

# Development of Enterprise Architecture Using Enterprise Architecture Planning (EAP) Based on the Zachman's Framework Approach

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## ABSTRACT

Dr. Agoes clinic is a company engaged in the health sector. To support the business process, Dr. Agoes has a patient data information system. However, this system has several drawbacks because it is not yet fully integrated. Therefore, this research is conducted to analyze and design an enterprise architecture information system, in order to create an overview of the information systems needed to support the business processes. This study aims to integrate the system in the clinic by defining the data architecture, application architecture and technology architecture, which later can provide a reference in the development of an integrated system in the clinic. The methodology used in integrating the system in this clinic is an Enterprise Architecture Planning (EAP) framework. The stages of this thinking framework begin with the planning initiation stage, then proceed with the stage of analyzing current conditions, namely business modeling and current systems and technology. Then the third stage is to define an architecture consisting of data, applications and technology. In the final stage, the stages of the implementation or migration plan will be explained. This research produces a blueprint document that can be used as a guide in developing an integrated system as well as a solution to the problems at Dr. Agoes clinic, so that there are no longer data clusters that cause difficulties in making cross-sectional reports.

## Keywords

Integrated systems, data architecture, technology and applications, Enterprise Architecture Planning (EAP)

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## Introduction

Individuals, companies, agencies and governments take advantage of the rapid development of technology in terms of strategic decision making and help provide business solutions. Not only that, the use of information technology has become one of the organizational strategies in helping organizations achieve organizational goals. One of them is by implementing an integrated information system in various organizational functions. However, the problem is that efforts to implement an integrated information system are often carried out without careful planning, resulting in the information system not meeting the needs based on the mission and purpose of implementing the information system itself.

Dr. Agoes is a company engaged in the health sector. Established in 1990 and located on Terusan Jakarta Street No. 307, Antapani Wetan, Kec. Antapani, Bandung City, West Java 40291. With the services currently available there is no integrated system causing inaccurate information, data redundancy and patient services take longer

than using an integrated system, for example registered patients will perform Examination requires medical record files that are manually searched in the medical record safe. It will slow down the service process. This can happen because Dr. Agoes does not yet have a strategic planning for information systems and information technology that identifies the system portfolio to support Dr. Agoes in carrying out their business activities.

To help improve the effectiveness of services at Dr. Agoes, it is necessary to plan and define an information system called Enterprise Architecture (EA), a tool to align information systems with the business functions being carried out, where this alignment can only be achieved by paying attention to the factors that are integrated in its development with the aim of reducing the problems that occur. occurs during the system development process.

Enterprise Architecture Planning (EAP) is a method or method developed to build an enterprise architecture. The stages of the builder are the stages to start, understand the current

conditions at the research site, understand the vision and mission in the future, and the stage for planning to achieve the vision and mission in the future. Based on the description above, the authors are interested in conducting a study with the research title Enterprise Architecture Development Using Enterprise Architecture Planning (EAP) Based on the Zachman Framework Approach.

## Literature Review

### Information System

Information system are systems that contain how an organization uses technology to obtain, process, store, use and disseminate information (Ward & Peppard, 2002). An integrated information system is a system that allows sharing of data located in a database so that it can be accessed for all parts of the organization (Monk, 2013).

### Enterprise Architecture

Enterprise is an organization that supports a business environment with predetermined goals, while architecture is a system development mapped in a model to produce a blueprint of review results from several perspectives (Hari Supriadi & Endang Amalia, 2019). From this definition, it can be concluded that enterprise architecture is a method of describing a model that describes a company by reviewing the components in the company to produce a blueprint that can be used to help achieve company goals.

### Enterprise Architecture Planning (EAP)

In 1987, John Zachman first published his zachman framework in his writings entitled "A framework for Information System Architecture" in the IBM System Journal (Zachman, 1987). The Zachman framework is a framework that maps the relationship between enterprise components to the architectural level that is of concern to interested parties with enterprise architecture (Suhendro, 2009).

