American International Journal of Business Management (AIJBM)
ISSN- 2379-106X, www.aijbm.com Volume 6, Issue 8 (August 2023), PP 132-143

Enterprise Architecture Planningfor Public Health Centers

Deden Prayitno[1]*, Budi Indiarto[2],Mercurius Broto Legowo[3]
[1,2,3,] Faculty of Information Technology, Perbanas Institute, Jakarta, Indonesia
*Corresponding Author: Deden Prayitno[1]

ABSTRACT: This strategy's implementation carries out a task in an information system whose completion necessitates a coordinated approach to planning, carrying out, and monitoring in line with the enterprise's business strategy.A rational, thorough, and holistic strategy for simultaneously designing and implementing systems and system components is called Enterprise Architecture.The unintegrated data in each section, as well as data duplication and information system architecture, makes it necessary to develop a good enterprise architecture to support enterprise business.This research aims to develop an enterprise architecture for a Public Health Center, with a case study at Setiabudi District Public Health Center, South Jakarta, Indonesia.This descriptive research uses the TOGAF-ADM method in designing enterprise architecture The TOGAF method analysis includes Business Architecture, Application Architecture, and Technology Architecture.Primary and secondary data had obtained through observational studies and interviews at the Public Health Center.The data analysis method used in this research is a gap analysis between the target architecture and the current state of the architecture.The main result of this development research presents an enterprise architecture design for a complete and integrated Setiabudi District Public Health Center, South Jakarta.This enterprise architecture study provides significant input and contribution to increasing the effectiveness and efficiency of Setiabudi District Public Health Center services in South Jakarta

KEYWORDS–*Enterprise Architecture, Public Health Centers, TOGAF-ADM*

I. INTRODUCTION

Currently, one of the important strategies in dealing with the development of information technology is the utilization and improvement of information system support for enterprises.This strategy carries out a mission in an information system whose fulfillment requires an integrated direction in planning, implementing, and controlling in line with the enterprise's business strategy.IT is a challenge to implement Enterprise Architecture (EA) in an organisation(Olsen & Trelsgård, 2016).Enterprise architecture is a tool or strategy to support business processes and achieve business goals(Syynimaa, 2016).The driving factor for information technology in organizations is the increasing need for service functions to be carried out.These conditions make the information system unable to be utilized as expected based on the mission and objectives of implementing information technology, namely efficiency, and effectiveness in meeting organizational needs, starting from meeting needs at the highest level within the organization to the lowest requirements, namely operational, in the study this is the case at the public health center.

According to the Regulation of the Minister of Health of the Republic of Indonesia No. 75 of 2014 concerning Community Health Centers, the definition of a Public Health Center (Puskesmas, abbreviated in Indonesia) is a health facility that manages public health and first-level individual health with more priority to promotive and preventive efforts and to achieve the highest level of public health in the taking area(Putra & Hadiana, 2020). Health Information Systems had broadly defined as a system that integrates data collection, processing, reporting, and use of the information necessary for improving health service effectiveness and efficiency through better management at all levels of health services(Cortez et al., 2023).The alignment of the application of information systems with organizational needs at the Setiabudi District Health Center South Jakarta has a solution through the integration factor in its developmentThe true purpose of integration is to reduce the gaps that occur in the system development process.To reduce this gap, a paradigm is needed in planning, designing, and managing information systems called enterprise architecture .

Enterprise Architecture (EA) is a methodology that aims to provide companies with a framework for information in business processes in ways that support the business strategy and provide the strategic alignment between the business strategy and information and communication technologies(Menchaca et al.,2013).According to Kotusev (2021), Some frameworks that created a guide or method for the establishment of the EA are The Zachman Framework, The Department of Defense Architecture Framework (DoDAF), and The Open Group Architecture Framework (TOGAF).Meanwhile, according to Budiman et al.,(2018), Enterprise Architecture Planning (EAP) is a modern approach to data quality planning to achieve that goalInformation Systems mission.EAP is also a planning process that defines data architecture, application architecture, and information technology architecture to support business.

The Open Group Architecture Framework (TOGAF) ADM is a framework used to carry out steps including Preparation, Vision Architecture, Business Architecture, Information System Architecture, and Technology Architecture(Putra & Hadiana, 2020).According to Girsang & Abimanyu(2021), the chosen methodology for Enterprise Architecture Planning is TOGAF ADM, based on its focus on the process and its flexibility to incorporate the most suitable artifacts and approaches to study cases at the Public Health Center.

Previous research on enterprise architecture planning for Public Health Centers had carried out by several researchers.Research fromPutra & Hadiana(2020), aims to build an integrated information system in East Curup Health Center.Their research produces a blueprint that supports integrated business processes by Designing Enterprise Architecture for Public Health centers using on TOGAF Architecture Development Method.Studies related to Enterprise Architecture Development for Healthcare useADM TOGAF conducted by Girsang & Abimanyu(2021). The results of this study also show how TOGAF ADM can increase the awareness of business users business itself.A study by Daeli et al.(2022)stated that Enterprise Architecture (EA) must be a priority, and enterprise modeling is a new field that continues to receive attention from the frameworks that are currently widely used in describing the architecture of an enterprise is the EA3 Cube Framework.Descriptive Study Analysis fromCortez et al.(2023)discusses health information system users in public health facilities. The researchers used the descriptive method the Dashboarding, Analysis, and Reporting or DAR method.The conclusion of the study states that use health information system (HIS) by designing encoders for each public health facility should be implemented.

This research aims to develop enterprise architecture planning for Public Health Center, with a case study at Setiabudi District Public Health Center, South Jakarta, Indonesia.The objectives of this study are to make business architecture modeling, Information System Architecture modeling, and technology architecture modeling.The findings of this enterprise architecture planning study provide significant input and contribution to increasing the effectiveness and efficiency of Setiabudi District Public Health Center services in South Jakarta and are a novelty in this research.

