions and establish findings and recommendations in the Audit Report.

5.1.3 Application Architecture Simulations

The Application architecture implementation is the adoption of application architecture artifacts that have been designed at the architectural design stage. The baseline simulation is carried out by adopting the designed artifacts as shown in Figure 17.

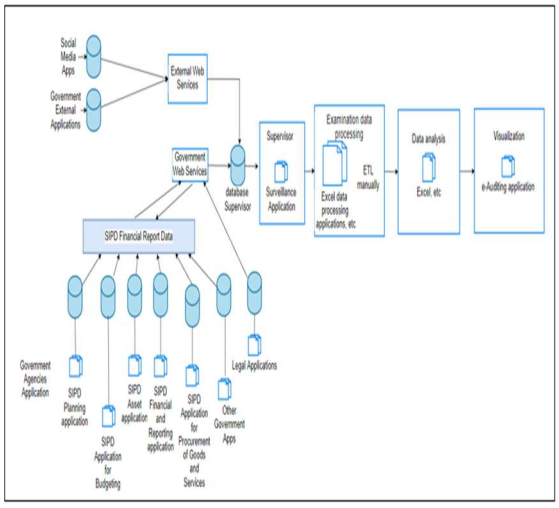

Figure 17: SIPD Application Architecture Baseline

The target simulation is carried out by adopting the artifacts that have been designed, the results are shown in Figure 18.

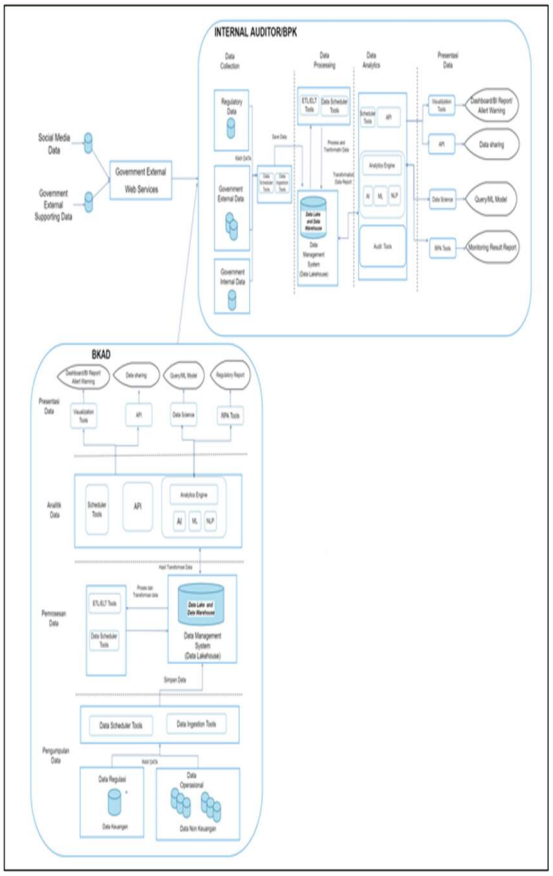

Figure 18: SIPD Application Architecture Target

The application architecture above is the adoption of an application architecture design that has been designed according to needs. The application architecture above can be applied to government agencies. Demonstrations were carried out on scenarios at BKAD for the process of Financial Reports. Regulatory Technology shows that the SIPD application can automatically adjust to regulatory changes issued by the Regulator on the JDIH application. In this case, the rules for changing account codes that affect financial statements can be changed through an ETL/ELT process automatically, then read in a machine that can be read by Artificial Intelligence (AI) and analyzed for compliance using Machine Learning (ML). The Compliance Report is then sent by the RPA to be audited by the Supervisor. Supervisor Technology takes data directly through data ingestion applications automatically through Automatic reporting using RPA and sending via API. Data is stored in data centers in a data lakehouse. Data processing uses the ETL/ELT application. The data that has been processed by the data analysis application is stored to be used as a monitoring model, and then further analyzed for the process of assessing compliance with supervision and fraud monitoring. Monitoring analytics applications can use Audit Command Language (ACL), Interactive Data Extraction and Analysis (IDEA), and other designed audit applications. The visualization process can use applications as needed for BI dashboards, data analytics, real-time monitoring, alert systems, and Automated reports with the help of RPA to be submitted to supervised entities and regulators.

5.1.4 Technology Architecture Simulations

The Technology architecture implementation is the adoption of technology architecture artifacts that have been designed at the architectural design stage. The baseline simulation is carried out by adopting the designed artifacts as shown in Figure 19.

