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INTEGRATED OPERATIONAL SYSTEM ENTERPRISE ARCHITECTURE DESIGNING USING TOGAF-ADM METHOD CASE STUDY AT PT. XYZ (CONSTRUCTION COMPANY)

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ABSTRACT

XYZ is a construction company that belongs to the civil sector of construction, especially in the field of water management and waterwaste management in private and public projects. In its journey, PT XYZ continues to grow following the development of existing technology. For the accounting, financial and procurement recording systems, PT XYZ has implemented ERP (Enterprise Resource Planning) technology with the implementation of ERP software that helps PT XYZ in managing the activities mentioned above. However, in its development in the implementation of information systems, it turns out that some of the main processes at PT XYZ are still carried out manually. So that problems arise and disrupt the business processes of PT. XYZ. These problems include problems with data integration, communication and loss of information due to certain things. Especially in processes that are still done manually such as warehouse and project management. Of course, this problem raises concerns from executive management where this problem ultimately has an impact on the performance of project work completion, and the company's financial problems. So in this case the existing ERP implementation still does not have a direct impact on the company. From this problem, an analysis will be made that will identify the problem in detail with company XYZ. So the idea of developing an integrated operational system emerged that would be built according to the Enterprise Architecture (EA) method. EA can be analogous to when building a building, a model, design and design of the building is needed. These things are needed as models and foundations for the design. Similar to the implementation of information systems, before its development, the basis and foundation of the design are needed in the form of information system models or architectures. In this research, the EA method that will be used is TOGAF-ADM. This method was chosen because TOGAF ADM is a complex method that can meet all EA development needs, so it is used based on organizational needs.

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KEYWORDS *Enterprise Architecture, TOGAF ADM, Construction Company, Warehouse, Project Management*

INTRODUCTION

This guide provides details to assist authors in preparing a paper for publication in JATIT so that there is a consistency among papers. These instructions give guidance on layout, style, illustrations and references and serve as a model for authors to emulate. Please follow these specifications closely as papers which do not meet the standards laid down, will not be publis A construction company is a company that operates in the field of design and construction, and can also be interpreted as a company that provides professional services that prioritize management and planning in industries related to design and construction (Indrayani, 2022). According to the Indonesian Standard Classification of Business Fields (KBLI), construction is new work activities, repairs, additions and alterations, the erection of prefabricated buildings or structures at the project site, and also temporary construction in the fields of building work, civil buildings and special construction work. the product is attached to the land or position (Central Statistics Agency 2020). The construction industry is one of the most dynamic industries compared to other industrial fields.

This is due to frequently changing market conditions, relatively short construction periods and price fluctuations of supporting materials that are difficult to predict. Reported by the Central Statistics Agency, in Indonesia itself the number of companies in the construction sector is relatively high, judging from their distribution. So competition between construction companies is also relatively high, and this causes companies to be required to increase operational and production efficiency so that in the future they can survive market competition in the construction sector and even win competition among construction companies in Indonesia.

Operational efficiency and production itself will also help efficiency in expenditure and use of resources in construction companies. In carrying out operational and production efficiency, companies should pay attention to the use of information systems, because information systems can fully support the company's operational and production management. Starting from the production design process, procurement and supply of raw materials, production processes, labor management to accounting calculations, everything can be supported by information technology. By using an information system, all the running processes mentioned previously will be able to run effectively, efficiently and economically (Sudirman et al., 2020).

The construction business is a business that has certain characteristics, and has limitations that must be met, such as time related to the project implementation period, costs related to the project budget, scope of project work related to the scope of work and quality related to specifications and work results. (Asnudin, 2012). Therefore, there is great hope from the BOD to be able to gain access to information

regarding the limitations that have been mentioned. Throughout its journey, PT XYZ continues to develop following existing technological developments. For the accounting, financial recording system and also the procurement process, PT XYZ has implemented ERP (Enterprise Resource Planning) technology with the implementation of ERP software which helps PT XYZ in managing the activities mentioned above.

However, in its implementation there are still several integration and communication problems and there is still a lot of work done manually. Work that is done manually is mostly done in the warehouse and project management departments. So ERP implementation still cannot have a direct impact on the company. The implementation of ERP, which is still limited to the finance and procurement modules, also has a big impact because there is often repetition of work and data that overlaps and is not aligned between departments. Companies also do not have sufficient understanding and knowledge that the application of technology and information systems must be adapted to existing business flows and the specific needs of the company in each department. A system that includes the implementation of technology and communications to obtain and send information that is aligned with business requirements (Febrianty et al., 2020).

The BOD from PT

The problems that occur are not only these things, they also include the need for inventory and warehousing records which have not been carried out in a system so that communication between procurement and warehousing activities still occurs manually. And this creates problems such as the lack of system integration between procurement and warehousing which will also create unequal accounting records, the length of the stock taking process because you have to dig up physical documents and the difficulty of reporting billing to the project owner. These problems also occur because in the process PT XYZ does not have a function that focuses on developing operational systems and supporting production processes.

The focus of PT

So, the idea emerged to develop an integrated operational system that would be built according to the Enterprise Architecture (EA) method. EA can be interpreted as a company's blueprint which consists of its building components and how the relationships between these components are (Darma & Adikara, 2022). It can be analogous to when building a building, a model, design and building plan are needed. These things are needed as a model and foundation for the design. Likewise with the implementation of an information system, before its development requires a basis and foundation for the design in the form of an information system model or architecture. So that the information system built is right on target, effective and efficient, and in accordance with the objectives of developing the company's information system. When developing an information system without a model, the final results may not be tracked thoroughly and the goals may not be achieved (William Darma 2022).