II. LITERATURE REVIEW

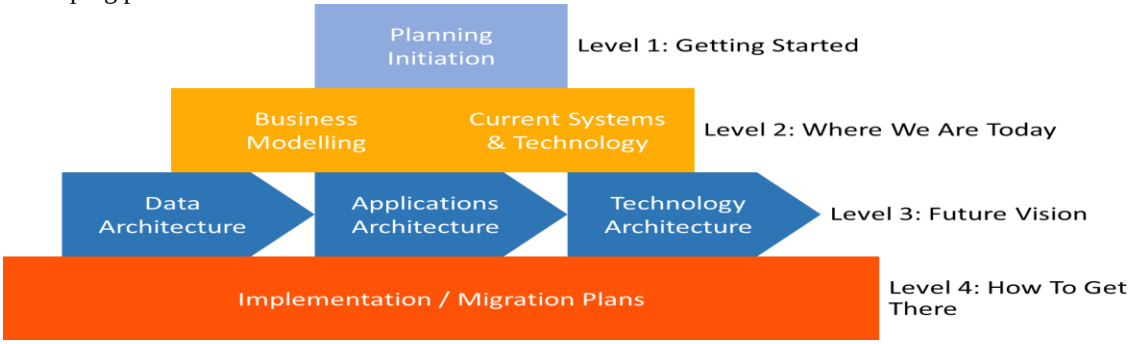
2.1 Public Health Centers

According to the Regulation of the Minister of Health of the Republic of Indonesia No. 75 of 2014 concerning Community Health Centers, the definition of a Public Health Center (Puskesmas, abbreviated in Indonesia) is a health facility that manages public health and first-level individual health with more priority to promotive and preventive efforts and to achieve the highest level of public health in the taking area(Putra & Hadiana, 2020).

2.2 EnterpriseArchitecturePlanning

A good definition of "enterprise" in this context is any collection of organizations that has a set of goals and a single bottom line. In that sense, an enterprise can be a government agency, a whole corporation, a division of a corporation, a single department, or a chain of geographically distant organizations linked together by common ownership.The definition of architecture used in ANSI/IEEE Std 1471-2000 is: "The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution."Enterprise Architecture is a description of the stakeholder mission, including information, functionality/usability, organizational location, and performance parameters.

Enterprise Architecture Planning (EAP) is a method developed for building enterprise architecture.Enterprise Architecture is the activity of organizing data to achieve business process organizational goals and a blueprint that explains how IT elements and information management work together as one unit.(Lase & Ranti, 2019). The level of EAP development shown in Figure 1., is the level for getting started, the stage for understanding current conditions, the level for defining a vision for the future, and the stage for developing plans to achieve a vision for the future.



Source:Lase & Ranti(2019).

Figure 1. Enterprise Architecture PlanningStages

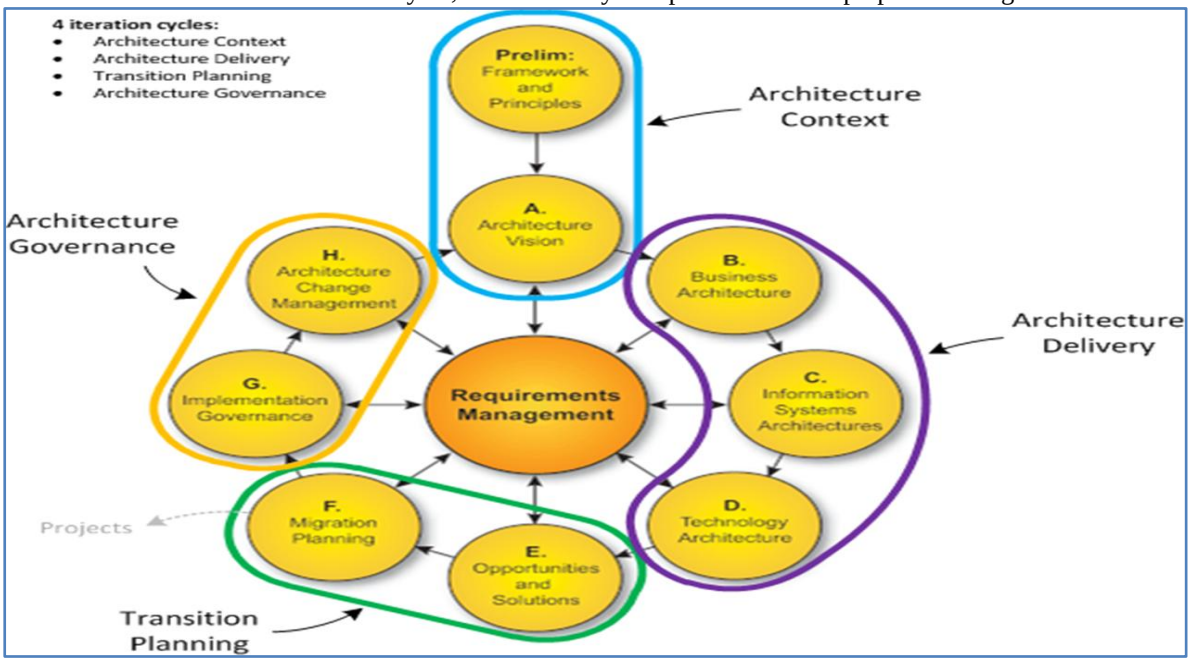
2.3 The Open Group Architecture Framework (TOGAF)

The Open Group Architecture Framework(TOGAF)is a comprehensive methodology, including a set of tools to develop an Enterprise Architecture(Dumitriu & Popescu, 2020). An architectural framework is a tool used to develop a wide range of different architectures.The architectural framework should describe a method for designing information systems in terms of a set of building blocks and for showing how the building blocks fit together.According to Girsang & Abimanyu (2021), four types of architecture are generally accepted as part of the overall enterprise architecture, namely business architecture, data architecture, application architecture, and technology architecture.The combination of data and application architecture is also known as information system architecture.TOGAF was originally designed to support the technology architecture. But TOGAF is growing and then supporting all four types of architecture.TOGAF consists of two main parts, namely:

***(1) ArchitectureDevelopmentMethod* (ADM).**

ADM is the core of TOGAF.From Figure 2 it can be seen that the heart of ADM is requirements management.Business architecture, information systems, and technology are always aligned with needs and related to business objectives.The arrows indicate a continuous process through the ADM stages.ADM includes 9 basic stages as shown in Figure 3, namely:

a. Preliminary Phase: Framework and principles.
b. Phase A: Architecture Vision. Defining scope, vision and mapping the overall strategy.
c. PhaseB:BusinessArchitecture.Describe the current and goal business architecture and define the gaps between them.
d. PhaseC:InformationSystemArchitecture.Develop target architectures for data and applications.
e. PhaseD:TechnologyArchitecture.Creating an overall architectural goal that will be implemented at a later stage.
f. PhaseE:OpportunitiesandSolutions.Develop an overall strategy, determining what to buy, build or reuse, and how to implement the architecture described in phase D.
g. Phase F:Migration Planning. Prioritize projects and develop planned migrations.
h. PhaseG:ImplementationGovernance.Determine preparations for implementation.
i. PhaseH:ArchitectureChangeManagementMonitor the running system for the benefit of change and determine whether to start a new cycle, it is necessary to repeat back to the preparation stage.

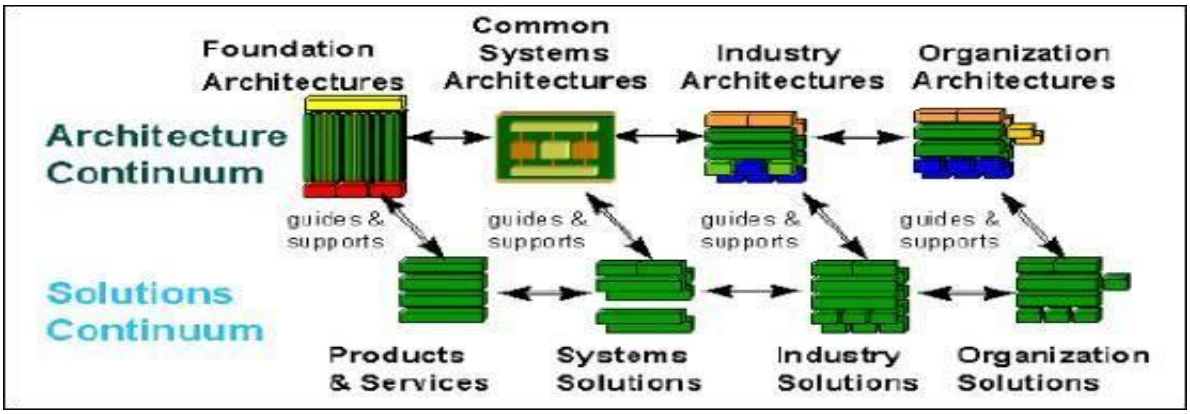


Source: Girsang & Abimanyu(2021)

Figure 2. ADM Basic Structure - Enterprise Architecture Development Cycle

***(2)* EnterpriseContinuum**

The enterprise continuum is a means of communication and understanding between individual customers and vendor organizations.

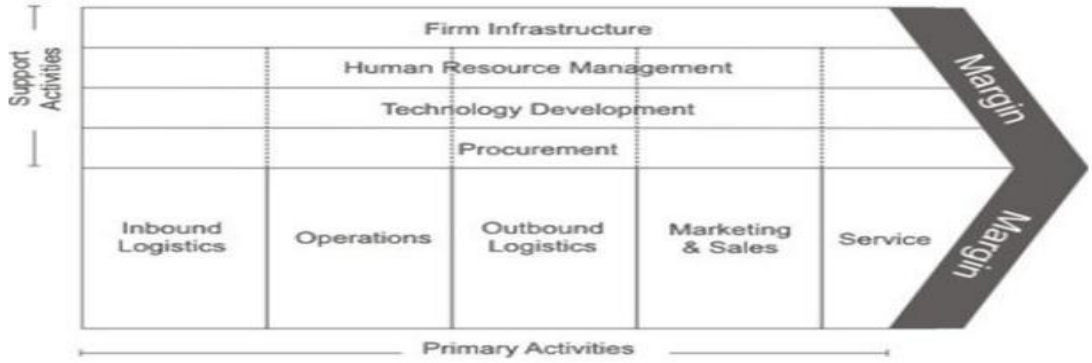


Source: Dumitriu & Popescu(2020)

Figure 3. ***Enterprise Continuum TOGAF***

2.4 Value Chain

Michael Porter was the first person who introduced the term "Value Chain' in his book Competitive advantage: Creating and Sustaining Superior Performance (Porter 1985). Michael Porter defines "Value Chain'' as a representation of a firm's value-adding activities, based on its pricing strategy and cost structure(Kumar & Rajeev, 2016).The value chain model focuses on specific activities in the business where competitive strategies can best be applied and where information systems provide the most strategic impact. This model identifies certain critical points where companies can use information technology most effectively to achieve a competitive position.The value chain model sees the company as a set or chain of basic activities that can add value to the business's products or services. These activities can be divided into main activities and supporting activities. This is as shown in Figure 4.

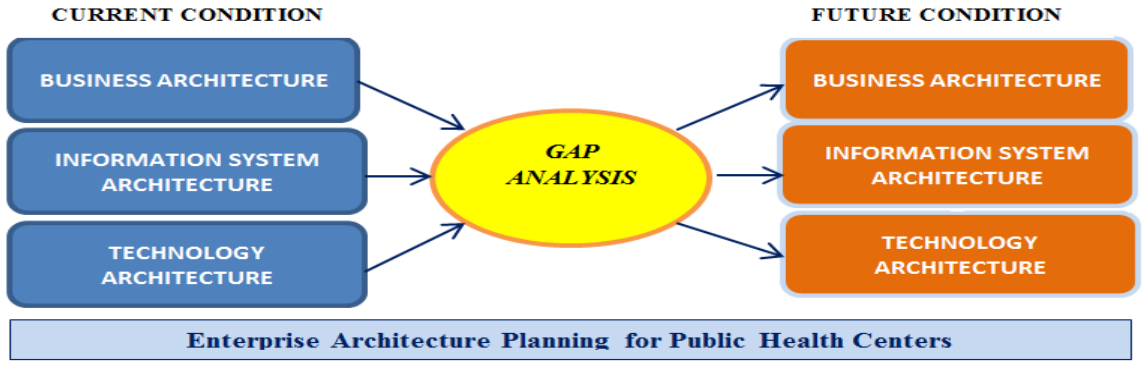


Source: Kumar & Rajeev(2016)

Figure 4. Michael Porter's Value Chain Model

2.5 Conceptual Framework

Conceptual frameworks that based on previous theoretical frameworks, are decisive concepts, are the main analysis in research(Adom et al., 2018).This conceptual framework is a Proposed Research Model in this study, shown in Figure 5.



