

DESIGN OF ENTERPRISE INFORMATION SYSTEM USING TOGAF FRAMEWORK FOR PUBLIC SERVICE AGENCY

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Abstract

As one of the government institutions in charge of serving the administration of the population, the Tagaraja sub-district office is currently unable to support the organization's strategy optimally. This is due to the lack of an information system that supports each process of data exchange from each management field. The role of information technology as a supporting tool in the organization as part of the information system has become part of the organization's strategy to achieve its goals. However, the current issue is that implementing information systems for the benefit of the entire organization is difficult. The business strategy and the technology strategy must be in sync. The integration factor in the development of information systems can be used to determine the alignment of information systems with organizational needs. The goal of this research is to create an appropriate enterprise information system architecture to achieve the organization's strategic goals in accordance with the Tagaraja sub-vision districts and mission. A comprehensive and user-friendly method is required to design an enterprise architecture. This research TOGAF utilizes a qualitative approach and data collection methods such as literature reviews, interviews, and direct observations, as well as the Open Group Framework (TOGAF) ADM architectural design method. The research findings are presented in the form of an integrated application proposal that can support business processes while also addressing issues related to the Tagaraja sub-district office's lack of an information system.

Keywords: Administration, Blueprints, Enterprise architecture, Information systems, TOGAF.

1. Introduction

The growing need for business functions is one of the driving forces behind the use of information technology, particularly in organizations. Information Technology is expected to be a supporting tool for organizational activities in achieving its strategic goals [1]. However, an issue that arises in the field is how the business strategy and the technology strategy can be aligned [2]. Every organization is competing to implement information system technology without first considering the organization's needs and interests. As a result, the applied technology does not operate in accordance with the expected organizational mission and goals, namely efficiency and effectiveness in meeting organizational needs [3].

One of the government agencies tasked with providing administrative services to the community at the village level is the Tagaraja Sungai Guntung sub-district office in Riau, Indonesia. According to the organizational structure, various fields regulate affairs such as certificate management, officialdom, finance, and others. In practice, however, the community service process is currently not optimal. This is due to the organization's lack of a proper strategy and information technology that has not been integrated as a whole. The administrative service process is still done manually, for example, by entering data into a computer or recording the service process on paper or documents. As a result, the process of exchanging data from each management field is ineffective. It can cause a variety of issues, including incorrect data input, writing errors, and a lack of time efficiency. To improve service quality, such as making cover letters and certificates, time efficiency is required. Good results must be accompanied by quick service times. Given that the letter will be used for a variety of purposes, mistakes in entering the letter's creation can be extremely complicated [4]. Valid data is transformed into authentic evidence that can be accounted for [5]. As a result of these issues, the sub-district office requires a new integrated information system that can support the sub-business district's processes, particularly administrative services to residents, while also reducing implementation time.

In order to implement a new information system, a plan or enterprise blueprint that can be used as a reference in implementing an integrated system that can run in accordance with the organization's goals, vision, and mission is required [6]. As a result, organizations must design the appropriate enterprise information system architecture in order to create a blueprint for a new architecture that is consistent with the organization's vision and mission, as well as to serve as a reference in future organizational development. The integration factor in the development of information systems can be used to determine the alignment of information systems with organizational needs.

Enterprise Architecture (EA) is a method for building an information architecture that focuses on business needs and how to implement the architecture to support business and achieve the mission of information systems and companies [7]. Many frameworks can be used in designing an architecture to support the running of the system in an enterprise. Among them are Zachman Framework, TOGAF ADM, EAF, and others.

TOGAF ADM was chosen as the design method for this study. The investigation was carried out in stages. The first stage is data collection, which includes conducting interviews and direct observations to assess the current state of the organization's business processes. The second stage is the preparation and implementation required

to create a new enterprise architecture. This stage produces a principle catalogue as well as the commitment of each relevant stakeholder. After determining the goal, the next step is to identify and design the architecture based on each phase of ADM using data gathered during the data collection process. The outcomes of the identified phases are used in the subsequent phase [8]. The final stage is to create a blueprint that documents the results of each architectural phase. The Blueprint is expected to assist in the decision-making process for the Tagaraja sub-district office's implementation of integrated information technology. This technology will support the organization's business activities in order to improve service quality and make it more effective and efficient.

The role of Enterprise Architecture is required to support the organization's main business activities as well as its supporting business. Therefore, this research is needed to analyse and find out in more detail about the ongoing business process problems and then provide the right solution in accordance with the goals and objectives of the agency.

