

Architectural Planning of Outpatient Registration and Queue Information System using Enterprise Architecture Planning at the Hospital

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Abstract

Perkembangan teknologi informasi mendorong organisasi pelayanan kesehatan untuk memiliki sistem informasi yang terintegrasi dan selaras dengan proses bisnis. Namun, masih banyak institusi yang menghadapi permasalahan seperti sistem yang belum terintegrasi, duplikasi data, dan ketidaksesuaian antara kebutuhan bisnis dan teknologi informasi. Kondisi tersebut menunjukkan perlunya perencanaan arsitektur sebagai dasar pengembangan sistem informasi yang terstruktur dan berkelanjutan. Penelitian ini bertujuan menyusun Enterprise Architecture pada layanan rawat jalan dengan mengacu pada Enterprise Architecture Planning (EAP). Metode penelitian meliputi studi literatur, analisis kondisi eksisting, pemodelan proses bisnis, serta perancangan arsitektur data, aplikasi, dan teknologi. Hasil penelitian berupa blueprint arsitektur enterprise yang diharapkan menjadi acuan pengembangan pelayanan Rumah Sakit yang terintegrasi, efisien, serta mendukung peningkatan kualitas layanan dan pengambilan keputusan manajemen.

Kata Kunci: *Arsitektur Enterprise, Enterprise Architecture Planning, Rumah Sakit*

Abstract

Advances in information technology have encouraged healthcare organizations to develop integrated information systems that are aligned with their business processes. However, many institutions still face problems such as unintegrated systems, data duplication, and mismatches between business needs and information technology. These conditions highlight the need for architectural planning as the basis for structured and sustainable information system development. This study aims to develop an Enterprise Architecture for outpatient services with reference to Enterprise Architecture Planning (EAP). The research methods include literature study, analysis of existing conditions, business process modeling, and data, application, and technology architecture design. The results of this study are an enterprise architecture blueprint that is expected to be a reference for the development of integrated and efficient hospital services that support service quality improvement and management decision making.

Keywords : *Enterprise Architecture, Enterprise Architecture Planning, Hospital*

1. Introduction

The increasingly rapid development of information technology has significantly impacted organizational activities in completing work. Technological advancements have also impacted changes in organizational management strategies and competitive patterns, including in the healthcare sector. Hospitals are experiencing rapid development along with advances in medical science and technology and diagnostic support equipment, enabling more effective and efficient healthcare delivery.[1].

As a large-scale organization, hospitals need to understand their strengths and weaknesses in order to develop strategies for optimal resource utilization. Alignment between information technology and hospital business processes is a crucial factor in supporting the achievement of organizational goals and providing tangible benefits for improving the quality of service.[2].

Hospitals have complex business processes involving various units, from registration and outpatient services to billing and medical records. One service that plays a crucial role in

ensuring the smoothness of subsequent services is outpatient registration and queue management. This service serves as the initial point of interaction between patients and the hospital, so process efficiency and data accuracy significantly impact overall service quality.[3].

Similar issues were also found in previous research. Setiawan et al. (2022), in their study on information system architecture planning in public service agencies, concluded that unintegrated systems have the potential to lead to data redundancy, inaccurate information, and inefficient service processes. This research shows that the approach Enterprise Architecture Planning (EAP) is able to produce structured architectural planning and supports information system integration.[4].

Based on the suitability of the characteristics of the problem, the EAP approach is considered relevant to be applied to Hospital X in order to produce blueprint a structured, integrated, and responsive outpatient registration and queuing information system that supports business process requirements. With clear architectural planning, it is hoped that registration services will be faster, queue management more organized, and the quality of hospital services will improve.

2. Research methods

This research uses an approach *Enterprise Architecture Planning* (EAP) as a method for planning information system architecture. EAP was chosen because it is able to provide a systematic framework in aligning business processes with data, application, and technology architecture, thus producing blueprint structured and directed architecture. This research is of a planning nature (planning-oriented research) and does not cover the system implementation stage.