In this research, the EA method that will be used is TOGAF-ADM. This method was chosen because TOGAF ADM is a complex method that can meet all EA development needs, so it is used based on organizational needs. However,

TOGAF ADM is also a general method, so if necessary, in practice TOGAF ADM is truly flexible and can be adapted to the specific needs of PT XYZ. TOGAF ADM is a generic method that contains a set of activities or sequential phases. TOGAF ADM refers to specific sequential phases and also provides and provides a set of resource guides such as templates, background information, and templates that can be used in modeling EA development. This method can also be adapted to changes and needs during design (Hudha et al., 2019).

LITERATURE REVIEW

Enterprise Architecture

Enterprise Architecture (EA) is a company blueprint for a project or system development based on company needs that will align the company's business needs and information technology solutions. Enterprise Architecture also has a role for companies to build business architecture as a tactical matter that will be used as a managerial target based on business capabilities. With a good definition of business architecture, information technology will become the right tool to support business (Yunis & Surendro, 2009).

Enterprise Architecture will help clearly define how Information Architecture, Application Architecture, and Information Technology Architecture will be developed. There are several steps to designing an Enterprise Architecture, such as collecting data about actual conditions and an analysis process about the architecture that has been built. In this digital business era, Enterprise Architecture has a very important role for companies, because it can meet the company's business, service and application integration needs. The Open Group, defines Enterprise Architecture as a blueprint for an organization to create enterprise business, information, and use technology to fulfill its vision. Enterprise Architecture is also defined as a set of principles, methods or models that companies can use to design the company's business that can be organized, and the use of Information Technology that will be needed (such as software, networks and hardware) so that everything can be aligned and support the fulfillment of the company's vision. (Roni Yunis 2009).

Enterprise Architecture design will use several steps, one of which is defining the actual architecture for the company which is called Current Architecture, and there will be a Reference Architecture as the proposed architecture in the future. Both will be compared and produce a GAP Analysis, as well as validation for business users. GAP Analysis users will become a reference for companies to build and create improvements for them.

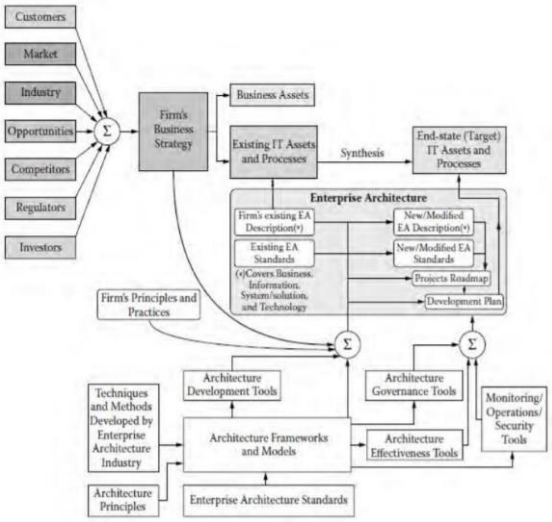


Figure 2.1 Elements of Enterprise Architecture (Minoli 2008)

Enterprise Architecture includes settings, configuration, partitions, interfaces, data, protocols, logic functionality, integration, and technology, where these functions are needed to support the business and fulfill the company's vision (Minoli 2008)

The elements of Enterprise Architecture include: (Minoli, 2008)

a. Business architecture: Defines business strategy and describes the organizational structure of a business.
b. Information architecture: Defining business targets and data exchange between applications within the company.
c. Application / Software Architecture: Defines the services and software (systems) that support business processes.
d. Infrastructure Architecture: Defines the physical landscape, storage systems and networks that support the software (system)

Enterprise Architecture A framework is a communication model for developing Enterprise Architecture that shows a set of methods, techniques and steps for planning and organizing development (Lankhorst, 2005). The following is the Enterprise Architecture framework standardized by the Open Systems Interconnection Reference Model (OSIRM) and published by the International Organization for Standardization in 1984 (Pruijt et al., 2012),

1. Zachman Enterprise Architecture Framework (ZIFA)
2. The Open Group Architecture Framework (TOGAF)
3. Extended Enterprise Architecture Framework (E2AF)
4. *Enterprise Architecture* Planning (EAP)
5. Federal Enterprise Architecture Framework (FEAF)
6. Treasury Enterprise Architecture Framework (TEAF)
7. Integrated Architecture Framework (IAF)
8. Joint Technical Architecture (JTA)

9. Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) and DoD Architecture Framework (DoDAF)
10. Department of Defence Technical Reference Model (DoD TRM)
11. Technical Architecture Framework for Information Management (TAFIM)
12. Computer Integrated Manufacturing Open System Architecture (CIMOSA)
13. Purdue Enterprise Reference Architecture (PERA)
14. Standards and Architecture for eGovernment Applications (SAGA)
15. European Union-IDABC & European Interoperability Framework
16. ISO/IEC 14252 (IEEE Std 1003.0)
17. IEEE Std 1471-2000 IEEE Recommended Practice for Architectural Description.