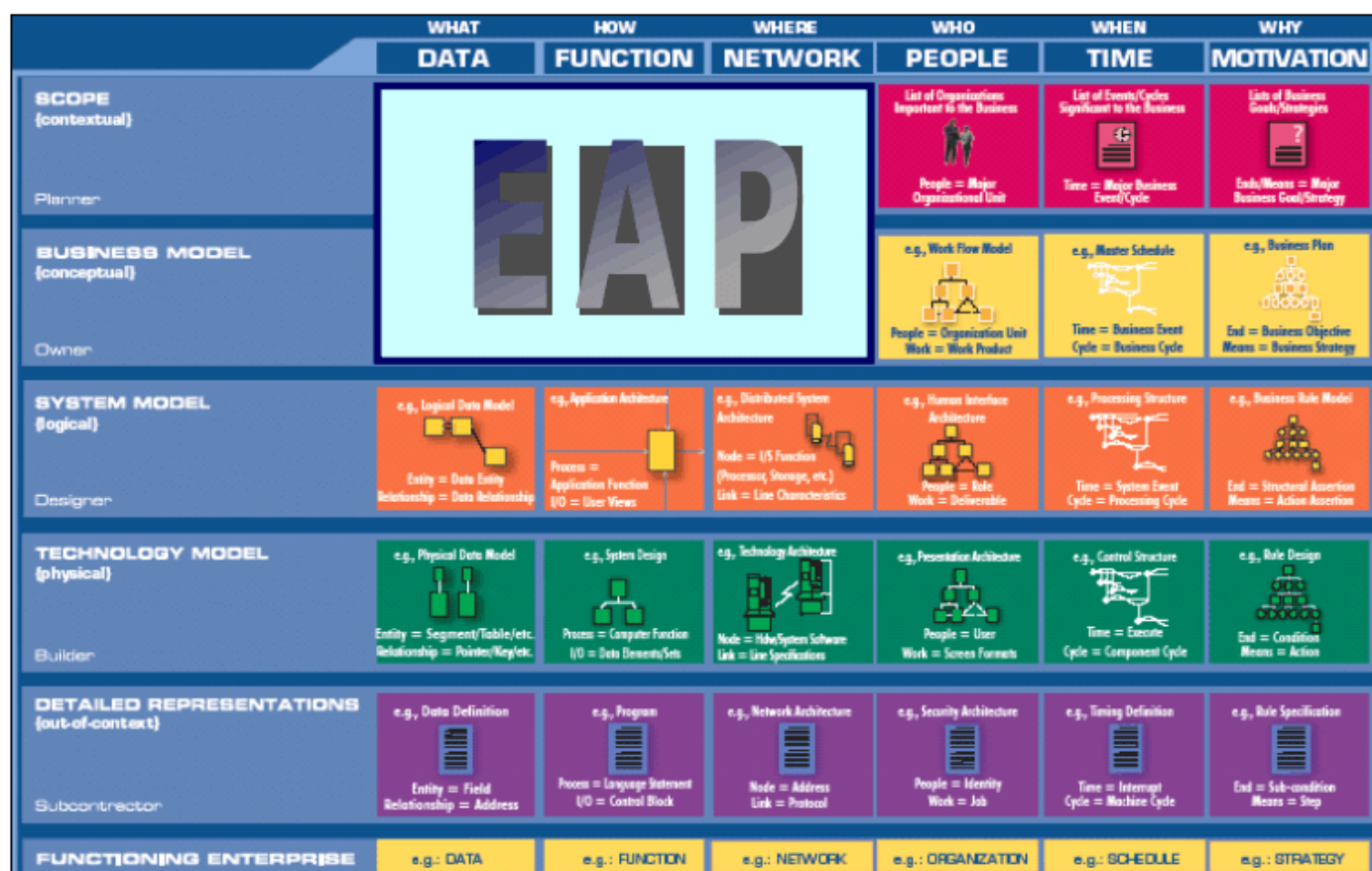
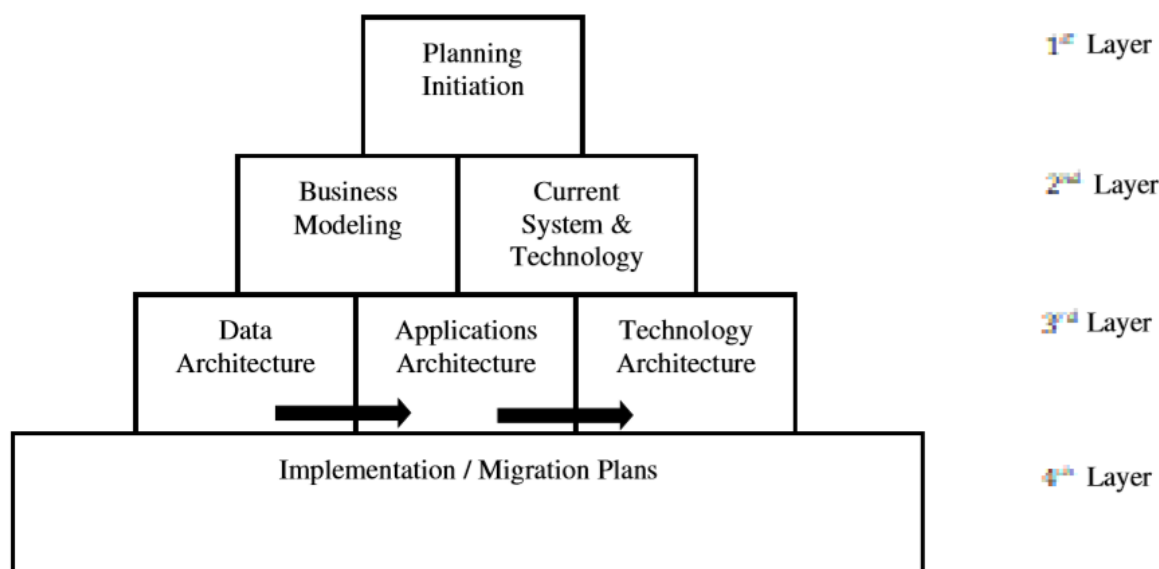


Figure 1. The EAP approach in the Zachman framework (Suhendro, 2009)

The Zachman framework puts EAP in the first two rows which are the planners and owners' perspective, and the first three columns cover data, functions and network information system architecture. According to Steven H Spewak, EAP is the definition of business and architecture, not business design and architecture. EAP involves

six things in the Zachman framework which is built into four stages, namely the planning initialization stage, the understanding stage of the current condition, the stage of defining the vision for the future and the last stage of the implementation plan (Suhendro, 2009).