2.1 Research Stages

The research stages in this study refer to the method Enterprise Architecture Planning (EAP) as proposed by Spewak, with adjustments to the scope of the research. The research stages involved include several stages, as shown in the image below.

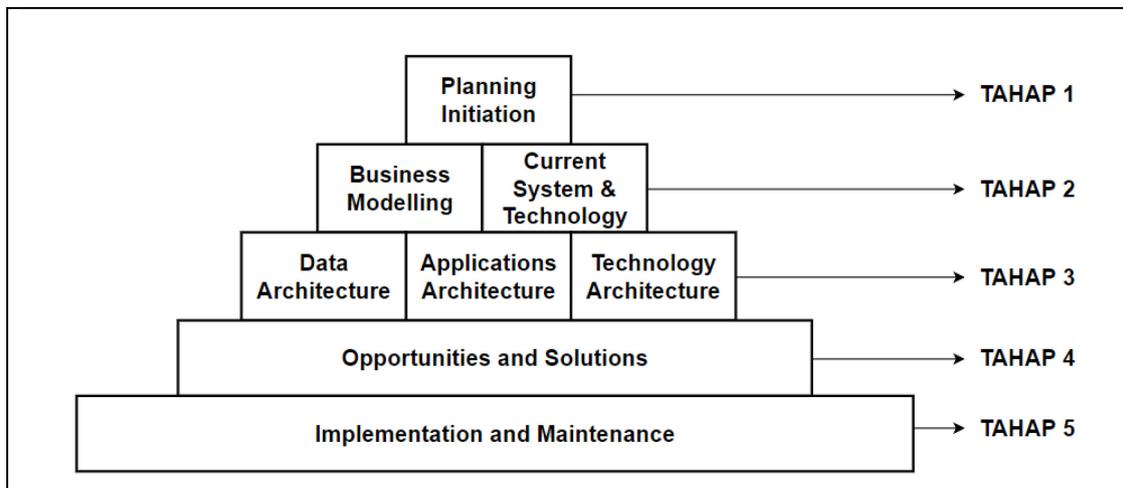


Figure 2.1 EAP Framework Stages

1. **Architectural Planning Initiation Stage**
This stage aims to determine the scope, objectives, and objects of the research. The focus of architectural planning is limited to outpatient registration and queuing services at Hospital.
2. **Business Process Modeling**
At this stage, modeling of the current business processes (AS-IS) and the design of the proposed business processes (TO-BE) are carried out to identify problems and opportunities for improvement.
3. **Current Systems and Technology Analysis**
This stage aims to identify the condition of the information and technology systems currently used to support outpatient registration and queuing services.

4. Enterprise Architecture Design
This stage produces a design of the business, data, application and technology architecture as a blueprint for the proposed information system.

The above stages are carried out sequentially to ensure alignment between business needs and information system planning.

2.2 Stakeholder Identification

Identification *stakeholder* Stakeholder identification is a crucial step in enterprise architecture planning because stakeholders are those directly or indirectly involved in business processes and impacted by the information system being designed. Stakeholder identification is carried out to ensure that the resulting architecture plan aligns with the needs and interests of all relevant parties.

Stakeholders involved in outpatient registration and queuing services at Hospital X include:

1. Outpatients
Patients are the primary users of registration and queuing services. They require a fast registration process, well-managed queues, and guaranteed service times.
2. Registration Officer
Registration officers are responsible for recording and verifying patient data and managing queues. They need a system that's easy to use and can reduce repetitive work.
3. Police Officer
Polyclinic staff use registration data to provide services to patients. They need accurate and readily available patient data without the need for re-entry.
4. Hospital Management
Hospital management acts as a decision maker and requires information and reports related to outpatient services for evaluation and planning purposes.
5. Information Technology (IT) Unit
The IT unit is responsible for managing and developing information systems. This unit requires a clear architectural design to guide future system development.

This stakeholder identification will later become the basis for business process modeling and enterprise architecture design.