TOGAF-ADM

TOGAF (The Open Group Architecture Framework) is a framework that is often used in a company or organization to develop Enterprise Architecture projects. TOGAF is the de facto industry standard framework, offering a methodological approach to design, planning, implementation, and governance in Enterprise Architecture. This framework provides a consistent view of architecture that can be well understood by all stakeholders in the organization. TOGAF was developed by The Open Group's Architecture Framework in 1995(Minoli 2008). TOGAF provides methods for developing and managing an Enterprise Architecture development, as well as how to implement it. Therefore. TOGAF provides a series of steps that can be carried out in the architectural process, known as the Architecture Development Method (ADM). ADM is not a prescriptive template but is a generic and adaptable methodology that can be applied to a variety of organizational use cases in developing enterprise architecture. The ADM method is a method that contains a series of activities used to develop a model for Enterprise Architecture (H. Harrison, 2009; R. Harrison, 2009).ADM is used as a guide for designing and developing information systems in organizations or companies (Roni Yunis 2009).

One of the things that needs to be considered in implementing TOGAF ADM is how to define preparation and identify the architectural context that will be developed (Wil PM Janssen 2017). Apart from that, it is also necessary to pay attention in determining the strategy for each architecture, here are the TOGAF ADM steps shown in the image below.

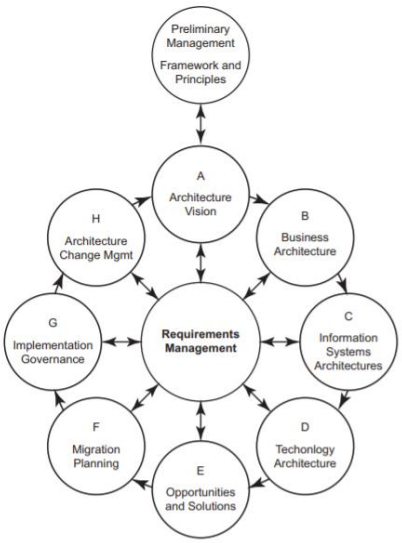


Figure 2.2 TOGAF ADM (architecture development) method (Tupper, 2011)

TOGAF ADM is the right tool and method for designing and evaluating Enterprise Architecture projects, in this case for this company TOGAF ADM is considered suitable for developing and designing Enterprise Architecture projects. The decision to use TOGAF ADM as the method for this project is because TOGAF ADM has specific sequential phases, and provides a set of resource guides such as templates, background information, and templates. TOGAF ADM steps will be based on four pillars, namely business architecture, application architecture, data architecture and technology architecture (Wartika, 2011). The stages of TOGAF ADM itself, if explained briefly but informatively, are as follows,

1. *Architectural Vision*

Creating a uniform view regarding the importance of enterprise architecture to achieve organizational goals formulated in the form of strategy and determining the scope of the architecture to be developed. This stage contains questions asked to obtain the ideal architecture.

2. *Business Architecture*

Defining the initial conditions of the business architecture, determining the desired business model or business activities based on the business scenario. At this stage, general tools and methods for modeling such as: BPMN, IDEF and UML can be used to build the required model.

3. *Information Systems Architecture*

At this stage, the emphasis is more on the activities of how the information system architecture is developed. Defining the information system architecture in this stage includes the data architecture and application architecture that will be used by the organization. Data architecture focuses more on how data is used for the needs of business functions, processes and services. Techniques that can be used are: ER-Diagram, Class Diagram, and Object Diagram. Application architecture places more emphasis on how application needs are planned using the Application Portfolio Catalog, as well as focusing on the application model to be designed.

Techniques that can be used include: Application Communication Diagram, Application and User Location Diagram and others.

4. *Technological Architecture*

Building the desired technology architecture, starting from determining the type of technology candidates required using the Technology Portfolio Catalog which includes software and hardware. This stage also considers the alternatives needed in selecting technology. The techniques used include Environment and Location Diagrams, Network Computing Diagrams, and others.

5. *Opportunities and Solutions*

At this stage there is more emphasis on the benefits obtained from enterprise architecture which includes business architecture, data architecture, application architecture and technology architecture, so that it becomes the basis for stakeholders to select and determine the architecture to be implemented. To model this stage in the design, you can use the Project Context Diagram and Benefit Diagram techniques.

6. *Migration Planning*

At this stage an assessment will be carried out in determining the migration plan for an information system. Usually at this stage the modeling uses an assessment and decision matrix regarding the main and supporting needs in the organization for the implementation of information systems

7. *Implementation Governance*

Develop recommendations for the implementation of implementation governance that has been carried out, the governance carried out includes organizational governance, information technology governance, and architectural governance. Mapping from this stage can also be combined with frameworks used for governance such as COBITS from the IT Governance Institute (ITGI)

8. *Architecture Change Management*

Determine the architectural management plan for the new system by monitoring technological developments and changes in the organizational environment, both internal and external, as well as determining whether the next enterprise architecture development cycle will be carried out. (Roni Yunis 2009)

Construction Companies

According to the definition of construction, it is a company that in a certain field makes efforts to achieve a result in the form of buildings or infrastructure (Sholeh, 2020). In Indonesia itself, construction services are divided into five, namely,

1. The field of architecture includes housing, warehousing and industrial buildings, commercial buildings, sports and recreation facilities, landscaping.
2. The Civil Sector includes roads and bridges, tunnels, ports/piers, drainage, weirs/dams, irrigation.
3. The Mechanical Field covers: AC and air ventilation installations, water piping, lift and escalator installations, mining and manufacturing, thermal installations, transportation equipment construction, oil piping construction, production facilities, oil and gas storage, construction equipment provider services.