**Figure 2.** Components in EAP (Spewak, 1992)

The first layer is planning initiation, the second layer consists of business modeling processes and identification of existing technologies, the third layer consists of data architecture, applications and technology. The fourth layer is an implementation plan, which defines the stages or steps in the implementation and implementation scheduling (Spewak, 1992).

### SWOT Analysis

SWOT is a tool grouping issues into strengths, weaknesses, opportunities and threats that are used for strategic planning (Glaister, & Falshaw, 1999). One of the most effective ways to collect and classify information, describe certain things to produce a strategic business planning idea (Chan, 2011).

**Table 1.** SWOT matrix

	Strength - S	Weakness - W
Opportunity - O	SO Strategy	WO Strategy
Threat - T	ST Strategy	WT Strategy

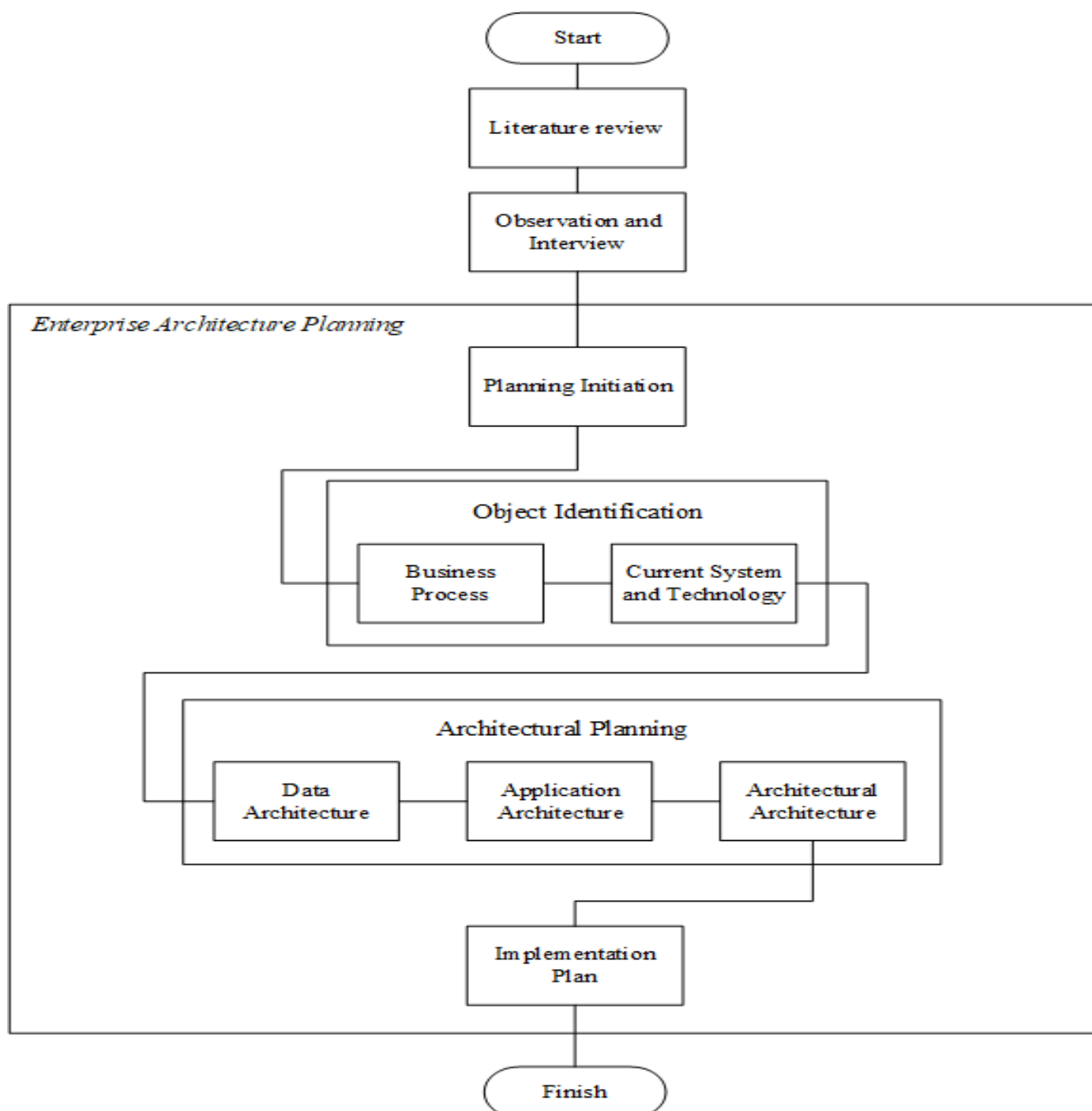
The first step to conduct a SWOT analysis is to determine internal and external factors. Factor determination is made according to logic that maximizes strengths and opportunities and minimizes weaknesses and threats. After finding the internal and external factors determine IFAS and EFAS. After obtaining the results from the IFAS and EFAS calculations, it will be found the position of the company in the quadrant where IFAS is on the X axis and EFAS is on the Y axis.