Source: Own Research, 2023

Figure 5. Conceptual Framework

III. RESEARCH METHODOLOGY

This development research uses a descriptive approach through a case study(Creswell, 2017).The research location is in Setiabudi District Public Health Center in South Jakarta.

3.1 Research Data Collection

The data obtained are primary data and secondary data.Primary data is a type of data obtained directly from sources (not through intermediary media) in the form of opinions or opinions of subjects (people) individually or in groups, which are collected to answer the formulation of problems in research.The data from direct observation are problems, the current state of enterprise architecture (EA), and data from debriefing with officials and employees at Setiabudi District Public Health Center in South Jakarta.Meanwhile, secondary data from the evidence of diaries or reports in published and unpublished archives (documentary data) and the procedure used by the Setiabudi District Public Health Center in South Jakarta.

3.2 Research Data Analysis

The data analysis method used in this study is gap analysis (gap analysis) between the target architecture and the current state of the architecture.The results of the gap analysis are analyzed with the technical basics of the selected framework for enterprise architecture planning.

IV. RESULTS AND DISCUSSIONS

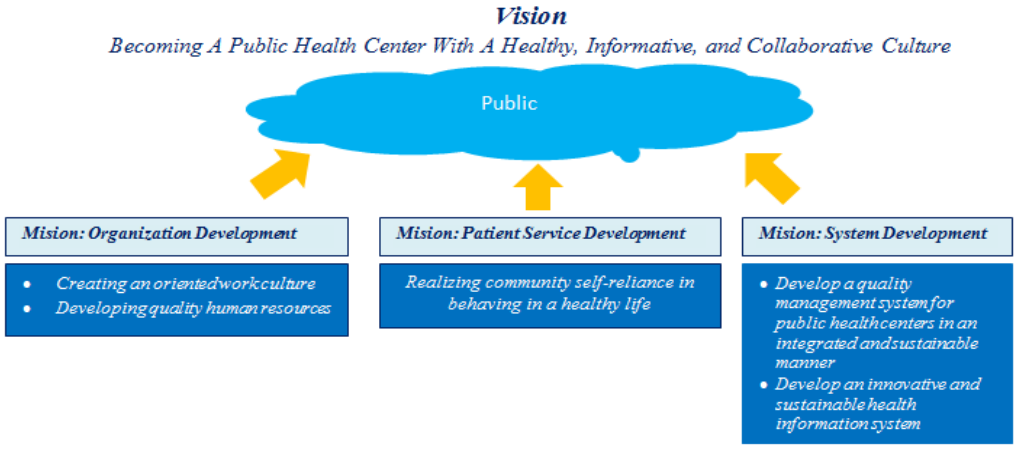
4.1 Architecture Vision

Setiabudi District Public Health Center in South Jakarta have already developed its Business Strategy in 2020, which covers period of 2023-2027. It is called Rencana Strategi Bisnis 2023-2027 and contain several Key information required to align the Architecture Development process to support the Business Objective. Vision and Mission of organization is included as shown below in Table 1.

Table 1. Vision and Mission of Setiabudi District Public Health Center in South Jakarta

Corporate Objects	Description
Vision	Becoming a Public Health Center with a healthy, informative, and collaborative culture.
Mision	Creating an oriented work culture
	Developing quality human resources
	Develop a quality management system for public health centers in an integrated and sustainable manner.
	Develop an innovative and sustainable health information system
	Realizing community self-reliance in behaving in a healthy life

The vision and mission must be able to capture the essence of the Setiabudi Public Health Center as a Community Health Center for the people in South Jakarta as desired by stakeholders. This study improves the abstraction of vision and mission by re-draws it as Figure 6



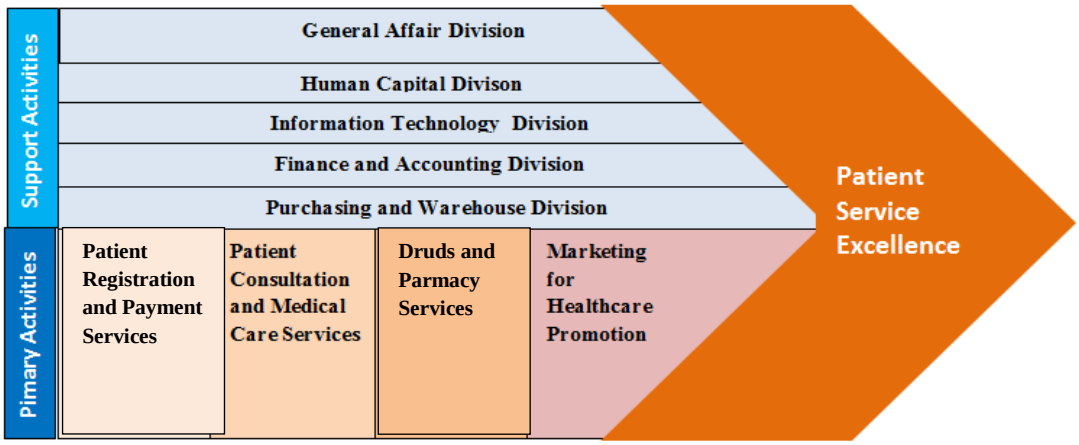
Source: Own Research, 2023

Figure 6. Vision and Mision - Setiabudi Public Health Center

As stipulated in the documents, the strategies to achieve vision are developed in Setiabudi Public Health Centerusing SWOT and Balance Score Card (BSC), which resulted in a Strategy Map. The strategy Map is consisted of 19 Strategies and distributed in 4 domains of: Financial Domain, Stakeholder's Perspective, Internal Process, and Learning / Growth. All this strategies are assigned to each related functions and units, and

broken down into several Performance Indicators with assigned parameters. Unfortunately, this strategy map is not equipped with high level diagram of Value Chain that explain the processes in Setiabudi Public Health Center. To ensure the alignment is in place, this study develops a Value Chain for the public health cemter using the previous information gathered. This Value Chain is capturing the primary activities within Setiabudi Public Health Center that directly contributes to main value creation and the supporting activities that support the success of those primary activities. The mapping is using Porter's approach for Value Chain Diagram. Figure 4 is showing the result of the development of Value Chain.