4. The Electrical Sector includes electric power generation, power transmission networks, electric power distribution networks, telecommunications distribution networks, control installations, electrical installations.
5. The field of Environmental Management includes long-distance water, oil and gas piping, local/urban gas and water piping, clean water processing, groundwater drilling work. (Asnudin, 2012)

In its development in Indonesia, of course construction companies will follow the existing market share. The market share of the construction business can be divided into two parts, based on the use of the construction and its ownership, namely):

1. Construction projects are used for public purposes (public projects), the contractor procurement system is carried out based on applicable regulations/legislation, such as local government policies (Autonomy of Construction Services Business Potential in Indonesia regulations), donor country policies (loans/grants), and programs - programs developed by non-governmental organizations (NGOs). (Asnudin, 2012)
2. Procurement of construction projects for private interests (private projects). As a project owner (owner) you have full authority to determine the criteria used for procuring contractors, including: The project owner (owner) is free to determine contractors in any way, is free to negotiate with one of the contractors and can limit the contractors who are invited/offered a job, announcements can be made. carried out openly (transparently) to obtain competitive contractor bids. (Asnudin, 2012)

RESEARCH METHOD

Research Framework

In this research, the author will conduct data research, design and plan an integrated operational system using enterprise architecture. The method used is as previously explained, namely TOGAF-ADM. The framework of this research will be illustrated with a flow diagram and explained next.

Based on the research framework above, in the first step the author will identify the problem and formulate it in chapter 1. Then the author will conduct a literature study of material related to planning. The results of the literature study that have been obtained are outlined in chapter 2 regarding the theoretical basis. To have a clearer and more structured research basis, the author also conducted research on previous research related to the author's research, which has also been outlined in chapter 2 of the theoretical basis related to previous research and how they conducted the research (Rachmawati, 2007).

Next, the author will collect data as a basic foundation for EA planning. The data collection method will be carried out in 3 ways, namely interviews and observation. Interviews were conducted with company executives regarding the problems faced by the company as well as expectations regarding the current implementation of information systems in the company, as well as the company's needs for information systems so that they can further improve employee performance and increase business efficiency (Pujaastawa, 2016). For observation, the author will

make observations on business processes and the use of information systems in the company and classify the company's problems.

After getting the basic foundation of data collection, the author will start designing enterprise architecture using TOGAF-ADM steps. In TOGAF ADM there are 8 work steps, but in this research the author will only carry out research up to the migration plan step, namely the sixth step. And for this research, the main focus of the author's scope is the warehouse and project management departments. The results of the analysis and planning will be compiled into a planning results document which will be outlined in chapter 4 of the research results. After the research results in the form of design and integration system planning documents are created, the author will submit the documents to the company as a company guide for implementation.

TOGAF-ADM Planning Steps

As the author explained in chapter 2 of the theoretical basis, in TOGAF-ADM there are several planning sub-steps that will be carried out, namely,

Pre Elimination

In this phase, research-related components are identified by means of observation and study of documents used in the business implementation process in the company. The steps taken in this phase include the following:

a. Data collection through interviews and collecting documents related to the company's vision, mission, standard operating procedures (SOP) and regulations. As well as collecting information, both documents and interviews, related to the company's organizational structure.
b. Identify business processes carried out according to the company's standard operating procedure (SOP) documents so that problems can be identified.
c. Carrying out checks and identification related to the implementation of technology and information systems related to the company's business processes, especially warehouse and project management.

Architectural Vision

This phase will focus on mapping the architectural vision and identifying company stakeholders. This phase is carried out to explain the importance of enterprise architecture in achieving the company's business goals. In this phase, map out the company's architectural vision and analyze it. The architectural vision analysis at the TOGAF ADM stage is used as a reference in determining targets for designing business architecture, data architecture, application architecture and technology architecture in the company. In chapter 4, an analysis of the architectural vision will be presented using the existing architectural principles at PT. XYZ in the form of tables and explanations.

Business Architecture

*Business architecture*is the TOGAF ADM phase which focuses on developing the company's business based on the architectural vision that has been previously analyzed and documented. This phase will develop the company's business

base and targets by carrying out designs which will be documented in*business process model notation*and Business Architecture Phase Gap Analysis in chapter 4.

Information Systems Architecture

This phase will include planning the data architecture and application architecture that will be used by the organization. The data architecture design and application architecture created will be made in harmony to support the analysis results of the business architecture.

a. Data Architecture:

At this stage, the data architecture is developed, and the analysis results from the architectural vision and business architecture will become the baseline and target for development at this stage. Manufacturing will be carried out*ER-Diagram*, and Class Diagrams for developing data architecture that can make the implementation and integration of technology and information systems in companies more efficient. At this stage, several mergers and integrations will occur between application entities and data sources used by the company. So that later, after ER-Diagrams and Class Diagrams are formed, data traffic in the company will be better depicted and will become a reference for developing application architecture and Technology Architecture.

b. Application Architecture:

At this stage the development of the application architecture will be designed according to the results of the data architecture and based on the results of the architectural vision and business architecture. In this stage, it will be createdwill create an Application Interface Catalog to display applications that will be designed with an explanation of the relationship to existing applications and supporting components of applications that will be built later.

Technological Architecture

The technology architecture phase will include planning the technology architecture and what will be used by the organization. This phase describes the relationship between application components and technology components that support both software components and hardware components to support the required business integration and a gap analysis will be made regarding the technology architecture as a comparison. Architectural planningtechnology and network, will be carried out with a list of devices, intended use and comparison of candidates using the Technology Portfolio Catalog.