### Value Chain

According to Michael Porter, the value chain is a description of a business picture as a chain of activities that converts input into output. which has value for customers (Porter, 1985). As a chain of activities, the value chain works by grouping functional areas into main activities and supporting activities to convert inputs into outputs so that they have value for customers (Suhendro, 2007).

## Methodology

The research framework includes the stages of Enterprise Architecture Planning (EAP). The steps in planning an enterprise architecture include:



**Figure 3.** Research framework

1. The literature review stage is a theoretical understanding related to problem finding at the previous stage. The theoretical reference materials can be taken from supporting books or documentation from the internet.
2. The data collection stage is carried out to find data related to research, it can be done in two ways, namely observation and interviews.
3. The planning initiation stage is the initial stage of doing good planning with the hope that research in this case the development of

enterprise architecture can be directed and run well.

4. This stage reviews the current conditions at the research location in two stages, namely:
  - a. Business Process
  - b. Systems and current technology
5. Architecture
  - a. Data Architecture Planning, defining data entities that are used and required for the company.
  - b. Application Architecture, determining the applications required by the company.
  - c. Technology Architecture, identifying and defining the technology required by the company.
6. Implementation Planning

This stage is the stage of making an application implementation plan that has been determined by the previous stage.

## Results and Discussion

### Planning Initiation

Object of this study was the clinic of Dr. Agoes in patient service activities and clinic operations with the aim of modeling an integrated system supported by information technology in the implementation of activities and business needs.

### Overview of Current Enterprise Conditions

SWOT analysis is useful for formulating organizational strategy systematically. This analysis aims to maximize strengths and opportunities and minimize weaknesses and threats. The following is the calculation of IFAS and EFAS and the coordinate points on the SWOT diagram:

**Table 2.** Internal Factor (IFAS)

Strategic Factor		Scale	Rating	Score
Strength	Cheap	0.3	3	0.9
	Experienced medical personnel, so get the patient's trust	0.3	3	0.9
	All staff is friendly	0.2	4	0.8
	Comfortable waiting room facilities	0.2	4	0.8
Total (S)		1		3.4
Weakness	Only one doctor's practice room	0.3	3	0.9
	There's no cooperation with the insurance	0.2	3	0.6
	Unable to handle emergency patients	0.2	3	0.6
	There's no information system yet	0.3	2	0.6
Total (W)				2.7
Difference Total (S) – Total (W)				0.7

From the results of the data analysis above strength has a score of 3.4 while weakness has a score of 2.7, so the IFAS calculation results are

the difference between the two results, namely 0.7.

**Table 3.** External Factor (EFAS)

Strategic Factor		Scale	Rating	Score
Opportunity	Got patient's trust	0.4	3	1.1
	The location is easily accessible	0.4	3	1.1
	The location is far from hospital	0.3	3	0.8
Total (O)		1.0		3.0
Threat	There's another clinic which is not far from the location	0.3	2	0.6
	Less promotion on social media	0.4	2	0.9
	Competitors have inpatient service and emergency room	0.3	2	0.6
Total (T)		1.0		2.0
Difference Total (O) – Total (T)				1.0



From the results of the data analysis above, the opportunity has a score of 3.0 while Threat has a score of 2.0, so the EFAS calculation result is the difference between the two results, namely 1.0.

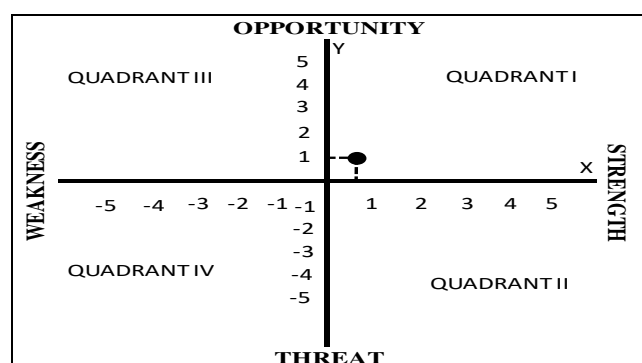


Figure 4. SWOT diagram

So, the coordinate point is  $(X, Y) = (IFAS, EFAS) = (0.7, 1.0)$ . Based on the coordinates of the position of the Clinic Dr. Agoes is located in quadrant I, where this condition is a favorable condition, the clinic can maximize internal potential as well as take advantage of existing opportunities. The strategy required by Dr. Agoes, namely aggressive or developmental strategies, for example the addition of related services such as emergency room or hospitalization in order to attract more patients, including urgent patients. In addition, other developments that can be done are cooperating with insurance companies and using clinical information systems to support clinical

service activities to make them more effective and efficient so as to improve the quality of clinical services to patients.

### Business model

Defining business models is done by classifying business functions using the Michael Porter value chain.