2.2.1 Tujuan Enterprise Architecture Planning

Enterprise Architecture Planning (EAP) aims to align an organization's business needs with the planning of the information systems and technology that support them. According to Spewak, EAP focuses on systematically defining data, application, and technology architectures as the foundation for long-term information systems development.

The purpose of implementing Enterprise Architecture Planning in this study is to produce a blueprint for the architecture of an outpatient registration and queue information system that is structured, integrated, and aligned with the business processes of Hospital X. This blueprint is expected to be a reference in developing an information system that is able to increase service efficiency, reduce data duplication, and improve the quality of information for all stakeholders.

2.2.2 Vision of the Outpatient Registration and Queue Information System

The vision of the information system in this research is to realize an integrated outpatient registration and queuing system, based on centralized data, real-time, and oriented towards improving the quality of patient services.

This vision emphasizes the importance of data integration between work units, particularly between the registration unit and the outpatient unit, so that patient information can be accessed accurately and timely. With a clear information system vision, enterprise architecture planning can be carried out in a focused and consistent manner, in line with Hospital X's business objectives.

2.2.3 Scope and Limitations of the Research

The scope of this research is focused on outpatient registration and queuing services at Hospital X, which includes analysis of business processes, information systems, and technology used to support these services.

The limitations of this research are as follows:

1. The research only covers the enterprise architecture planning stage and does not cover the system implementation stage.
2. The services analyzed were limited to outpatient services and did not include inpatient care.
3. The analysis was carried out based on the conditions of the system and technology running at the time the research was conducted.

The determination of the scope and limitations aims to maintain the focus of the research and ensure that the results of architectural planning can be compiled in depth and in accordance with the principles of Enterprise Architecture Planning.

2.3 Business Process Modeling

2.3.1 Value Chain Diagram

One of the techniques used in the business process modeling phase of Enterprise Architecture Planning (EAP) is the Value Chain Diagram. The Value Chain is used to illustrate the series of primary and supporting activities that provide value to the organization in achieving its vision and mission.

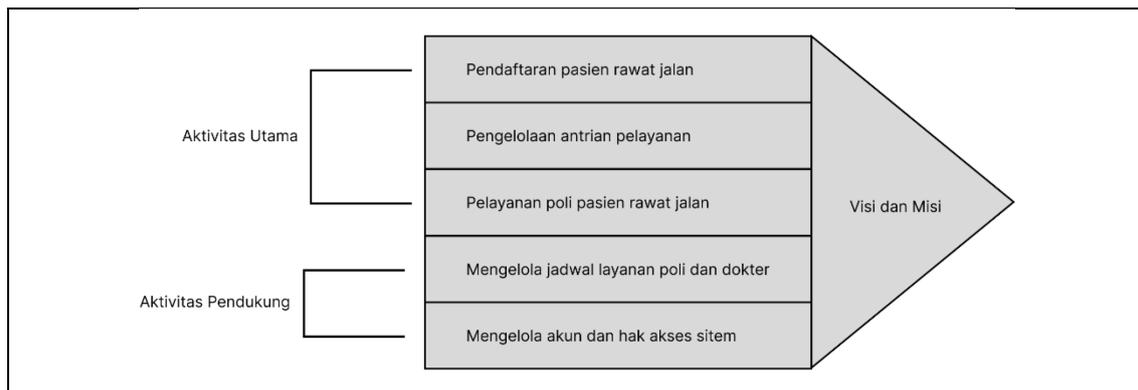


Figure 2.2 Value Chain Diagram

Based on the Value Chain Diagram shown in Figure 2.2, it can be identified that Hospital X's main business processes in outpatient services include outpatient registration, service queue management, outpatient polyclinic services, and polyclinic and doctor service schedule management. These activities directly play a role in providing service value to patients. Meanwhile, account management and system access rights act as supporting activities that ensure the security, regularity, and continuity of information system operations. All activities in this value chain are integrated and directed to support the achievement of Hospital X's vision and mission in improving the quality and efficiency of health services.