The goal of this research is to create an Enterprise Architecture that will assist in the implementation of business processes by implementing information systems technology in the Tagaraja sub-district office, making it more efficient. Literature review, interviews, and observation are used as the data collection. In terms of the design method, the TOGAF ADM framework was used.

2. Related Works

Information Technology is expected to be a supporting tool for organizational activities in achieving its strategic goals. However, an issue that arises in the field is how the business and technology strategies can be aligned. The goal of enterprise architecture design is to achieve alignment between an organization's business processes and information technology [9, 10]. To be effective and efficient, the technology used must be in accordance with the organization's vision, mission, and goals. Technology must be able to meet the needs of the organization, from the highest level of needs to the lowest level of needs, namely operational needs. As a result, enterprise architecture plays a critical role in organizational development [11, 12]. The enterprise architecture framework is used in a variety of studies to help obtain an initial design for implementing information technology in organizations or businesses.

Ramadiani et al. [13] conducted research at the Sempaja Timur sub-district office employs the Enterprise Architecture Planning (EAP) framework to generate enterprise architecture plans and a roadmap for developing integrated applications. Several other studies use the EAP framework in the design of enterprise architecture [14, 15]. Tannady et al. [16] used Zachman as a framework for companies involved in aerosol and paint manufacturers because the business operations still have flaws. Because of the need for business architecture, information architecture, application architecture, and enterprise technology architecture, the Zachman framework was chosen. Rifai et al. [17] used the TOGAF ADM framework as a framework in designing enterprise architecture for the Pageraji sub-district office because the system used is still conventional. This study concentrated on the four stages of ADM. Research conducted at universities by Prayitno [18] also used the TOGAF framework as a step in increasing competitive advantage and institutional competitiveness.

Some of these studies use government agencies or other organizations as research subjects. The difference between this research and our research is in the framework used, the elements discussed, and the final results obtained in the application of information systems strategic planning. This comparison will be used as a starting point for future developments on this research topic.

TOGAF ADM is one of the frameworks commonly used by businesses to design a new enterprise architecture. This is due to the fact that TOGAF is a framework that can be adapted flexibly to all changes and needs during the planning process. This framework also includes detailed methods and tools for implementing the architecture, which sets it apart from other EA frameworks [19]. Setiawan's research compares several frameworks that can be used for EA design [20]. The study was carried out by comparing several important criteria in EA design. The results show that the TOGAF framework outperforms the other frameworks. TOGAF has the advantage of 8 ADM phases and structure evolution support. Based on this, the appropriate framework for a case study at the Tagaraja Sub-district Office is TOGAF, because the office lacks an enterprise architecture and requires easy, clear, and appropriate development.

3. Research Methodology

3.1. Data collection method

The Tagaraja sub-district office is located on Jend. Sudirman street, No. 31 Sungai Guntung, Kateman District, Indragiri Hilir Regency, Riau Province, Indonesia. From April to July 2021, the research was conducted over a four-month period. This study uses a qualitative approach with literature reviews, interviews, and observations as data collection methods (Fig. 1). The qualitative approach was chosen because this study aims to reveal facts, variables and circumstances that occurred during the research. This study also interprets the data obtained with the problems that are happening, the effect on conditions and others at the Tagaraja Sub-district Office.

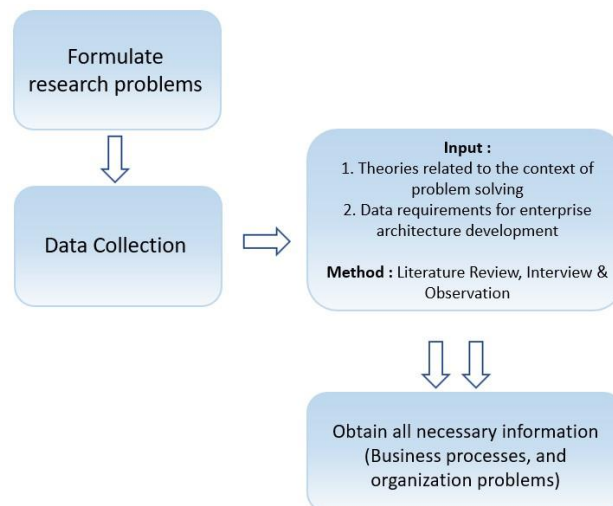


Fig. 1. Data collection stage.