Within this proposed Value Chain, this study categorize all the activities that interact directly with patients as primary, and the rest of activities without direct interaction with patients as supporting. The Value Chain is showing the Value Creation of 3 main missions in Setiabudi Public Health Center (Organization Development, System Development, and Patient Service Development), supported by other primary activities and also supporting activities.This is the basis for Business Process creation in Setiabudi Public Health Center. This study is also proposing an elaboration of Marketing for Healthcare Promotion Value activities which are directly related to the objective of being financially independent through increase of revenue, and Service activities which are directly influencing the achievement of positive engagement with customers / patients and also sustainability of revenue.



Source: Own Research, 2023

Figure 7. Value Chain Diagram of Setiabudi District Public Health Center

Both are key to supporting the Setiabudi Health Center's Strategy in increasing revenue and reducing dependence on the Regional Expenditure Planning Budget (APBD) in Jakarta Province.

4.2 Business Architecture Modeling

In the early stages, architectural modeling for processes directly related to the patient service process in the Setiabudi District Public Health Center in South Jakarta.

Gap Analysis of Business Architecture

The results of the Gap Analysis of Business Architecture in this study are shown in Table 2.

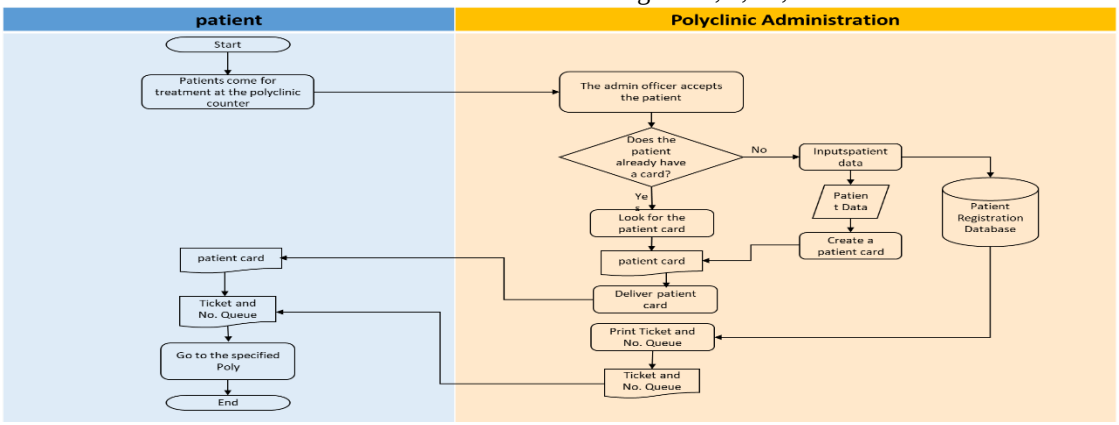
Table 2. ***Gap Analysis of Business Architecture***

Current Business Architecture	Gap Analysis	Future Business Architecture
IT activities are partial regardless of collective effectiveness at the organizational level	Upgrade clear IT planning policies and strategies	The implementation of IT activities is integral in all organizational units with a clear IT strategy
There has been no change in work procedures or policies regarding current IT activities.	Upgrading work policies and procedures in IT management	Policy changes and work procedures and their retention with existing systems
Organizations have not fully used IT as the main supporting requirement.	Upgrading IT facilities by implementing IT in all service/business processes	The Public Health Center service/business process can be fully supported by IT as a primary requirement
There are still Human Resources who do not understand IT	IT-related technical training/guidance	Human Resources already has certification in IT-related work fields

For the results of the Business Architecture modeling to meet the targets will be achieved, before carrying out the IT implementation process, both as a whole and partially, the first step is to analyze the gap (Gap Analysis) of business processes and policies in IT management at the Setiabudi District Public Health Centerwhich is currently running. Then carry out analysis of completion solutions and implement business architectures and policies which are the main targets of IT management in the future

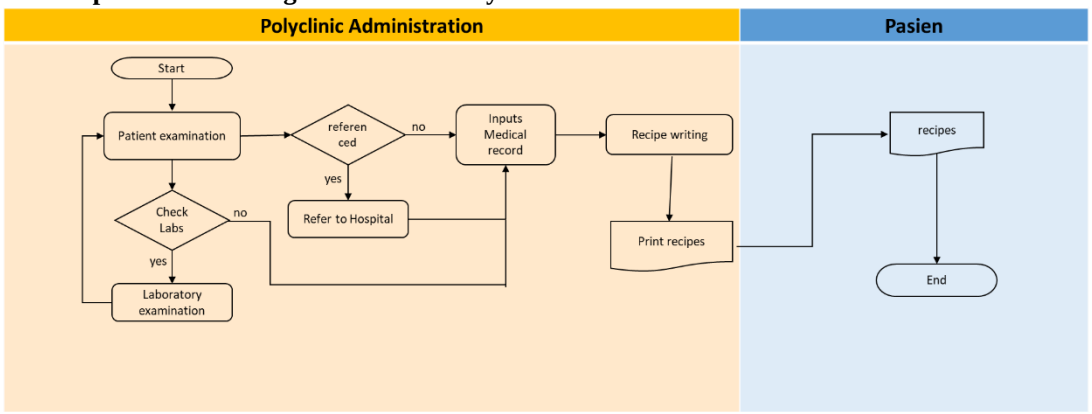
Defining Key Business Processes in Public Health Centers