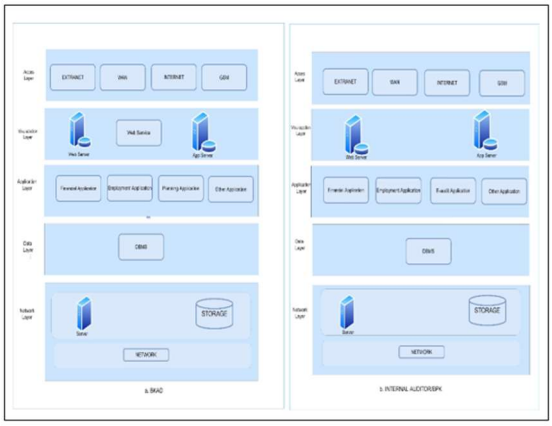

Figure 19: SIPD Technology Architecture Baseline

The target simulation is carried out by adopting the artifacts that have been designed, the results are shown in Figure 20.

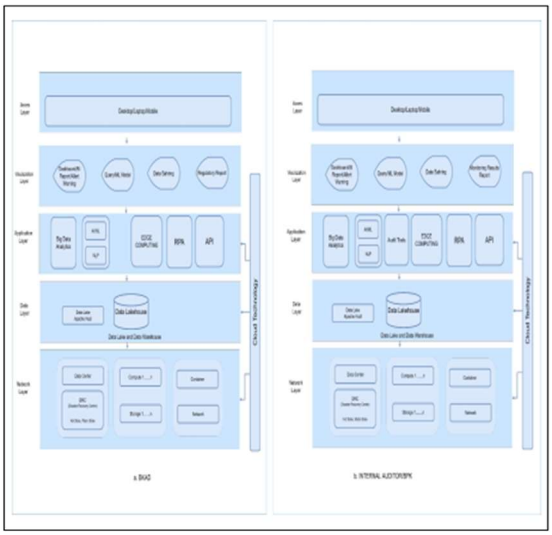

Figure 20: SIPD Technology Architecture Target

In the technological architecture, it can be seen that BKAD currently does not have cloud services and technology that supports the regulatory technology development process and in the supervisory architecture, it also does not have cloud services and technology that supports supervisory technology. In the target technology architecture scenario, you can see the need for cloud services, data centers, Disaster Recovery Centers, servers/compute, storage, containers, networks, and other supporting software at BKAD and supervisory institutions.

5.1.5 Supporting Factors Simulations

As a result of the supervisory transformation, most of the supervisory work can be automated. Human resources such as auditors and legal analysts were reduced, but their expertise in data science and data analysis was increased. From an organizational point of view, roles, and responsibilities have changed. Regulatory governance must also be adjusted after changes in business processes for supervision and data security

5.2 Evaluation

The proposed architecture is evaluated by checking conformity with the design requirements. In addition, the assessment criteria were also examined. The architectural Design Evaluation is shown in Table 9. This shows that the design requirements meet the research objectives.

Table 9: Evaluation Of Design Architecture.

NO	Requirements	Results	Fulfilled
1	Improving Compliance with Regulations and Policies	Presence of regulations analyzed by AI and compliance analysis	v
2	Resource efficiency	The efficiency of time and energy can be seen in the Bizagi experiment	v
3	Data Accuracy	Processing processed data not based on sampling data	v
4	On-time	There is an automatic delivery of reports	v
5	Real-time	There is ongoing monitoring of real-time	v
6	Transparency	There is an exchange of data from several entities	v
7	Integrated supervision	Supervisors can directly monitor entity operational data	v
8	Reduce risk	There is fraud detection an alert warning system	v
9	Fraud detection	there is a process that is monitored in real-time and analyzed if an anomaly occurs	v
10	Scalability	exists storage capable of storing large amounts of data	v

5.2.1 Evaluation of Business Architecture

The business transformation process that has been defined for validation is fulfilled in achieving the designed architecture. Evaluation from the baseline business architecture to the target business architecture is shown in Table 10.

Table 10: Evaluation of Business Architecture.

NO	Requirements	Architectural Achievements	Fulfilled
1	Automated regulatory business process changes solutions	There is a sub-process of reading regulations using Machine-readable regulatory	v
2	Business process change solutions that can replace human work	There is a sub-process analysis using AI	v
3	Business process change solutions that can collect, process, analyze, and process decisions automatically	There is an automatic collection sub-process, processing using ETL/ELT, using analysis using data analytics	v
4	Business process change solutions that can send reports in real-time and batch	There is a sub-process of sending Reports automatically	v
5	Business process change solutions that can monitor business processes on an ongoing basis in real-time	the process can visualize monitoring in real time and automatically	v
6	Solutions for changing business processes for data	There is a collection sub-process on a storage	v

NO	Requirements	Architectural Achievements	Fulfilled
	collection in one data repository		
7	Integrated supervisory business process change solutions in all supervised areas	There is a connected sub-process between the entity being supervised and the supervisor and regulator	v
8	Business process change solutions that can mitigate risks earlier	There is a warning alert system sub-process to mitigate risks	v
9	Business process change solutions that can detect fraud quickly	There are sub-processes for fraud detection	v
10	Business process change solutions capable of storing large amounts of data	There is a sub-process of storing data on data lakehouse	v

5.2.2 Evaluation of Data Architecture

The transformation data architecture that has been determined to be validated meets the architectural achievements designed starting from the baseline data architecture to the target data architecture as shown in Table 11.