The literature study phase was carried out to study various theories related to the problem-solving framework, which were obtained from company documents related to research, TOGAF ADM documentation, scientific journals with related topics, and other references [21]. The interview stage is carried out with parties who are considered to know and master the ins and outs of the organization. The interview process was carried out to the Sub-district Head, Head of Government and Community Section, as well as office employees in charge of managing community administrative services. Interviews were conducted freely, not based on structured notes, but only focused on the outline of the problem and the data needed. The purpose of interviews with authorized parties is to obtain accurate data and information regarding ongoing business processes. In addition to direct interviews with several parties in the office, direct observations of ongoing activities accompanied by data collection were also carried out. This direct observation focuses on ongoing business processes and the structure of information technology in the form of hardware, software, and networks used by government agencies.

3.2. Enterprise architectural design method

TOGAF framework is used in the enterprise architecture design method. TOGAF has detailed methods and tools for putting this design into action. This framework was released in 1995 by The Open Group's Architecture Forum [22]. TOGAF is built on an iterative process model that is backed up by best practices and a reusable set of existing architectural assets. TOGAF has a detailed method on how to build, manage and implement information systems and enterprise architecture called the Architecture Development Method (ADM). Figure 2 shows the TOGAF framework workflow consisting of a series of activities that describe the progress of each ADM phase as well as the architectural model used during the enterprise architecture development phase [23].

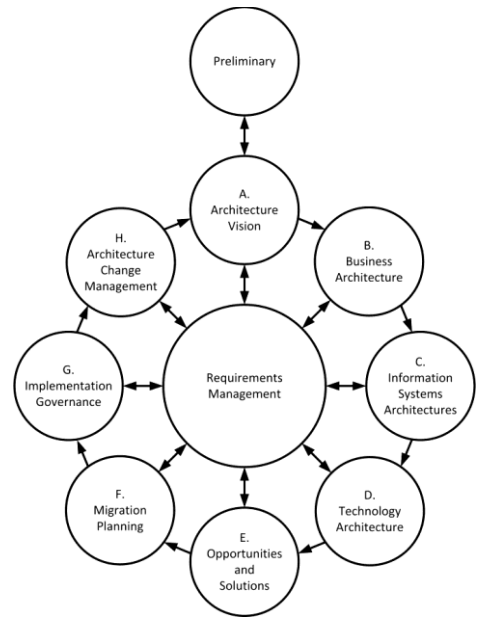


Fig. 2. Architecture development method (ADM) phases.

Each phase of ADM should be based on the business processes and strategies outlined in the Requirements Management phase to match the data found in the field. The essence of ADM is the management of requirements where the needs of business processes, information systems, and technology architecture are aligned according to the goals and needs of the company.

3.3. Scope and limits of research

The design of the enterprise architecture system development in this study is limited to the main activities of the Tagaraja Sub-district Office, namely Resident Administrative Service, Employee Administration Management, and Archive Management. This is because the main activity as a core business process in the organization has not used the system and has not been optimal.

This study does not discuss the measurement of Return on Investment (ROI) or the usual estimation analysis of the initial investment in the use of hardware and software, as well as system maintenance required in the design of the proposed system by measuring how much the costs will be incurred and the available budget. This is because a permit and a tender process are required for government agencies to procure goods which will take a long time. Therefore, this research will only focus on 4 stages of TOGAF ADM starting from the Preliminary Phase, Requirements Management, then to the EA design stage, namely Architecture Vision, Business architecture, Information System Architecture, and Technology Architecture.

4. Results and Discussion

4.1. Preliminary phase

- a) This is the preparation stage for planning the enterprise architecture in the organization, which includes determining the necessary planning principles. The following are some of the design principles that will be used as a basis:
- b) Enterprise architecture must be in accordance with the Tagaraja Sungai Guntung Sub-district Office's objectives, activities, business processes, and functions.
- c) Enterprise architecture must be manageable and simple to use.
- d) Enterprise architecture must facilitate the continuation of business activities or processes.
- e) Secure enterprise architecture is required.
- f) Enterprise architecture should make future development easier.
- g) A user-friendly information system
- h) Each section's data must be consistent and managed as an asset.
- i) Data security and confidentiality.

To assist stakeholders in evaluating and approving proposed enterprise architecture changes, the Principles Catalog describes the principles used and the targets for each principle.