2.3.2 Current Business Process (AS-IS)

Currently, the outpatient registration and queueing process at Hospital X is still manual and has not been integrated across units. The current business process flow is as follows:

1. The patient comes to the outpatient registration counter.
2. Patients fill out the registration form manually.
3. The registration officer records patient data into a local system or physical document.
4. The officer gives the queue number manually.
5. Patients waiting to be called in the queue.
6. After being called, the patient goes to the poly unit.
7. Polyclinic officers re-enter patient data before services are provided.

2.3.3 AS-IS Business Process Issues

Based on AS-IS business process modeling, several main problems were found, including:

1. Duplication of patient data occurs due to repeated recording at the registration counter and poly unit.
2. The registration and queuing process takes a relatively long time.
3. Unavailability of real-time queue information.
4. There is no data integration between the registration unit and the poly unit.

2.3.4 Proposed Business Process (TO-BE)

In the proposed state (TO-BE), the outpatient registration and queuing business processes are designed to be integrated with information system support. The proposed business process flow is as follows:

1. Patients register for outpatient care through the digital registration system.
2. The system stores and manages patient data and registration data centrally.
3. The registration officer verifies and validates the registration data through the system.
4. The system generates queue numbers automatically based on valid registration data.
5. The system distributes registration and queue information to the relevant polyclinic units.
6. Polyclinic officers access patient registration and queue data through the system without re-input.
7. The polyclinic officer calls the patient according to the queue number and updates the service status.

The design of the TO-BE process is expected to increase service efficiency and reduce administrative errors.

2.3.4 Purpose of Business Process Modeling

Business process modeling is conducted to gain a comprehensive understanding of the current outpatient registration and queuing process (AS-IS) and the proposed process (TO-BE). This stage aims to identify operational issues, non-value-added activities, and opportunities for business process improvement. The results of this business process modeling serve as the basis for designing data, application, and technology architectures in the subsequent Enterprise Architecture Planning phase.

2.4 Current Systems and Technologies

Based on an analysis of existing conditions, the systems and technology used to support outpatient registration and queuing services at Hospital X still have limitations. The registration system is local and not integrated with the polyclinic units, while queue management is still manual.

Furthermore, there is no centralized database for storing patient data, and no system capable of providing real-time queue information and service reports. The existing information technology infrastructure is still limited to the use of standard computer devices without the support of a planned information system architecture. This situation demonstrates the need for enterprise architecture planning as a reference for the future development of outpatient registration and queue information systems.

2.4.1 Information System Inventory

Based on the analysis of existing conditions, the information systems used for outpatient registration and queuing services at Hospital X are still separate and not yet integrated. An inventory of the information systems currently in use can be seen in the following table.

Table 2.1 Inventory of Inpatient Care Information System

Component	Present condition
Registration System	Local / manual system
Queue System	Manual (physical number)
Patient Database	Not centralized
Inter-Unit Integration	Not available
Information Presentation	Not real-time

Table 2.1 above illustrates the results of an inventory of the information systems currently used to support the outpatient registration and queuing process at Hospital X. This table shows that most system components are still manual and not yet fully integrated. The registration and queuing systems are still locally managed and use physical numbers, the patient database is not yet centralized, and integration between service units is not yet available. Furthermore, information presentation is not yet carried out in real time. This condition indicates limitations in the efficiency of data management and service flow, potentially leading to delays, data duplication, and obstacles in coordination between units.

2.4.2 Information Technology Infrastructure

The current information technology infrastructure is still limited to the use of standard computer equipment in each service unit. There is no centralized server or network infrastructure to support information system integration between units. This situation results in the existing information system being unable to support optimal data exchange.

2.4.3 System and Technology Issues

Based on the inventory of systems and technologies, the main problems identified include:

1. The occurrence of redundancy and inconsistency in patient data.
2. The data input process is carried out repeatedly by different units.
3. Unavailability of real-time queue information.
4. It is difficult for management to obtain service reports quickly and accurately.

This condition shows the need for enterprise architecture planning as a reference for developing integrated and sustainable information systems.