Opportunities and Solutions

In this phase, an evaluation of the domain architecture from business to technology architecture is carried out based on the gap analysis of each phase that has been carried out. The focus is on the development and planning ofThe analysis obtained from the previous steps is Architecture Vision, Business Architecture, Information System Architecture and Technology Architecture. This information will later become the basis for the author to develop what will be implemented.

Technically, the plans that will be produced are project context diagrams and accumulated GAP analysis documents.

c. *Project Context Diagram*:

This diagram will present the scope of implementation of enterprise architecture in the company. This diagram will show the development of enterprise architecture starting from the stakeholders, requirements, business functions, business processes, application components and external applications that will have an influence within the company.

Migration Planning

At this stage an assessment will be carried out in determining the implementation migration plan of the enterprise architecture planning. This phase will use an assessment and analysis matrix of the main and supporting needs in the company.

In this phase, the Implementation Factor Assessment and Deduction Matrix and Consolidate Gaps, Solutions and Dependencies Matrix documents will be created.

d. *Implementation of Factor Assessment and Deduction Matrix:*

What will be done in this phase will be to document the factors that influence implementation plans and risks in a matrix. The factors include risks, problems, dependencies, actions and impacts.

RESULT AND DISCUSSION

Preliminary Phase

Preliminary phase is the first stage in the enterprise architecture planning method with TOGAF ADM. In this phase, we will explain the initiation of activities that support the implementation planning of the operational integration system in the company. This phase will also explain and analyse the principles which will later become the basis for the next phases. The activities that will be carried out in the preliminary phase are as follows:

Determining the Scope of Enterprise Architecture Planning

Enterprise architecture planning at the company PT. XYZ will focus on building integration between systems that the company already has as well as building information systems for departments that still carry out all their activities manually, namely warehouses and projects.

Determining the Framework for Enterprise Architecture Planning

In this research, the framework that will be applied in enterprise architecture planning is the TOGAF ADM framework.

Identification of Strategic Planning for Enterprise Architecture Implementation

This strategic planning will be based on the company's vision and mission. In the data collection process, the author conducted an interview with the CEO of PT. XYZ and get an overview of the vision and mission as well as strategic planning that is the company's expectations. According to the CEO of PT. XYZ's vision is to

become a leading construction company that can provide sustainable construction for all its clients. Meanwhile, the mission of PT. XYZ is able to complete projects perfectly, economically, functionally and full of creativity. So the strategic planning direction from PT. XYZ based on the company's vision and mission is as follows,

1. Information systems and information technology are the main foundation in business processes
2. Data becomes a benchmark for decision making

Identify Problems in the Company

Data collection through interviews and collecting documents related to the company's vision, mission, SOPs and regulations. The collection of this information will be closely related to how to analyse the problems of the PT company. XYZ. The following are the problems and current conditions of companies related to the implementation of technology and information systems.

Table 4.1Table of Identification of Company Utilization and Problems Regarding Information System Implementation

Object	**Software Implementation**	**Utilization**	**Problem**
Warehouse	*File sharing*	- Recording the goods movement process in the warehouse (internal between warehouses and external receipts from vendors and project expenditures) - Stock calculation (stock taking)	- Recording is done outside the system - Hardcopy documents are still being created for the approval process - Hardcopy documents are still stored for reconciliation with Finance
Project Management	- *Microsft Excel* - *Microsoft Project*	Recording and monitoring projects from planning to completion and operations.	- Recording with excel and projects - Reports are carried out weekly and manually, a recurring process. - Hardcopy documents are still being created for the approval and billing process to the project owner.

From the problems explained in the table above, it can be concluded that the company's knowledge regarding the use of information systems already exists but its use is not in accordance with needs and is not in harmony. Below the author will present a table that describes the information system needs for each department in the PT company. XYZ.

Table 4.2 Information Needs per Unit at PT XYZ

	Movement Management	Inventory Management	Stock Management	Purchase Management	Product Managament	Combid Evaluation	Requisition Management	Schedule Management	Project Management	Budget & Project Estimation Management	Accounting Management	Tax Management	Ledger	Pre Project Management
All activity is done by application														
Integrated data across unit														
Interactive reporting and analysis														
Digitalized approval system														
Self analytical data access														
Reconciliation Otomation														
Calculated all process by system														
Activity monitoring by system														
Integrated print out form by system														

IMPLEMENTED
TARGET IMPLEMENTED

In the table above, the green column is the implementation target, while the gray column has been implemented. From the table above we can see and analyze that the need to utilize information systems in the warehouse and project management departments is very crucial, where the existing conditions of these departments do not yet have a structured information system and require data integration with other related departments such as finance and procurement. Then for the entire department an information system is needed that can integrate data, so that there is no longer a manual integration process. As well as making it easier for executive management to monitor the business and make decisions related to the business accurately and based on valid data.

Identification and explanation of architectural principles

At this stage, identify the architectural principles that will be used as a baseline in the next phase at the PT company. XYZ. These architectural principles will be collected together in a principal catalog table. These principles will be related to enterprise architecture planning at PT. XYZ.