4.2. Requirement managements

This stage contains the findings from the requirements stage for the information systems technology architecture that is currently in operation at the Tagaraja sub-district office in Sungai Guntung. The findings of the observations presented as requirements indicate that the Tagaraja Sungai Guntung sub-district office is still limited to the use of simple software technologies such as Microsoft Office, general hardware technologies such as PCs/Laptops and Printers, and lacks network architecture and information systems that can support business activity management.

4.3. Architecture vision

4.3.1. Value chain analysis

In its implementation, the Tagaraja sub-district office has both main and supporting activities. The activity describes the business area that was modelled using the value chain shown in Fig. 3.

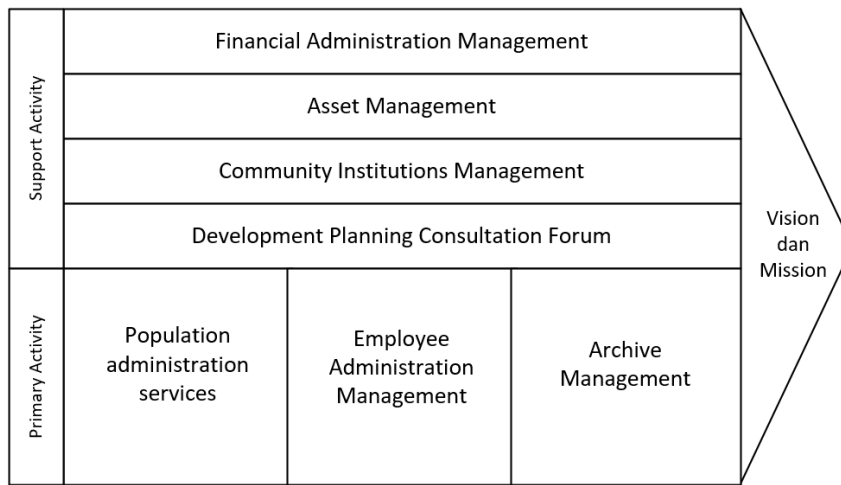


Fig. 3. Tagaraja sub-district office value chain.

4.3.2. Scope

In this study, the scope of the architecture enterprise refers to the main activity of the Tagaraja sub-district office, namely the community service institution. It consists of several components, namely population administration services, employee administration management, and archives. This is because the organization's main activity, as a core business process, has not used the system and has not been optimized.

4.3.3. SWOT analysis

The goal of a SWOT analysis is to identify important aspects of an organization's strengths, weaknesses, opportunities, and threats. It is expected that by understanding these four aspects, this study will be able to maximize strengths,

minimize weaknesses, reduce threats, and create opportunities in the future. SWOT Analysis explains how a strengths-based strategy can affect opportunities and threat and how a weaknesses-based strategy can be overcome with opportunities and threats. Table 1 is the result of the Tagaraja sub-district office's identification of internal and external factors.

Table 1. Identification of internal and external factors.

Strengths	Weakness
Free administrative services	The population administration service process is still completely manual
Vision and mission that support service quality	The population administration service process is still completely manual
The simplicity of service procedures that are uncomplicated and easy to understand	Data storage is not centralized
	Security on data storage is not optimal
	Public trust in government services
	The service process takes a relatively long time
	Dissemination of information to the public
	Demands for improving service quality
	Competent human resources are still limited
	Do not have a network infrastructure to support the implementation of business processes
Opportunities	Threats
Government support for the implementation of an electronic-based service system	Frequently changing laws or regulations
Application of computer and internet advances	Limited government budget to support e-government
Empowering employee on technology	The development of computer crimes such as mail forgery

Following the identification of internal and external factors, problem-solving strategies in the form of a SWOT Matrix will be developed (Table 2). This matrix will explain how the strength strategy affects opportunities and threats and how the weakness strategy overcomes opportunities and threats.

The results of this SWOT analysis can be used to develop proposed problem-solving strategies for organizations in order to integrate the needs of the Tagaraja sub-district office with the most recent technological developments.

Table 2. SWOT matrix.