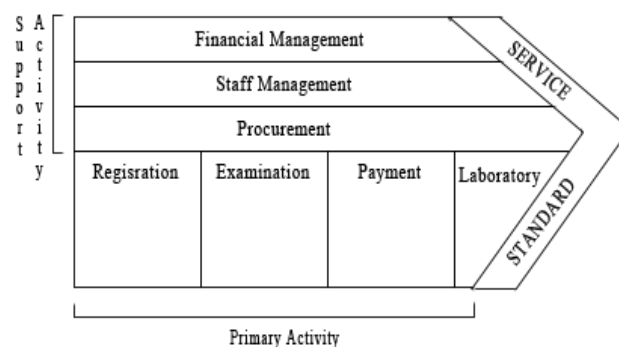


Figure 5. Value chain analysis

Based on the results of value chain analysis at Dr. Agoes, the main activities consist of registration, inspection, payment and laboratory processes. Supporting activities consist of financial management, staff management and procurement. The following is a hierarchical chart of all clinical activities:

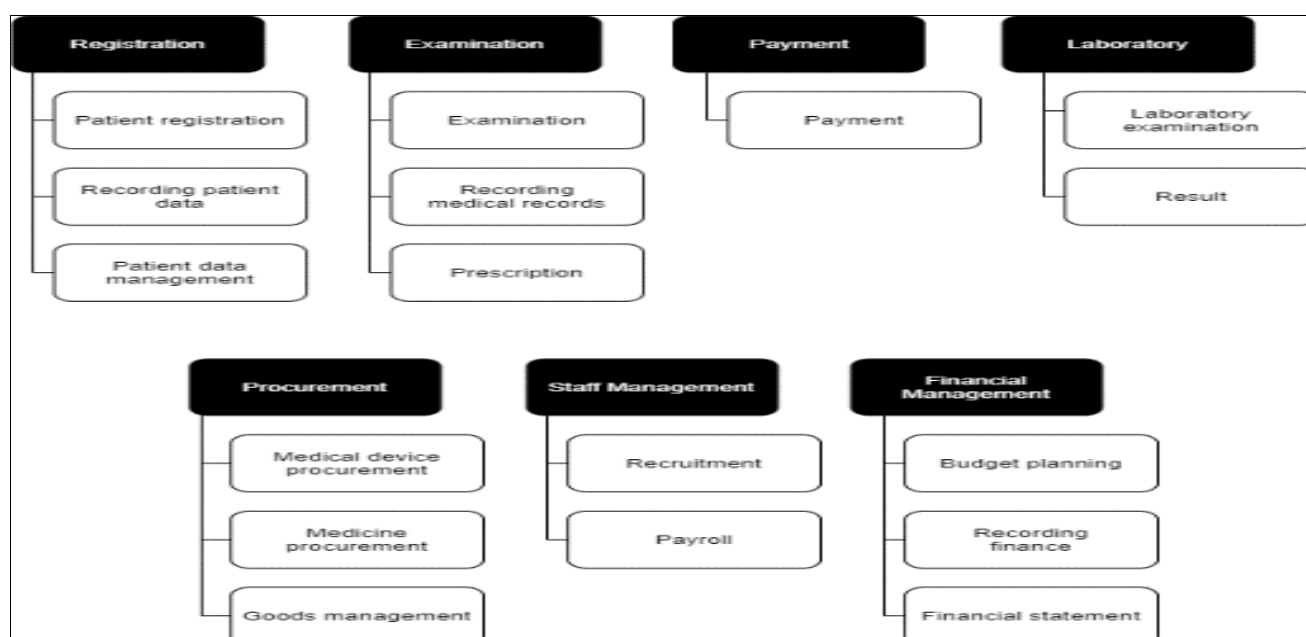


Figure 6. Hierarchy diagram

### Current system and technology

Based on observations and interviews, the current system and technology is the patient recording information system. Hardware consists of 1

personal computer, using the Windows 7 operating system.

**Table 4.** Existing application

Application	User	Function	Time to Use
Patient data information system	Registration Staff	Record patient data	Office hours

## Architecture Planning

At this stage make three architectures that consist of data architectures, application architecture and technology architecture.

### Data architecture

#### Candidate entity list

Candidate entities will be part of the enterprise architecture design, so that the determination can be based on a previously defined value chain, the business functions contained in the value chain will become business entities which will then be defined as data entities so that the defining plan of the architecture data can be formed. The following are candidate data entities from business entities.

**Table 5.** SATA entity candidate

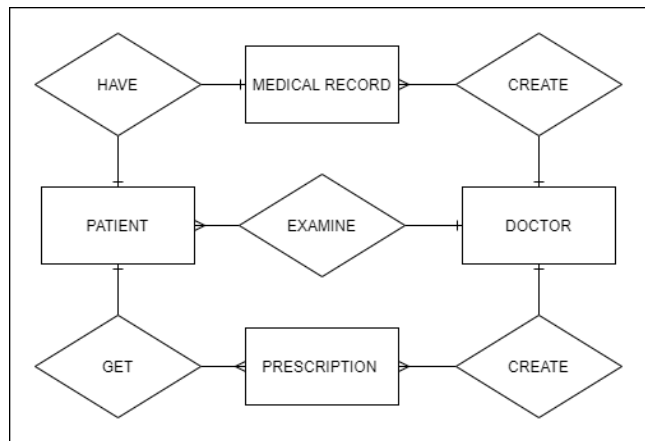
Business Entity	No.	Data Entity
Registration Entity	1	Patient Entity
	2	Registration Staff Entity
Examination Entity		Patient Entity
	3	Doctor Entity
	4	Medical Record Entity
	5	Prescription Entity
Payment Entity	6	Transaction Data Entity
	7	Patient Entity
Laboratory Entity	8	Payment Staff Entity
	9	Patient Entity
	10	Laboratory Staff Entity
Procurement Entity		Laboratory Result Entity
	11	Medicine Entity
	12	Medical Devices Entity
	13	Procurement Staff Entity
Staff Management Entity	14	Supplier Entity
	15	Staff Entity
	16	Attendance List Entity
	17	Recruitment Entity
Financial Management Entity	18	Division Entity
	19	Salary Details Entity
	20	Financial Staff Entity
	21	Income Entity
	22	Expense Entity
	23	Financial Record Entity
	24	Budget Entity
	25	Financial Statements Entity