Based on the Public Health Centers' main service process scheme and observations of several related documents, an analysis of business processes and functions related to services had carried out, and the definition of sub-processes was in the form of more detailed activities.Some business processes that are the key to services at the Setiabudi District Public Health Center are illustrated in Figures 8, 9, 10, and 11



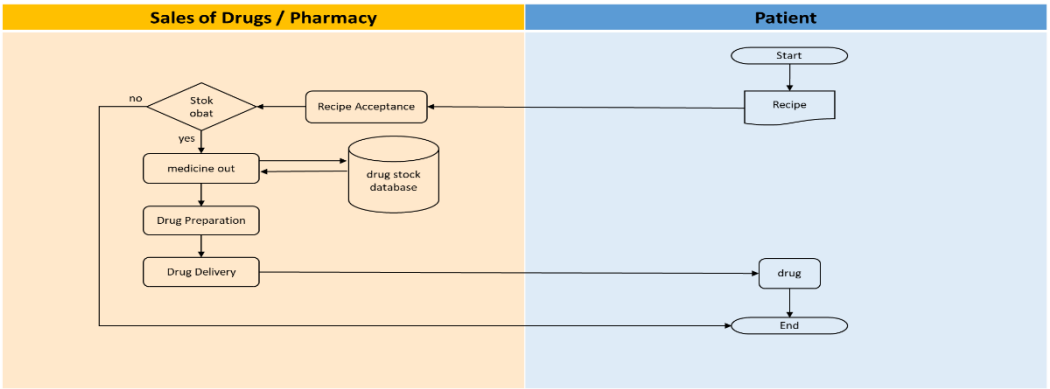
Source: Own Research, 2023

Figure 8. Proposed Patient Registration and Payment Services Process



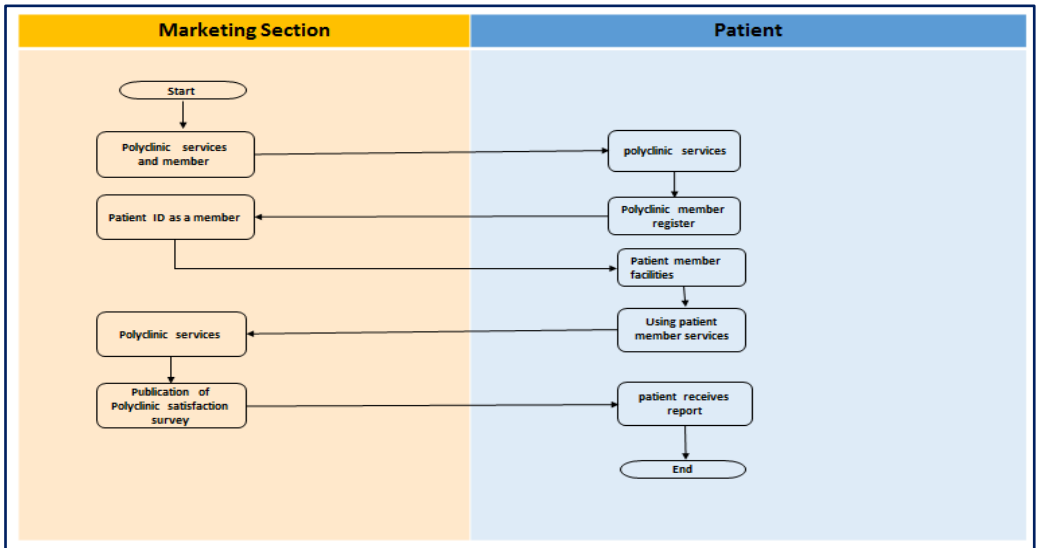
Source: Own Research, 2023

Figure 9. Proposed Patirnt Consultation and Medical Care Services Process



Source: Own Research, 2023

Figure 10. Proposed Drugs and Pharmacy ServicesProcess



Source: Own Research, 2023

Figure 11. Proposed Maarketing for HealthcareServicesProcess

4.2. Information System Architecture Modeling

In this section, Information System Architecture modeling had carried out in the Registration, Polyclinic, and Pharmacy sections by dividing it into two main stages, namely Data Architecture Modeling and Application Architecture Modeling.

Gap Analysis of Information System Architecture

Gap Analysis is intended so that the results of information system modeling meet the desired target (Table 3).The current gap analysis on Information Architecture is based on the results of observations on IT management at the Setiabudi District Public Health Center in South Jakarta.

Table 3. Gap Analysis of Information System Architecture

Current Information System Architecture	Gap Analysis	Future Information System Architecture
Information system applications that have been used are not standard	Upgrading applications and their development according to needs	All IS applications are standardized
Existing applications are not user friendly	Upgrade the application so that it is easy for users to use	The application is user friendly under windows
The application used does not specifically handle existing activities.	Application development in dealing with specific problems.	There are applications that deal specifically with existing activities.
There is no specific information system for management	Application development for top-level management and IT infrastructure upgrades.	There is a top-level information system (Executive Information System).
There is no data integration, resulting in duplication of data	Upgrading the data infrastructure and designing an integrated database	Data Integration in all information system