Internal Factor	Strengths (S)	Weakness (W)
	<ol style="list-style-type: none"> 1. Free administrative services 2. Vision and mission that support service quality 3. The simplicity of service procedures that are uncomplicated and easy to understand 	<ol style="list-style-type: none"> 1. The population administration service process is still completely manual 2. Do not have an integrated system to support the service process to the community optimally 3. Data storage is not centralized 4. Security on data storage is not optimal 5. Public trust in government services 6. The service process takes a relatively long time 7. Dissemination of information to the public 8. Demands for improving service quality 9. Competent human resources are still limited 10. Do not have a network infrastructure to support the implementation of business processes
External Factor	SO Strategy	WO Strategy
	<ol style="list-style-type: none"> 1. Planning for the implementation of an integrated administrative service information system to facilitate service procedures to the community in accordance with existing regulations and regulations 2. Utilizing technological advances and implementing employee empowerment in realizing the vision and mission of improving the quality of service to the community. 	<ol style="list-style-type: none"> 1. Creating an integrated and electronic-based service information system that can help the service process and delivery of information to the community become more optimal 2. Create a system with centralized data storage to prevent loss, damage, and data access from irresponsible parties 3. Provide HR training on the use of information system technology to form competent HR and follow IT trends 4. Implementing a new network infrastructure that can support integrated business processes
Opportunities (O)		
<ol style="list-style-type: none"> 1. Government support for the implementation of an electronic-based service system 2. Application of computer and internet advances 3. Empowering employee on technology 		

-
3. Improving the quality of human resources to support the effectiveness of services in accordance with government instructions regarding improving the quality of services to the community

Threats (T)	ST Strategy	WT Strategy
<ol style="list-style-type: none"> 1. Frequently changing laws or regulations 2. Limited government budget to support e-government 3. Crime rate of fabrication or document falsification 	<ol style="list-style-type: none"> 1. Planning the implementation of integrated IS/IT in accordance with the prevailing regulations and regulations from the central and local governments 2. Coordinate and communicate with the central government regarding budget issues for additional infrastructure to support office operational activities 3. Implementing information system technology that can optimize processes and service quality to minimize attempts at falsifying administrative documents 	<ol style="list-style-type: none"> 1. Implementing information system technology as an effort to implement government regulations and regulations regarding electronic-based services to improve the quality of public services effectively and efficiently. 2. Planning to upgrade the system from manual to computerized 3. Improve the data security system so as to minimize data loss, and limit access from unauthorized parties 4. Coordinate the increase in the budget for operational costs of developing information systems and improving supporting infrastructure facilities 5. Adding network infrastructure so that data users have easy access to the data/information needed and the data/information can be served quickly

4.4. Business architecture

During this phase, an analysis of ongoing business processes is conducted to determine the problems and goals to be achieved by the Tagaraja sub-district office. It is also done to develop strategies in achieving the stated business goals by conceptualizing information system-based business solutions based on current conditions [24]. Business processes are identified by describing each running business activity using the Business Process Modeling Notation (BPMN) tool

based on the function of the primary activity (Fig. 3). Figure 4 depicts one of the business activities carried out at the Tagaraja Sungai Guntung sub-district office.

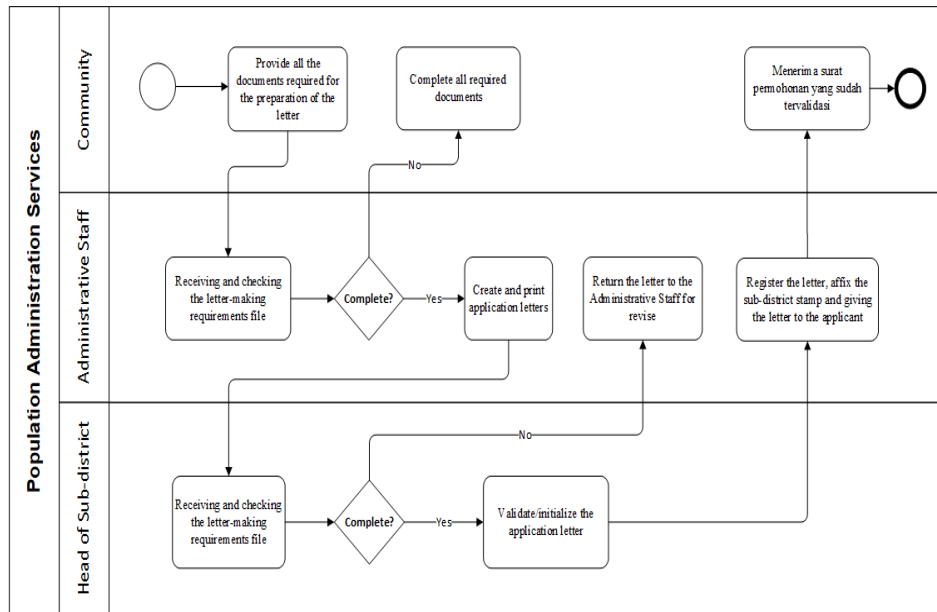


Fig. 4. BPMN of the population administration service process.