Table 4.3Principal Architectural Catalog

Architecture	Principle	Description
Business	The information systems and information technology	The implementation and utilization of information systems and information technology makes work more efficient and effective in all lines and departments of PT. XYZ.

	implemented must provide benefits	
	Business continuity	Implementation of information systems and information technology is one of the supports in the sustainability and continuity of business processes at PT. XYZ
Data	Data is one of the company's assets.	The data system implemented is not only to support business processes but will be treated as a company asset. So there will be regular maintenance and maintaining the data system.
	Data is a reliable and accessible entity	Information managed in the implemented data system produces data that can be accounted for and is easy to access by all company entities.
	Data security is an important aspect	Data security at the company will be maintained with a certain level of security so that data access and management will be regulated according to capacity.
Application	Applications must support and meet existing business needs.	The implementation must be in accordance with needs and in harmony with the business so that it can support the company's business processes.
	The application is easy and functional (Ease-of-Use)	The application is easy for users to use, both in UI/UX integration and functionally.
Technology	Development and additions based on business needs	Implementation and changes in technology must be based on business needs and additions are not permitted without an appropriate business basis
	Compliance with technology standards	Software and hardware implementation must comply with standards.

Architectural Vision

*Architectural vision*is the next phase in enterprise architecture planning, after completing identifying several things in the preliminary phase, in this phase it will be explained how business values are applied in accordance with the company's existing vision and mission. Several documents that will be produced in this phase include stakeholder map matrix, value chain, solution concept diagram and gap analysis.

Company Organizational Structure

In enterprise architecture planning, it is important for the author to understand the business processes and organizational structure of the company. The company's business processes themselves will be discussed in detail in the business architecture phase. The following is the organizational structure of PT. XYZ,

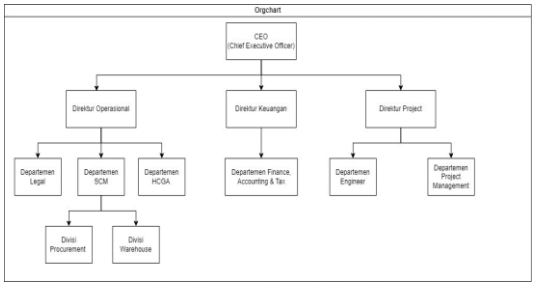


Chart 4.1PT Organizational Structure. XYZ

In the organizational structure of PT. XYZ, this company is led by a CEO (Chief Executive Officer) who will be fully responsible for all strategic decisions that will be taken by the company. The CEO himself supervises 3 directors who are plotted according to the company's needs, namely the operational director, financial director and project director. The operational director is responsible for company operations and company business operations, therefore the operational director oversees 3 departments, namely legal, Supply Chain Management and Human Capital – General Affairs. Furthermore, the financial director oversees and is responsible for all matters related to company finances and business finances of the company. Finally, the project director oversees the department related to the project which is the business of PT. XYZ, namely the engineering department and project management department.

Stakeholder Map Matrix

At this stage, an analysis process is carried out on stakeholders related to the design of enterprise architecture at PT. XYZ. In this step, the stakeholders involved in designing enterprise architecture at the Ministry of Home Affairs are defined. These stakeholders are mapped in a model which will contain an explanation of the function of each stakeholder in a business process along with the tasks and impact of the decisions taken. Before being mapped, stakeholders will be identified in a power/interest matrix.

Table 4.4Power to Interest Map Matrix

Power	***High***	*Keep Satisfied*	*Key Players*
	Low	*Minimum Effort*	*Keep Informed*
		High	***Low***
	Interest		

The purpose of the power/interest matrix is as follows,

a. *Low Power – Low Interest: Minimal Effort*

These stakeholders will always be monitored for their performance and will be directly actively involved in the project

b. *Low Power – High Interest: Keep Informed*

They are stakeholders who must know information related to the company but do not play an active role and do not have much impact.

c. *High Power – Low Interest: Keep Satisfied*

Is a stakeholder who has decision-making authority and must always be in a satisfied and happy state. These stakeholders are also not actively involved

d. *High Power – Haigh Interest: Key Players:*

They are stakeholders who have the authority to make decisions, but they must also be involved

Therefore, from the results of the matrix explanation above, when mapped to the condition of the company and analysis of the functions and tasks that have been described previously, the results of the matrix are as follows:

Table 4.5Power to Interest Map Matrix PT. XYZ

Power	***High***	*Keep Satisfied*	*Key Players*
		CEO, Finance Director, Project Director, Finance Director	*Head Department* (all departments)
	Low	*Minimum Effort*	*Keep Informed*
		Staff (all departments)	
	High		***Low***
	Interest		

Value Chain

Value chain is a type of business analysis that can be used to identify main activities and supporting activities in an organization. Classification of activities at PT. XYZ was obtained from the results of data collection regarding department duties and functions. At PT. XYZ's main activities are procurement, warehouse, design and engineering and project management, then its supporting activities are human resource development, legal activities, technology development and finance accounting. The main activity at PT. XYZ plays a major role in implementing its business processes, while supporting activities are activities that help the main activities to run. The following is a further explanation regarding the analysis and description of PT's main and supporting activities. XYZ in the value chain diagram.

Architecture Vision Gap Analysis

Gap analysis is an analysis carried out to compare the current situation, called the baseline, and the target situation in the future. The following are the results of the gap analysis at PT. XYZ is related to current business processes.