3. Literature Study

This chapter discusses the literature review used as a theoretical basis in the research on designing the enterprise architecture for the outpatient registration and queue information system at Hospital X. The literature study was conducted by examining various relevant references, such as books, scientific journals, standards, and previous research related to the concept of enterprise architecture, Enterprise Architecture Planning (EAP), business process modeling, and health care information systems.

3.1 Enterprise Architecture

Enterprise Architecture (EA) is a systematic approach used to describe, design, and manage the structure and operations of an organization as a whole. EA functions as a blueprint (*blueprint*) that integrates the vision, mission, business strategy, business processes, information systems, and information technology infrastructure into a unified whole. Enterprise Architecture can ensure that information technology development does not proceed in isolation, but rather supports the organization's strategic objectives in a sustainable manner.

Enterprise Architecture covers several main domains: business architecture, data architecture, application architecture, and technology architecture. Business architecture focuses on processes, functions, and organizational structure; data architecture governs the management and utilization of data as a strategic asset; application architecture describes the systems and applications used to support business processes; and technology architecture describes the hardware, software, network, and technology platform infrastructure used. These four domains are interrelated and must be designed in an integrated manner for an organization to operate effectively and efficiently.

Enterprise Architecture is necessary because it acts as the foundation of an organizational system that is composed of various components that are interconnected and interdependent, and are related to the surrounding system environment. In addition, Enterprise Architecture provides a set of rules and guidelines used in the design process and system evaluation as a whole. comprehensive[5]. In the context of public sector organizations, Enterprise Architecture plays an important role in supporting transparency, service efficiency, and the implementation of the Electronic-Based Government System (SPBE). Therefore, Enterprise Architecture becomes an important foundation in the management and development of organizational information systems in a structured and long-term oriented manner.

3.2 Enterprise Architecture Planning

Enterprise Architecture Planning is a planning process that aims to formulate the architecture for utilizing systems and information to support the needs and business strategies of the organization, while also preparing a plan for implementing this architecture in a directed and effective manner.integrated[1]. EAP aims to produce an enterprise architecture implementation plan that is systematic, focused, and aligned with the organization's strategy. This method emphasizes a top-down approach, starting with an understanding of the organization's business objectives and processes, then working down to information needs and supporting technology.

Enterprise Architecture Planning usually consists of several main stages, namely planning initiation, modeling current conditions (as-is), designing the desired conditions (to-be), gap analysis (gap analysis), and the development of an implementation plan. In the initial phase, the organization identifies the scope, vision, and architectural principles. Next, an analysis of the existing system is conducted to understand the weaknesses and limitations of the current system. Based on this analysis, a target architecture is designed that is expected to support the organization's future needs.

3.3 Hospital X Profile

Hospital X is a healthcare institution that provides comprehensive healthcare services to the community, including outpatient care and other medical support services. Hospital X's vision is to become a hospital that excels in providing quality, professional healthcare services that are oriented towards patient satisfaction. To realize this vision, Hospital X's mission includes the following.

1. provide quality, safe and affordable health services for the community;
2. improving the professionalism and competence of human resources in the health sector;
3. develop and utilize information technology to support hospital services and management;
4. and increase the effectiveness and efficiency of the health service process through integrated system management.

Hospital X provides a variety of healthcare services, particularly outpatient services, including patient registration, queue management, and specialist polyclinic services. Outpatient services are a key service with a high patient volume and play a crucial role in determining the overall quality of hospital services. Therefore, ensuring a smooth registration process and managing outpatient queues is a key focus in Hospital X's operations.

Organizationally, Hospital X has an organizational structure consisting of the hospital leadership as the primary person in charge, supported by several fields or work units. Each unit has interrelated roles and responsibilities in supporting the healthcare process. However, the interrelationships between these units require an integrated information system so that workflow and data exchange can run effectively and efficiently.

Based on the characteristics of the vision, mission, services, and organizational structure, Hospital X requires a focused and integrated information system architecture plan to support outpatient registration and queuing services. This plan is expected to align the hospital's business needs with the use of information technology, thereby improving service quality, operational efficiency, and patient satisfaction.