4.5. Information system architecture

The application and data plans that support the enterprise business architecture are identified and defined during the information system architecture phase. This phase consists of a combination of application and data architecture [24].

4.5.1. Application architecture

The application architecture must be identified in order to determine the application's requirements. Based on the results of the previous phase's identification of activity needs, three applications have been proposed, namely the population administration service application, the employee application, and the archive application. The three applications are integrated and supported by centralized data storage to ensure that the data required by officers is properly managed. Use case diagrams are used to describe the system that will be built as well as the functions that will be provided by the system. To explain each process that exists in each of the proposed applications, use case application diagram modeling is required. The use case diagram for one of the proposed applications is shown below (Fig. 5).

The use case describes an interaction between one or more actors and the created information system, whereas the actor is the user/actor who interacts with the system [25].

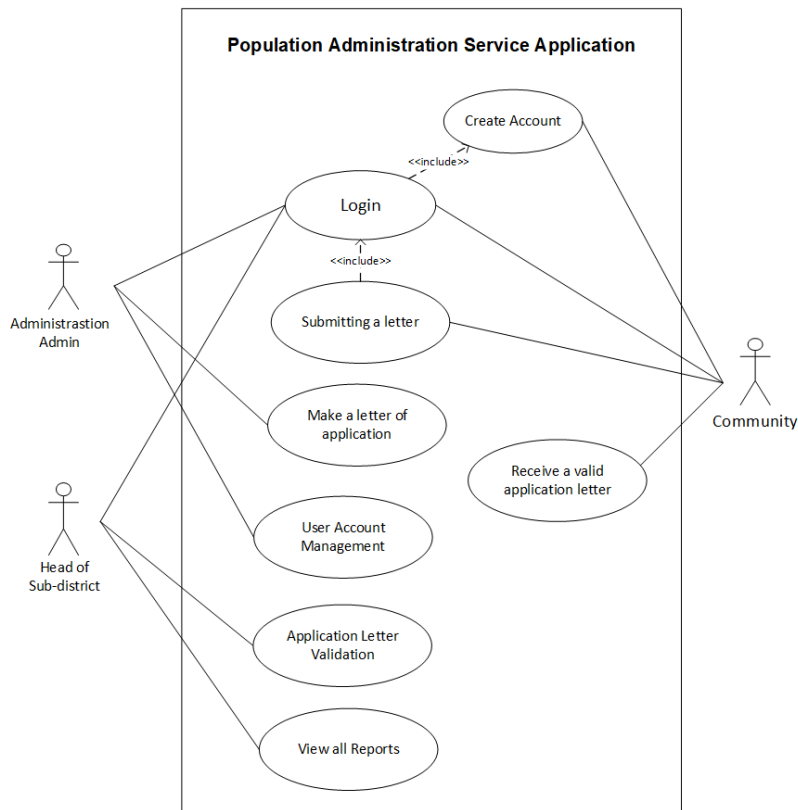


Fig. 5. Use case diagram of the population administration service application.

4.5.2. Data architecture

All data components that the application used will be identified based on the needs of the business functions that have been determined to produce the information required by the organization [26]. Data dissemination diagrams and class diagrams will be used in the design of the data architecture (Figs. 6 and 7).

The class diagram above describes the relationship between classes in a system designed to define data requirements in the form of entities that will be used in the application architecture but are not related to database design [27].

4.6. Technology architecture

The technology required to support the implementation of the proposed application will be determined during this phase [28]. This technology architecture is represented in modeling by software, hardware, and network infrastructure.

4.6.1. Software configuration

Table 3 contains a list of proposed software that the Tagaraja sub-district office will require in order to develop applications that will be used.

Software	Specification
Operating System	Windows 10
Web Browser	Google Chrome, Mozilla Firefox
Web Server	Apache v.2.4.48
DBMS	MySQL
Coding	PHP
Word Processing	Microsoft Word 2020
Spreadsheet	Microsoft Excel 2020
Presentation	Microsoft Power Point 2020

4.6.2. Hardware configuration

A device that allows for standardization, convenience, and support for the implementation of business activities is required to support the application that will be built [29]. As a result, the following are additional hardware suggestions, as well as the minimum specifications required by the Tagaraja sub-district office (see Table 4).