Source: Own Research, 2023

List of Data Classes

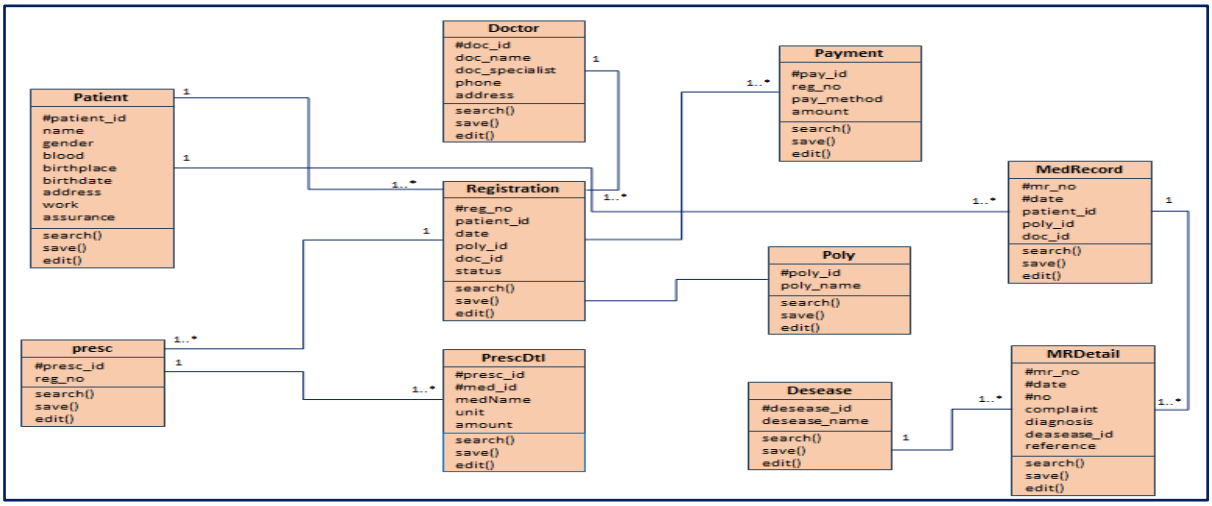
The following results of class data analysis can be seen in Table 4.

Table 4. List of Data Classes

Service Process	Data Classes
Patient Registration and Payment	Registration and Payment
Consultation and Medical check up Services	Consultation and Medical check up
Drugs and Pharmacy Services	Drug Inventory (pharmacy)
Marketing and Healthcare Promotion Services	Marketing and Medical Promotion

Modeling Relationships Between Data Classes Using Class Diagrams

Attributes for each data class are obtained from the development of data classes and manual data formats.



Source: Own Research, 2023

Figure 11. Modeling Relationships Between Data Classes

List of Application Candidates and Application Definitions

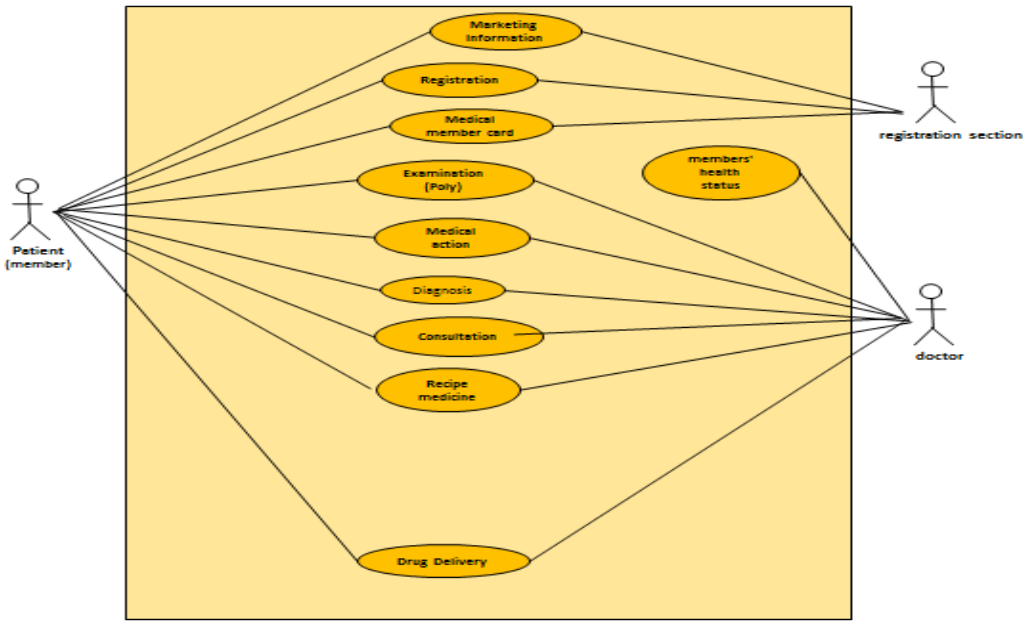
From the results of grouping the IS requirements, the IS requirements and the applications involved can be obtained.Table 5 below lists the applications resulting from the development of the process of service activities in community health centers, as in Table 5.:

Table 5. List of Application Candidates and Application Definitions

Information System	Database Subject	Application Candidates	Definition	Benefits for Long-term
Patient Management Information System	Registration Counter	Patient	The system that manages registration and patient visits	Provide information about the identity of patient data and activities
		Registration	System that regulates registration	Provide queue and payment information
		Payment	The system that manages payments	Provides information about patient registration
Medical Record Information System	Medical checkup record	Patient Consultation	A system that manages patient consultations	Provide information about the patient consulting
		Patient Medical checkup	A system that manages medical records	Provide information about medical history and examination
Inventory and Pharmaceutical servicesInformation system	Pharmacy services	Pharmacy Inventoy	A system that manages inventory, expenses, receipts at the pharmacy	Provide information about the state of drug supply in pharmacies
Marketing and Healthcare Information System	Marketing and Promotion Service	Marketing	A system that manages marketing for public health center	Provide information about marketing services
		Healthcare Promotion	A system that manages healthcare promotion	Provide information about healthcare promotions services

Source: Own Research, 2023

These four information systems are the focus of attention in Information System Architecture Modeling. This modeling is based on the Value Chain Analysis developed in the Setiabudi District Public Health Center.
A detailed description of the Public Health Center Services for each case and actor activities in the information system had described using a Use Case Diagram, as shown in Figure 12.



Source: Own Research, 2023

Figure 12. Use CaseDiagram Detail Public Health Center Services

4.3. Technology Architecture Modeling

Building an information system architecture is inseparable from the desired technology and will be used in helping a reliable information system.This stage also considers the alternatives needed in the selection of technology.