#### Entity relationship diagram

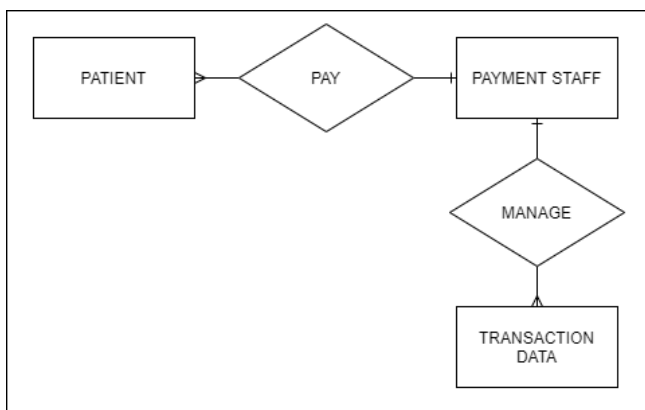
To model the relationship between data entities, the depiction is done using ER-Diagram, as follows:



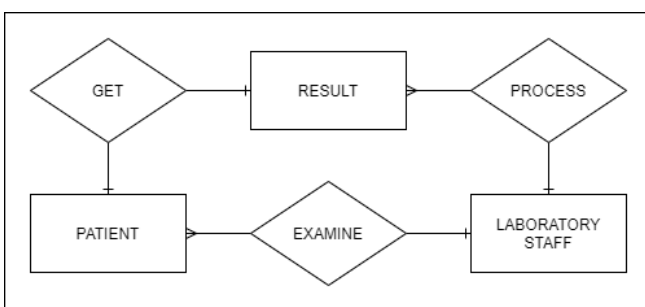
**Figure 7. Registration ERD**



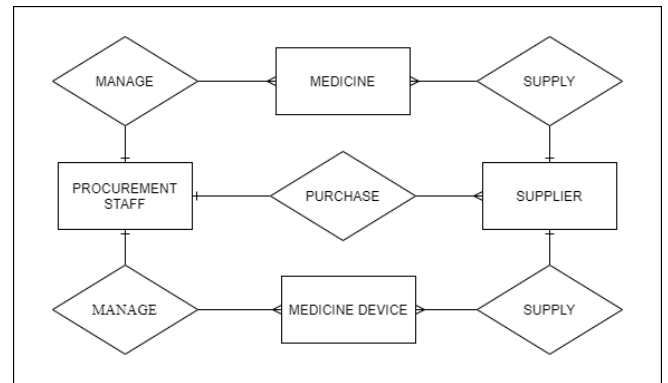
**Figure 8. Examination ERD**



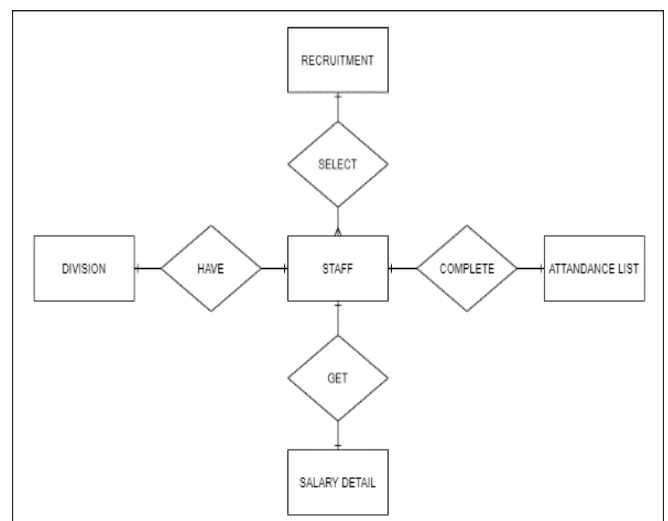
**Figure 9. Payment ERD**



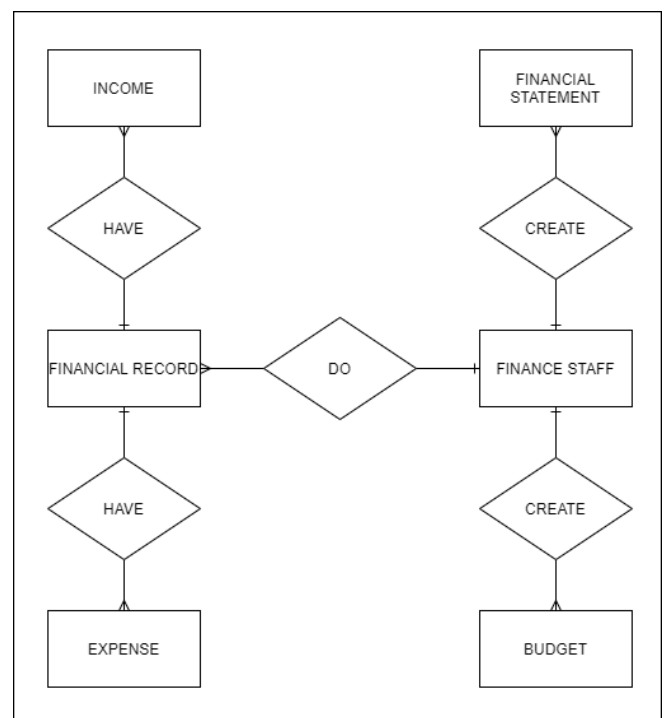
**Figure 10. Laboratory ERD**



**Figure 11. Procurement ERD**



**Figure 12. Staff management ERD**



**Figure 13. Financial management ERD**

**Data entity relationships and business functions**



Data Entity \ Business Function	Registration Staff	Patient	Doctor	Prescription	Medical Record	Payment Staff	Transaction Data	Laboratory Staff	Result	Procurement Staff	Medicine Device	Medicine	Supplier	Recruitment	Staff	Division	Attendance List	Salary Detail	Income	Expense	Financial Record	Budget	Financial Statement
Patient registration	R	RU																					
Recording patient data		CRU																					
Management patient data	UR	RU																					
Examination		R	R																				
Recording medical record		R	R	R	CRU																		
Prescription				C								RU											
Payment		R				R	CU																
Laboratory examination		R						R															
Lab result processing								R	CR														
Medical device procurement										R	CRU		CR										
Medicine procurement										R		CR	CR										
Goods management										R	R	R											
Recruitment														CU									
Payroll															R	R	R	CR				R	
Budget planning																						C	
Recording finance																			R	R	CU		
Financial statement																			R	R	R		CU

Figure 14. Data entity and business function relationship matrix

Purpose of this stage is to determine the data entities that are created, used and updated by business functions. The business functions defined in the business model are related to data entities in the form of a matrix. C is for data entities generated by business functions, U for data entities that are updated or managed by business

functions and R for data entities used by business functions. The image below describes the relationship matrix of data entities and business functions at Dr. Agoes Antapani.

### Application architecture

Activity	Requirement	Proposed Application	Annotation
Registration	Requires an information system that can handle the patient registration process starting from patient data, queues and estimated waiting times offline and online	Registration Information System	New system
Examination	Requires an information system for examinations such as patient medical record data	Clinic Website Examination Information System	New system New system
Payment	Membutuhkan sistem untuk menangani dan mengelola pembayaran pasien	Payment Information System	New system
Laboratory	Membutuhkan sistem untuk pemeriksaan laboratorium dan penyerahan hasil	Laboratory Information System	New system
Procurement	Requires an information system to handle and manage patient payments	Procurement Information System Inventory Information System	New system New system
Human Resource Management	Requires an information system to manage employee data, employee recruitment processes and employee appraisals	Human Resource Management Recruitment Information System	New system New system
Financial Management	Requires an information system that can manage the financial system	Financial Management Information System	New system