Table 4. Suggested software configuration.

Hardware	Specification
Processor	Intel Core i5
Memory	8 GB RAM
Storage	HDD 2 Terra Byte
VRAM	2 GB Dedicated
Optical Drive	DVD RW/Adapter
Networking	Ethernet 1 Gb 4-port 331i Adapter
Input Device	Keyboard, Mouse
Output Device	Monitor LED

4.6.3. Network configuration

The Tagaraja sub-district office lacks an internal network. All business processes have not been integrated and are still carried out on each device separately. The exchange of data is still done traditionally in the form of documents. As a result, the most recent network technology is proposed, as shown in Fig. 8:

According to Fig. 8, the network is linked via switches and wireless. All computers can be linked together using a core switch, which is supported by bandwidth. Therefore, they can connect to the internet while being protected by a firewall. A disaster recovery center has been added, which is linked to a router for data backup. External users can use a smartphone or web browser that is already connected to the internet to access the Tagaraja sub-district application. Internal users can use the internet or a Local Area Network (LAN) to access the entire application.

The application data created will be saved on the server. The server stores all sub-district data, including data processing for population administration services, employees, and archives. This is due to the absence of a centralized and integrated data store at the Tagaraja sub-district office at this time.

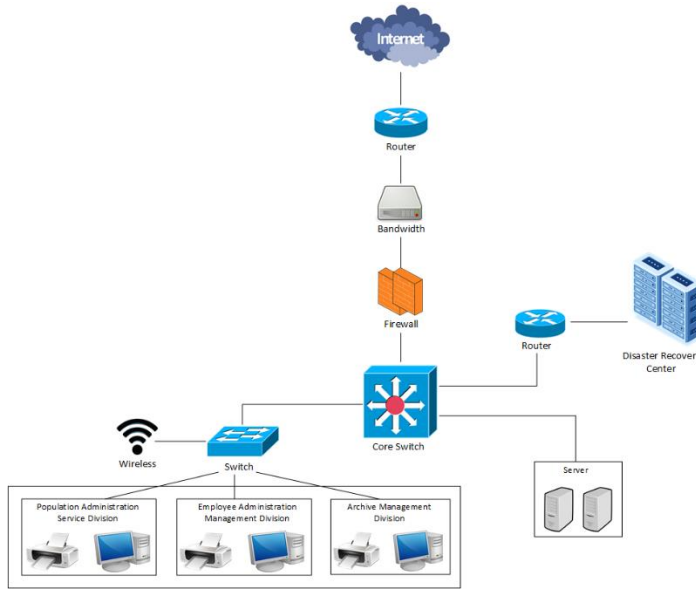


Fig. 8. Suggested network architecture.

4.7. Initial application design

The next step is to describe the design of the required applications into a prototype model based on the data specifications and applications that have been designed. Figure 9 depicts the preliminary design of the population administration application.

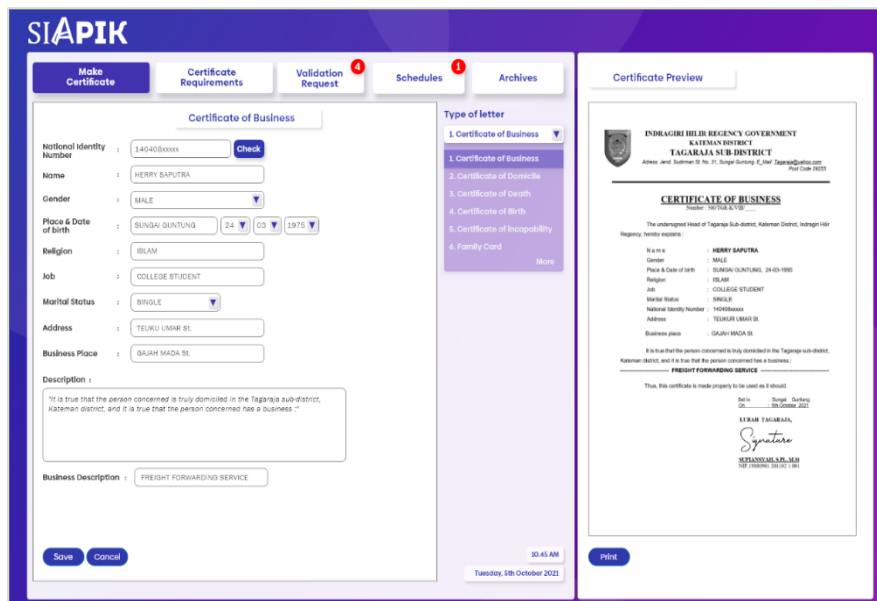


Fig. 9. Initial design of population administration service application.