4. Results and Discussion

This section contains the results and discussion of research related to data architecture, application architecture, technology architecture, and implementation plans of Hospital X.

4.1 Data Architecture

Data architecture aims to identify the main business entities along with data entities that support the registration process, patient queues, and polyclinic services at Hospital X. Data architecture is used as a basis for designing application and technology architecture, so that data can be managed centrally, consistently, and integrated between units.

Table 4.1 Outpatient Service Data Architecture Entities

Business Entity	Data entity	Description
Outpatient Registration	Patient Entity	Storing patient identity data
	Registration Entity	Storing patient visit data

	Poly Entity	Save destination poly information
	Poly Schedule Entity	Save the polyclinic service schedule
	Officer Entity	Saving registration officer data
Patient Queue Management	Queue Entity	Save queue number and status
	Registration Entity	Queue relationship with registration
	Poly Entity	Information on service poly
	Poly Schedule Entity	Validation of service time
	Officer Entity	The officer who calls the queue
Outpatient Polyclinic Services	Patient Entity	Information on patients served
	Registration Entity	Patient visit data
	Queue Entity	Patient service status
	Poly Entity	Service unit
	Officer Entity	Police Officer

In the Outpatient Registration business entity, the business process is supported by a patient data entity that stores patient identity information as the basis for services. Furthermore, the registration data entity is used to record patient visits for each outpatient service. The clinic and clinic schedule data entities play a role in determining the purpose and time of service a patient will receive, while the staff data entity is used to record the registration staff responsible for the registration process.

The Patient Queue Management business entity is supported by a queue data entity that stores patient numbers and queue status. The registration data entity acts as a link between patient data and queue data, allowing each queue number to be traced based on valid registration data. In addition, the clinic and clinic schedule data entities are used to ensure that queue management is in accordance with the service units and available service times. The officer data entity serves to record the officers responsible for calling and managing patient queues.

In the Outpatient Clinic Service business entity, the service process is supported by a patient data entity that provides information on the patient to be served, and a registration data entity that displays data on patient visits to the relevant clinic. The queue data entity is used to monitor patient service status, while the clinic data entity represents the service unit where the patient receives care. The staff data entity records the clinic staff who provide care to the patient.

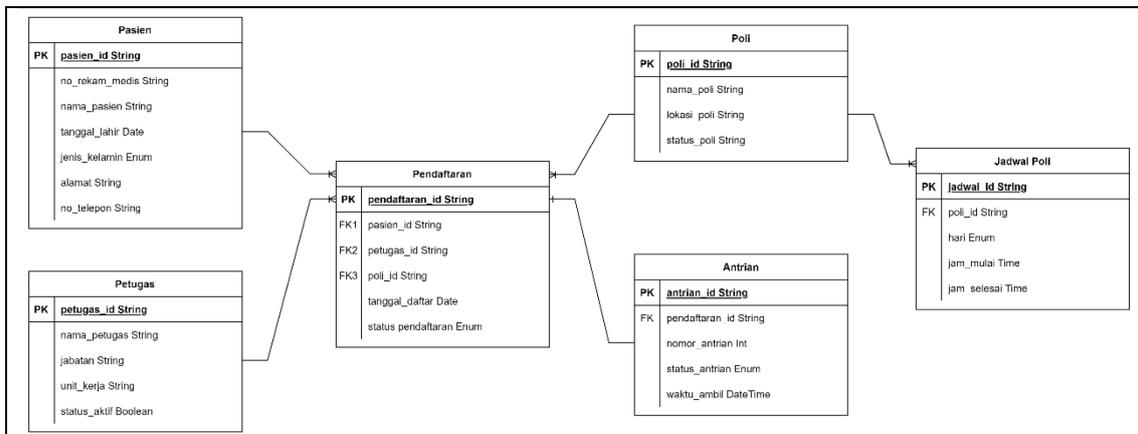


Figure 4.1 Physical Data Model

Physical data model describes the table structure and data relations used to support the implementation of the outpatient registration and queue information system at Hospital X. This

PDM represents the results of the reduction of conceptual and logical models into physical table form which will be implemented in the database.