Figure 15. Application architecture

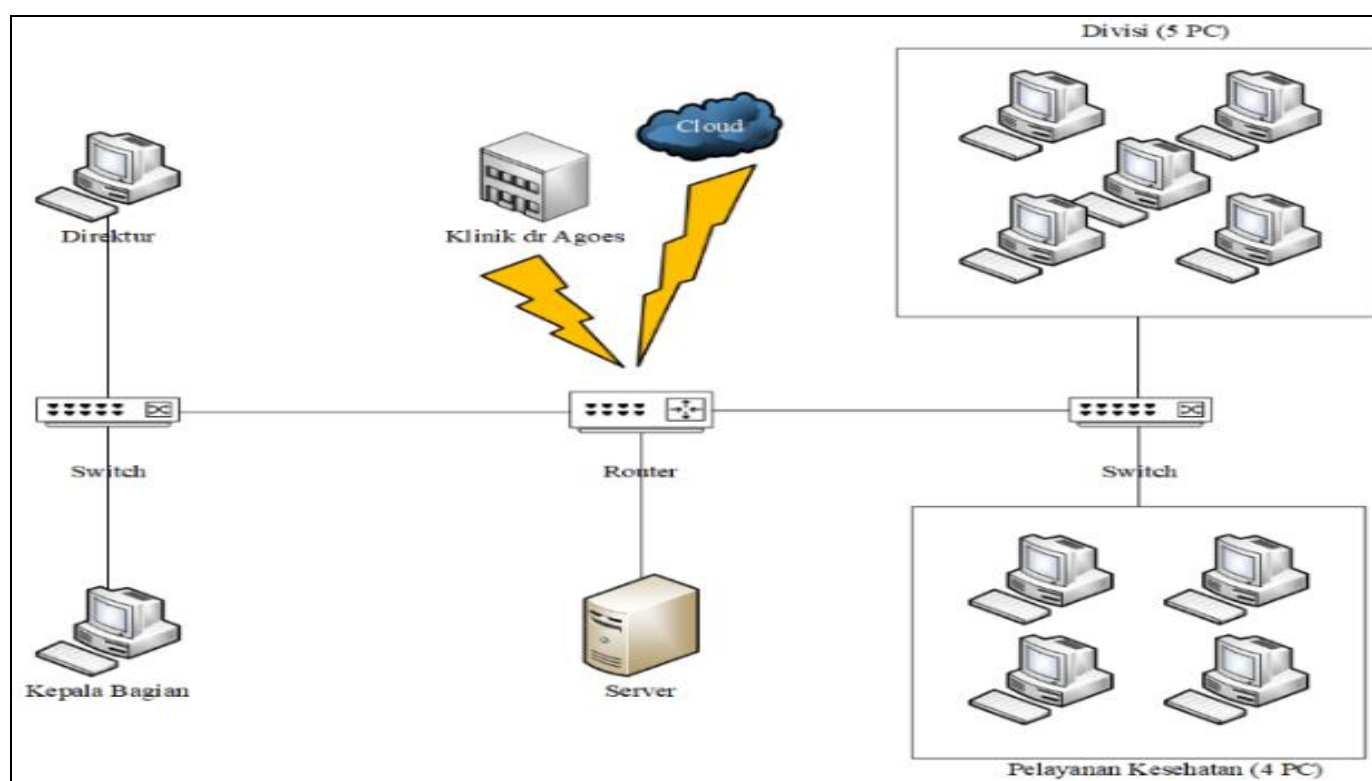
Data Entity \ Application	Registration Staff	Patient	Doctor	Prescription	Medical Record	Payment Staff	Transaction Data	Laboratory Staff	Result	Procurement Staff	Medicine Device	Medicine	Supplier	Recruitment	Staff	Division	Attendance List	Salary Detail	Income	Expense	Financial Record	Budget	Financial Statement
Registration Information System	R	CUR																					
Examination Information System			R	C	CRU							UR											
Payment Information System		R				R	CU												U		U		U
Laboratory Information System		R			RU			R	C														
Procurement Information System										R	R	R	CR							U	U	U	U
Inventory Information System											CRU	CRU											
Recruitment Information System														CRU									
Human Resource Information System	C		C			C		C		C					CRU	CRU	CRU	CRU		U		U	U
Financial Information System							R												CRU	CRU	CRU	CRU	CR
Clinic Website		R	R																				

**Figure 16.** Data entity and application relationship matrix

### Technology architecture

At this stage, the company defines the type of technology needed to provide an environment for applications that manage data. The technology

platform configuration will be built placing applications and data on location and can be accessed by users so that data and information will be available to company units that need them.



**Figure 17.** Technology architecture

Technology  Application		Software					Networking			Platform		SMS Gateway
		Operating System		Programming		DBMS	Networking and Device					
		Windows	Mobile	PHP	Java	MySQL	LAN	Internet	Switch	Web	Mobile	
i	Registration Information System	√	√	√	√	√		√	√	√	√	√
ii	Examination Information System	√	√	√	√	√	√		√	√	√	
iii	Payment Information System	√	√	√	√	√	√		√	√	√	
iv	Laboratory Information System	√		√		√	√		√	√		
v	Procurement Information System	√		√		√		√	√	√		
vi	Inventory Information System	√		√		√	√		√	√		
vii	Recruitment Information System	√		√		√		√	√	√		√
viii	Human Resource Information System	√		√		√	√		√	√		
ix	Financial Information System	√	√	√	√	√		√	√	√	√	
x	Clinic Website	√	√	√	√	√		√	√	√	√	

**Figure 18.** Application and technology relations

### Implementation plan

The first step in compiling an implementation plan is to determine the sequence of applications to be built based on business dependence on data.

Ord	Application
1	Human Resource Management
2	Inventory Information System
3	Financial Management Information System
4	Registration Information System
5	Examination Information System
6	Payment Information System
7	Laboratory Information System
8	Procurement Information System
9	Recruitment Information System
10	Clinic Website

**Figure 19.** Sequence of implementation

Application	Start Month	End Month	Month											
			1	2	3	4	5	6	7	8	9	10	11	12
Human Resource Management	1	4	■	■	■	■								
Inventory Information System	1	4	■	■	■	■								
Financial Management Information System	1	4	■	■	■	■								
Registration Information System	5	7					■	■	■					
Examination Information System	5	7					■	■	■					
Payment Information System	5	7					■	■	■					
Laboratory Information System	8	10								■	■	■		
Procurement Information System	8	10								■	■	■		
Recruitment Information System	8	10								■	■	■		
Clinic Website	10	12										■	■	■

**Figure 20.** Implementation plan schedule

The sequence of implementation plans is carried out using a data driven model as suggested by EAP. Applications that create data must be implemented before applications that use data.

### Conclusion

Enterprise Architecture is used to plan an information system architecture based on the need to support business activities for the achievement of clinical goals. This study produces a blueprint document that can be used as a guide in

developing an integrated system as well as a solution to the problems at Dr. Agoes so that there are no longer islands of data which cause difficulties in making cross-sectional reports.

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