Table 4.6 Gap Analysis Architecture Vision PT. XYZ

Need	**Gap Analysis**		**Conclusion**
	Baselines	**Target**	
Use of a system to record all activities to avoid manual reconciliation	Several processes/activities already use ERP, except for warehouse and project management	The entire process is digitalized and uses the same system	System development carried out
Ease of document approval	System approval so there is no need for hardcopy document storage. Approval uses a wet signature whose form comes from a print out of the system		System development carried out
Ease of recording project progress and billing	Recording of project progress and supporting billing documents is done manually		System development carried out
Centralized information for dynamic monitoring by BOD	Recording is recorded separately systemically and manually, so it requires manual data compilation to create a monitoring report for BOD	Data system integration to create information and reporting portals	System development carried out

Business Architecture

In the business architecture phase, the company's needs in carrying out business functions to achieve certain goals will be explained. This phase defines the desired business model based on existing needs. The design results of the business architecture are the baseline for the next architectural phase.

Business Flow Process PT. XYZ

In general, the general business process of the PT company. XYZ begins with the appointment of project work by the project owner. Purchase orders will be sent complete with a Cost Budget Plan (RAB) by the project owner, then from PT. XYZ will carry out budget planning or Project Budget Plan (RAP) and start the pre-engineering process by preparing a Bill of Materials (BOM) and project estimates. Then after the RAP and BOM are formed they can be sent to the project team. The project team will process the BOM and RAP into WBS and requests for project work and materials. After the offer is issued, the process will be drawn up into planning the purchase of goods by the Procurement team. The process that runs in the procurement team until the goods or services are ordered is completed. If the purchase is in the form of services, it will be handled directly by the project team, but if it is material, it will be received at the warehouse. Items that enter the warehouse will be released according to requests from the project team. The work on the project will also be monitored by the project team for progress in completing the work.

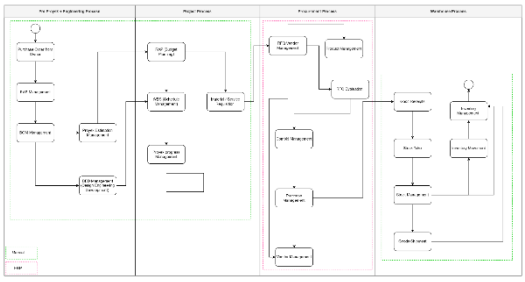


Chart 4.2Business Flow Process General Baseline PT. XYZ

Business Flow Process Project

The project business process will start with the preparation of the Project Budget Draft (RAP). RAP is a budget that will be prepared by the project team as a reference for the financial budget for each ongoing project. The RAP will be prepared with the project costs paid by the project owner as the basis, usually the RAP will be worth lower than the project costs paid by the project owner. Then the process will continue with activities, namely creating a project schedule and work based structure (WBS), followed by material planning and service requisition based on the bill of materials (BOM) that was created previously in the engineering design process. The material request process will later be included in the procurement process for purchasing materials and the warehouse for the process of receiving and storing materials. If all the requested materials and services are available, the project will start a manual request process to the warehouse to release the materials to be sent to the project location and used. During the process and activities related to the project, there will be recording of the project progress, this is needed for project evaluation and also billing documentation.

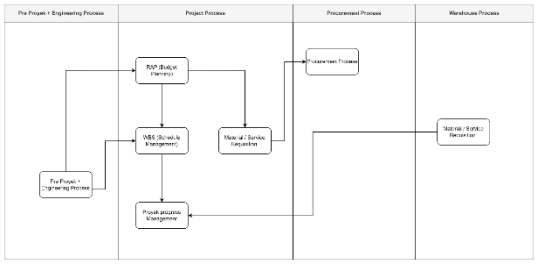


Chart 4.3Business Process Flow Project Baseline

Business Flow Warehouse

The warehouse process begins with registering goods that are already in purchasing into Excel so that the goods/materials will have their own labels to record assets in the warehouse. Then, after the goods have been purchased, they will be received at the warehouse (goods receipt) and will be recorded as stock and then allocated to certain locations in the warehouse. The process of releasing goods from the warehouse will begin with a request for goods leaving the project. All movement

processes and incoming and outgoing items will be recorded separately in Excel as inventory management.

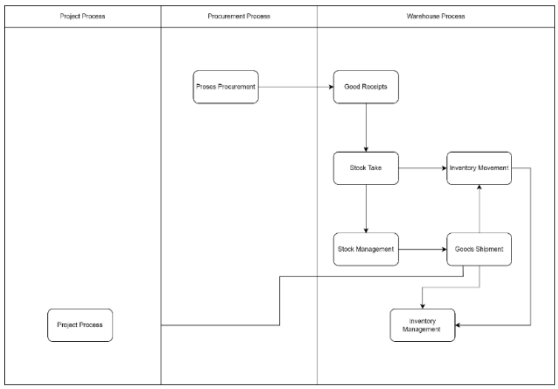


Chart 4.4Business Flow Process Warehouse Baseline

Driver/Goal/Objective Catalog

The next stage is an explanation of the relationship between drivers, goals and objectives which will be explained further in the following table,

Table 4.7Driver/Goal/Objective Catalog PT. XYZ

No.	**Catalog**	**Information**
1.	*Drivers*	The need for information systems and information technology to record all activities and avoid manual reconciliation
		Efficient process for document approval and project billing recap
		The need for centralized information for monitoring and reporting
2.	*Goals*	The information systems implemented and to be implemented will be integrated with each other.
		There is a support system for warehouse and project management activities
		PT's work efficiency. XYZ as a whole because all processes have been integrated
		Information regarding data from the company's business results (reporting) will be easier to monitor
3.	*Objective*	Designing an integrated enterprise architecture so that information systems are connected to each other and facilitate running business processes
		Utilization of enterprise architecture planning in all activities of PT. XYZ so it becomes more efficient
		Utilization of integrated data will help PT monitoring and operations. XYZ

Proposed Business Flow PT. XYZ

At this stage, the proposed business architecture will be explained. This process is structured based on needs and efficiency in the business process. Based on the data that has been collected, the following are the results of the proposed business process for PT. XYZ.