The Patient entity stores patient identity data as the primary reference in the service process. The Registration entity records every outpatient visit and acts as a liaison between patient data, staff, and the destination clinic. Each registration data generates one Queue data used to organize the order of patient services at the related clinic. The Clinic entity stores outpatient service unit information, while the Clinic Schedule entity stores service schedule data used as a reference for validating patient service times. The Staff entity stores system user data that plays a role in the registration and clinic service process. Relationships between entities are designed to ensure data integrity and consistency, and support centralized and integrated data storage.

4.2 Application Architecture

The application architecture is designed to identify the applications needed to support the outpatient registration and queuing business processes at Hospital X. This architecture explains the application functions, their relationship to business processes, and the data entities managed, so that they can support data integration and service efficiency.

Tabel 4. 2 Application Portofolio

Applica tion Code	Application Name	Description	Supported Business Functions	User
SI01	Patient Registration Application	Managing the outpatient registration process	Outpatient registration	Patients, Staff, Management
SI02	Queue Management Application	Manage patient queue numbers and status	Service queue management	System, Police Officer
SI03	Outpatient Polyclinic Service Application	Supporting the patient service process in the polyclinic	Outpatient polyclinic services	Doctors, Nurses

Table 4.2 describes a collection of applications designed to support the integrated business processes of outpatient services in a hospital. Each application has a specific role in supporting core business functions and engaging users according to their respective authorities and responsibilities.

The Patient Registration Application serves as the main entry point for outpatient care, supporting digital patient registration and visit recording. The Queue Management Application automatically manages patient numbers and queue status to ensure orderly and efficient service delivery. The Outpatient Clinic Service Application supports medical care in the clinic by utilizing pre-existing registration and queue data.

In addition to the core application, the Clinic Schedule Management Application is provided to manage clinic and doctor service schedules to ensure services run according to established schedules. The User Management Application serves as a supporting application that manages user accounts and access rights, ensuring security and controlled access to the hospital's information system. Application Portfolio is designed to support integration between applications, data consistency, and improving the quality of outpatient services.

4.3 Technology Architecture

The technology architecture is designed to define the information technology platform required to support the implementation of the outpatient registration and queuing system at Hospital X. This architecture serves as an infrastructure foundation that allows applications and data to run in an integrated, reliable, and efficient manner.