Table 11: Evaluation Of Data Architecture.

NO	Requirements	Architectural Achievements	Fulfilled
1	Data solutions needed are in the form of regulatory data, external government data, other supporting data, operational data, models, compliance report assessment analysis data, and audit report data.	The existence of the required data architecture in a data matrix	v
2	Structured, unstructured, and semi-structured data storage solutions	There is architecture data lakehouse	v
3	A good data storage management solution	There is architecture data lakehouse	v
4	A well-accessible data storage solution for analytic tools	There is architecture data lakehouse	v
5	data storage solution that has the scalability of adding large amounts of data	There is architecture data lakehouse	v
6	A data repository solution that has a schema real-time, batch, and hybrid	There is architecture data lakehouse	v
7	data storage solution capable of retrieving data historical quickly	There is architecture data lakehouse	v

5.2.3 Evaluation of Application Architecture

The application architecture transformation that has been determined to be validated meets the designed architectural achievements starting from the baseline application architecture to the target application architecture as shown in Table 12.

Table 12: Evaluation Of Application Architecture.

NO	Requirements	Architectural Achievements	Fulfilled
1	Application solutions that can collect data in real-time, batch, and hybrid	There is an Ingestion Tool	v
2	Application Solutions that can perform good automatic data processing in real-time, batch, and hybrid	There is an Ingestion Tool	v
3	Application solutions that can perform data analysis automatically are good real-time, batch, and hybrid	There is an Ingestion Tool	v
4	Application Solutions that support data analysis using NLP	There is an Ingestion Tool	v

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

NO	Requirements	Architectural Achievements	Fulfilled
5	Application Solutions that support data analysis using AI/ML	There is an Ingestion Tool	v
7	Application Solutions that support building models using ML	There is a data science Tool, analytic Engine Tool	v
8	Supporting Application Solutions data analytics audits	There is an Analytic Audit Tool	v
9	Application Solutions that support data management for metadata	There is a Data Management Tool	v
10	System management compliance application solutions	There is a Compliance Management System	v
11	Application Solutions that support sending reports automatically	RPA Tools, API Tools, Reporting Tools	v
12	Application Solutions that support Visualization BI Dashboard, real-time monitoring, warning alert system, and automatic reports	There is Visualization Tool, Reporting Tools, API Tools	v

5.2.4 Evaluation of Technology Architecture

The technology architecture transformation that has been determined to be validated meets the designed architectural achievements starting from the baseline technology architecture to the target technology architecture as shown in Table 13.

Table 13: Evaluation Of Technology Architecture.

NO	Requirements	Architectural Achievements	Fulfilled
1	Infrastructure solutions Data Center	There is a Data Center	v
2	Infrastructure solutions Compute and Storage	There is Compute and Storage	v
3	Infrastructure solutions Containers	There is Containers	v
4	Network infrastructure solutions (Networks)	The existence of a network (Networks)	v
5	Infrastructure solutions Edge Computing	There is Edge Computing	v
6	API infrastructure solutions	There is an API	v
7	RPA infrastructure solutions	The existence of RPA	v
8	Infrastructure solutions Cloud Technology	There is Cloud Technology	v
9	Infrastructure solutions Big Data Analytics	There is Big Data Analytics	v
10	AI/ML infrastructure solutions	The existence of AI/ML	v
11	NLP infrastructure solutions	There is NLP	v
12	Infrastructure solutions auditing data analytics and forensics	There are Auditing Tools	v

Based on the results of the design of business architecture, data, applications, and technology can answer the research objective solutions. The result is a standard architectural design proposal that can be used as a reference for supervisory transformation that can be used in government agencies. Evaluation and validation of the fulfillment of artifact design and architectural requirements to carry out supervisory transformation have been fulfilled.

6. CONCLUSION

(1) In this research, a supervisory process transformation solution plan has been produced in the form of a supervisory solution architecture design for government institutions which includes the business layer, data layer, application layer, and

technology layer, (2) In this research, the identification plan for competency adjustment, organization as well has been generated. , and governance supports the design of solutions for the transformation of supervision processes in government institutions (3) Based on the evaluation results, the solution architecture design can answer the research objectives, namely compliance with regulations and policies, efficient resources, data accuracy, timely, real-time, transparent, integrated, reduced risk, fraud prevention, and good scalability. Furthermore, future research can be continued to the security architecture phase to obtain a clearer and more detailed blueprint when adopted by government institutions.

7. ACKNOWLEDGMENTS

This paper was supported by a scholarship from The Ministry of Communication and Information of the Republic of Indonesia.

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