Gap Analysis of Technology Architecture

Gap analysis intends so that the results of information system modeling meet the desired target.To get a gap analysis on the current technology architecture based on the observations of the state of the infrastructure described above. The gap analysis result of the technology architecture can be seen in Table 6.

Table 6. ***Gap Analysis of Technology Architecture***

Current Technology Architecture	**Gap Analysis**	**Future Technology Architecture**
Computer Network / Local Area Network is not working	Infrastructure upgrades for computer networks	A gigabit Ethernet LAN network is already available
The server is down, but not down at all	Server Procurement	Server computers are available, such as IBM PC, HP, ACER with specifications as needed, which can support access in the use of work applications.
There isn't any yet Storage Area Network.	Storage Area Network Procurement	The network device is already available Storage Area Network (SAN)
Personal computers (PCs) are inadequate	PC upgrades	Each section has a personal computer (PC)
Backbond has not yet used Fiber Optic	No fiber optic installation yet	Data communication runs more smoothly

Source: Own Research, 2023

The technology architecture that is the target of this development is shown in Figure 6.

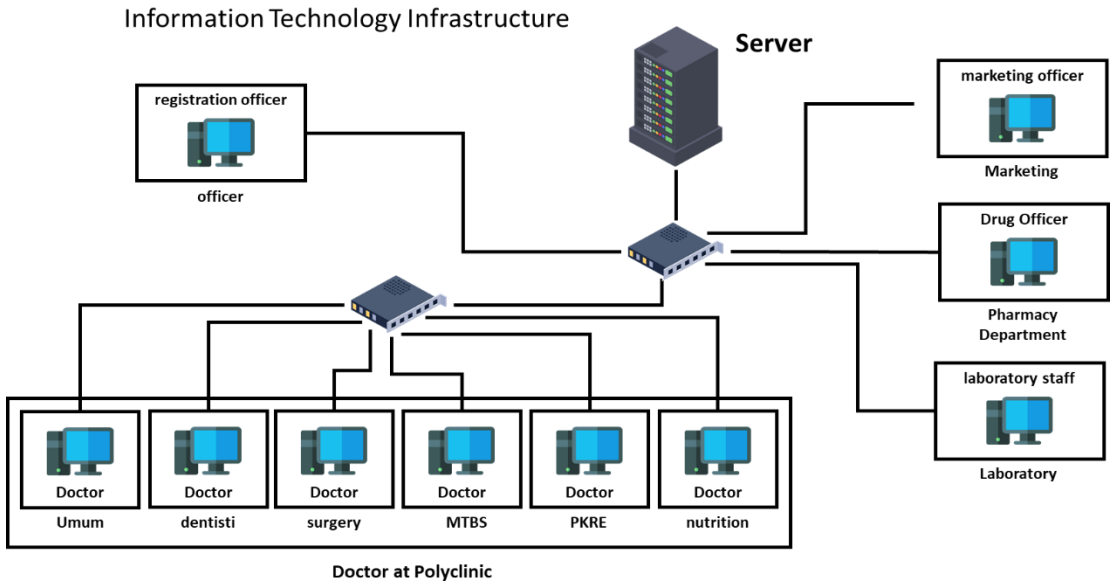


Figure 6. Target Technology Architecture (Computer Networks)

4.4. Discussion

In implementing Enterprise Architecture Planning, the main thing to consider is knowing in advance the vision and mission of the organization.This is in line with previous research by Girsang, & Abimanyu, (2021)..ADM methodology as a tool in designing information system architecture at the produces an architectural model that is following the vision and mission of the organization. Selanjutnya merujuk pada Visi dan Misi Organisasi pada tahap awal sebelum implementasi Enterprise Architecture Planning, pengembang membuat Value Chain Analysis. Value Chain'' as a representation of a firm's value-adding activities, based on its pricing strategy and cost structure(Kumar & Rajeev, 2016). In this study, the value chain is showing the value creation of 3 main missions in Setiabudi Public Health Center (Organization Development, System Development, and Patient Service Development), supported by other primary activities and also supporting activities.

The Open Group Architecture Framework(TOGAF)is a comprehensive methodology, including a set of tools to develop an Enterprise Architecture Planning(Dumitriu & Popescu, 2020).Furthermore, all the results of the gap analysis are converted as recommendations for enterprise improvement and mapped into three objectives in enterprise architecture modelingthis research resulted in four purpose recommendations for improving the business architecture, five purposes recommendations for improving information system architecture, and five recommendations for maximizing the use of IT in technology architecture.

This research has theoretical and managerial implications for Setiabudi District Public Health Center on how to develop an Enterprise Architecture Planning through a gap analysis.The results of this study have significant implications for the management of the Setiabudi District Health Center, both theoretical and managerial aspects, especially for those who work in the South Jakarta patient health service.

This paper has certain limitations: First, the findings limit the study of the Public Health Center,selected in the South Jakarta, Indonesian context.Second, This study of Enterprise Architecture Planning only emphasizes a gap analysis that looks at current conditions and future targets. Finally, the gap analysis approach is not free of the researcher's subjectivity.

V. CONCLUSION

This research emphasize to develop an enterprise architecture for a Public Health Center, with a case study at Setiabudi District Public Health Center, South Jakarta, Indonesia.

Enterprise Architecture Planning Setiabudi District Public Health Center is analyzed using TOGAF analysis, which includes Business Architecture, Application Architecture, and Technology Architecture.The use of the TOGAF ADM methodology as a tool in designing information system architecture at the Setiabudi District Public Health Center.ini produces an architectural model that is following the vision and mission of the organization.The impact of implementing Enterprise Architecture Planning on business processes is that it is possible to create effectiveness and efficiency of service operational performance at the Setiabudi District Public Health Center.

For further research, studies related to enterprise architecture planning try other frameworksin addition to TOGAF ADM for permanent cases at Public Health Centers.

ACKNOWLEDGEMENTS

The author expresses his deepest gratitude to the Perbanas Institute Directorate of Research and Community Service for his support in completing this research in 2023..

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**Corresponding Author: Dedeb Prayitno[1]*
[1](Faculty of Information Technology, Perbanas Institute, Jakarta, Indonesia)