Residents can use this application to submit a letter-making application without having to visit the sub-district office. Residents must only enter all required documents into the application and wait for confirmation from a sub-district employee (Fig. 10). The validated letter can be downloaded in the "my document" menu.

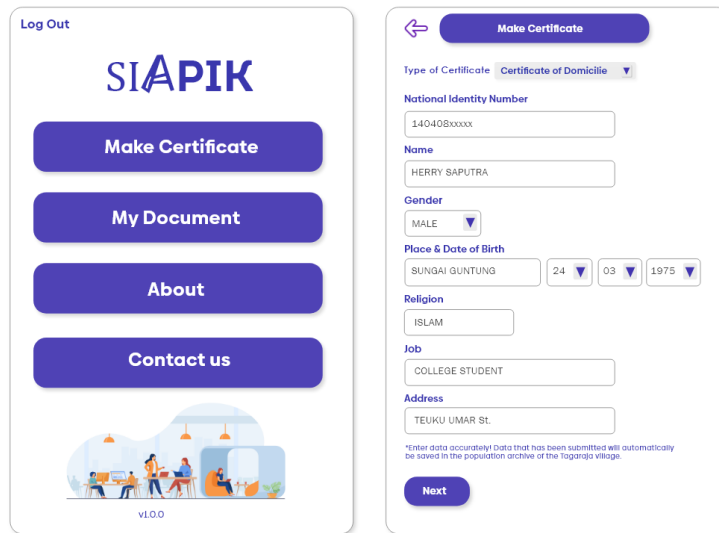


Fig. 10. Initial design of submitting letter process by residents.

Figure 11 depicts the initial employee application design's attendance features. Employee attendance data can be managed more easily with this application. This application manages position, class, and salary data for employees in addition to attendance.

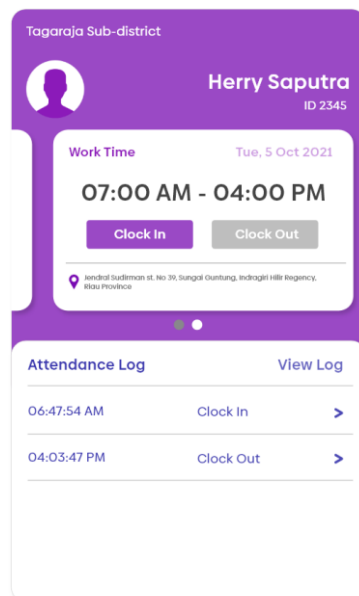


Fig. 11. Initial design of attendance feature on employee application.

The blueprint or enterprise architecture design obtained from the outputs of each phase that is passed can be used as a reference in decision making in the transition process from the old system to the new system in accordance with the desired goals. From these outputs also obtained a new information system design that produces an integrated and comprehensive business process for each section, so that the problem regarding the lack of integrated information system support at the Tagaraja Sub-district Office can be resolved.

However, in order for the development, implementation, and system at the Tagaraja Sub-district Office to run well. In addition, Human Resource (HR) training is needed in the field of technology and information systems to develop a competitive HR so that the system that has been applied can be well maintained and continue to grow.

5. Conclusion

In the implementation of its business processes, the Tagaraja Sungai Guntung Sub-district Office has not yet optimized the use of information systems and information technology. To be implemented, business processes and technology must be aligned. As a result, an Enterprise Architecture design was carried out in this study using the TOGAF ADM framework to produce a blueprint that could be used as a guide for developing an integrated information system to optimally support the implementation of the organization's business processes. The vision architecture, business architecture, information system architecture, and technology architecture are the four phases of ADM that EA design is focused. The results of this design produced a proposed information system capable of producing a comprehensive and integrated business process throughout the section, thereby resolving the issue of the Tagaraja Sub-district Office's lack of integrated information system technology support. The proposed integrated information system is made up of three applications, namely the Population Administration Service Application, the Employee Application, and the Archives Application. It is expected that this application will be able to simplify every existing business process and improve the quality of service provided to the community in accordance with the organization's vision, mission, and goals.

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