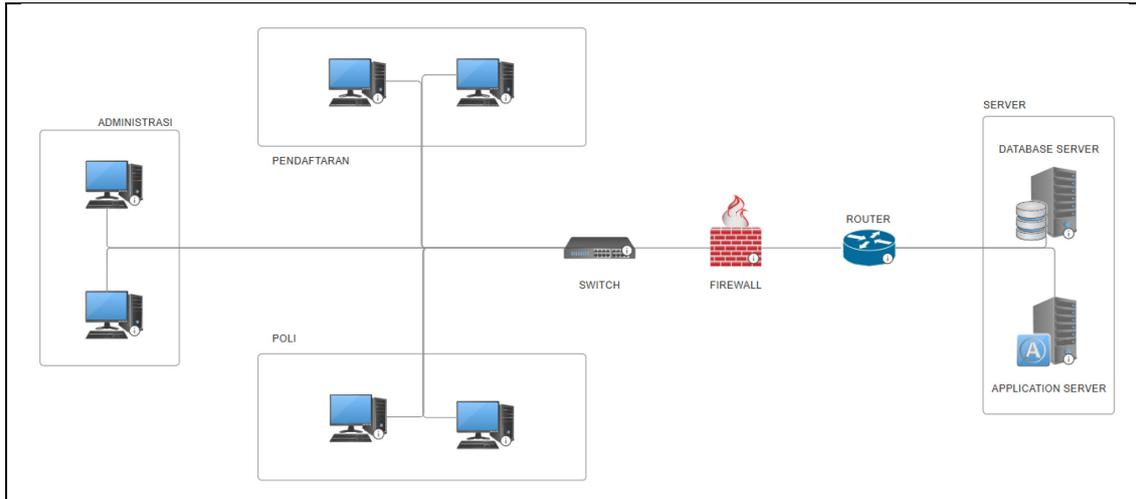


Figure 4.2 Network Topology

The topology shows in the figure 4.2 proposed technology architecture to support the registration information system and outpatient polyclinic services at Hospital X. In this architecture, user devices in the Registration, Polyclinic, and Administration units in the form of client computers are connected to the local network through a switch as an internal connectivity center. The switch functions to connect all client devices with a firewall that is placed as a network security layer, before being forwarded to a router that acts as a link between the internal network and the server. Next, the router directs data communication to the server consisting of an application server and a database server. The application server functions to run registration applications, queue management, polyclinic services, and other supporting applications, while the database server plays a role in storing and managing patient data, registration data, and queue data centrally. With this architecture, each work unit can access the same applications and data in an integrated manner without the need for re-input, thus supporting the smooth running of TO-BE business processes, improving data consistency, as well as improving security and accelerating outpatient services.

4.4 Implementation Plan

The implementation plan is prepared to provide an overview of the application implementation priorities that have been defined in the application architecture. In the context of Enterprise Architecture Planning (EAP), the implementation plan serves as a conceptual guide in determining which applications need to be implemented first based on their contribution to the organization's business processes.

Table 4.3 Implementation Plan

Strategic / Main	Operational Support
SI01 – Patient Registration Application	SI04 – Polyclinic Schedule Management Application
SI02 – Queue Management Application	SI05 – User Management Application
SI03 – Outpatient Polyclinic Service Application	

The implementation plan table shows the grouping of applications based on their implementation priorities in supporting the business processes of Hospital X. Applications in the strategic/main category consist of the Patient Registration Application, Queue Management Application, and Outpatient Poly Service Application, which are prioritized because they play a direct role in the main flow of outpatient services starting from patient registration, queue management, to services in the poly unit, and have a significant impact on data integration and service efficiency.

Meanwhile, the Polyclinic Schedule Management Application and the User Management Application are placed in the operational support category because they function to support the operational and administrative management of the information system, such as setting service schedules and managing user access rights, but are not directly involved in the patient service flow. This grouping is done to facilitate determining the priority of application implementation within the Enterprise Architecture Planning framework, so that system implementation can be carried out in stages and focused on primary business needs first.

The application development roadmap is designed to provide an overview of the priority plan for developing an outpatient information system application at Hospital X within a specific timeframe. This roadmap serves as a planning guide that shows the application development stages based on their priority categories. The time division in months is indicative and is used to help visualize the implementation plan within the context of Enterprise Architecture Planning.

Information system development is planned in two main stages. The first stage focuses on the development of strategic/main applications, namely the Patient Registration Application, the Queue Management Application, and the Outpatient Clinic Service Application. These applications are prioritized because they play a direct role in supporting the core business processes of outpatient services. Furthermore, the second stage focuses on the development of operational support applications, namely the Clinic Schedule Management Application and the User Management Application. The preparation of this roadmap aims to ensure that application development is carried out in stages according to priorities.

5. Conclusion

Based on the results of the analysis and design that have been carried out, it can be concluded that the implementation Enterprise Architecture Planning (EAP) is expected to be able to provide an overview of the relationship between business processes, data, applications, and technology in outpatient services at Hospital X. Through this approach, the organization can identify existing conditions and information system needs in a more structured and targeted manner.

The resulting data architecture demonstrates the interrelationships between key entities such as patients, registration, queues, clinics, and service schedules, thus supporting data integration and minimizing redundancy. Meanwhile, the application architecture is designed in the form of application portfolio has mapped business functions into applications with clear roles and users. The proposed technology architecture also provides adequate infrastructure support to support application performance and system security. It is expected that the structure of blueprint enterprise architecture in this way, the organization has a strategic reference in developing information systems in the future. Blueprint not only helps improve operational efficiency, but also supports improved quality of healthcare services and more informed decision-making by management.

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