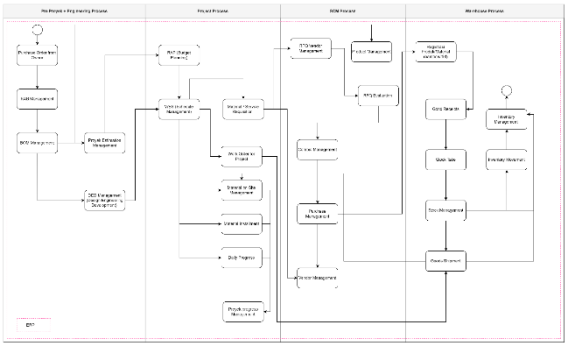


Chart 4.5Proposed Business Process Flow General PT. XYZ

In the proposed business architecture, most of PT's business processes. XYZ will be integrated with the implementation of the warehouse and project modules in ERP. Overall, for recording activities at PT. XYZ will use ERP which has been previously implemented in procurement and finance. Apart from that, there are major changes related to projects, product management, goods shipments and goods receipts.

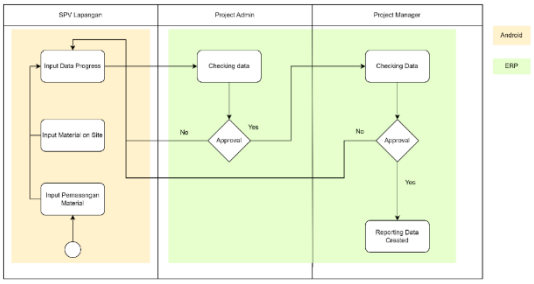


Chart 4.6Proposed Flow Process for Daily Progress Recording PT. XYZ in Project Management

On projects, the recording process will be more detailed in recording material arrival, material installation and daily progress records, so that progress management calculations will be more accurate and reliable. The process will be started by the field SPV who inputs data for progress purposes, namely, materials on site, material installation and daily work results. Then the admin will compile and check the data that has been input, if it is deemed inappropriate then it will be rejected so the field SPV must correct it according to the standards that have been set. The daily progress input process will be carried out using the Android application that will be built and the data will be calculated in the ERP project management module. The

following is a proposed business process for progress with additional daily monitoring,

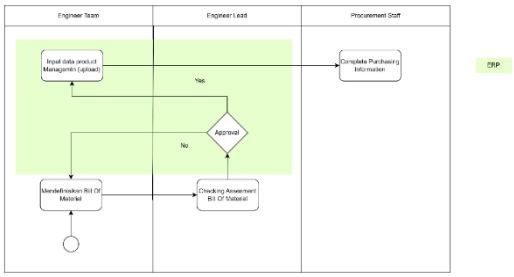


Chart 4.7Proposed Process Flow Product Management

For product management, the previous product process is managed by procurement and is formed when an item is purchased. In the new process, recording will be carried out starting after the BOM has been created by the engineering team, so that the product entered is more accurate and in accordance with the request from the user. Then procurement will enter information related to the commercial product.

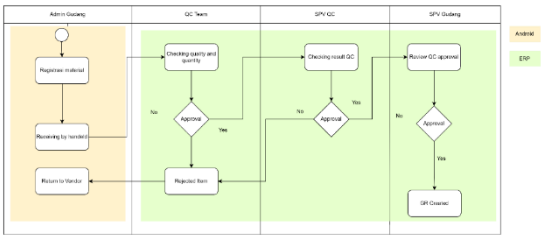


Chart 4.8Proposed Process Flow Goods Receipts PT. XYZ

For the goods receipt process, there are changes related to the process of initiating goods receipt. In the process of receiving goods, the previous process was carried out after the goods arrived at the warehouse. For future development, the material to be received must be recorded and registered as a company asset. So the process of receiving goods will begin with material registration with a barcode / RFID tag. These tags and barcodes will also be used to support project progress reporting. Then the receiving process will continue with quality and quantity checks by the Quality Control team and reviewed up to the SPV QC and SPV warehouse levels. If approval from the SPV warehouse is complete then goods receipts will be formed automatically.

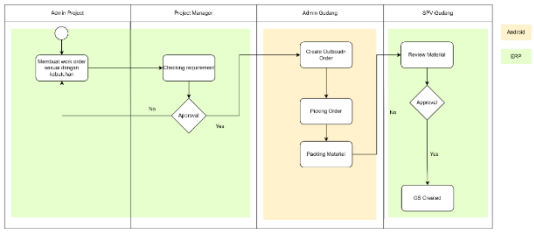


Chart 4.9Proposed Goods Shipment Process PT. XYZ

The goods shipment process begins with a work order proposed by the project so that there will be justification for the goods leaving the warehouse as the correct goods that will be used for project needs by the Project Manager. After PM

approval, the warehouse admin can continue the goods shipment process by creating an Outbound Order then continuing picking and packing materials. When the process is complete, it will be reviewed by the warehouse SPV after which the goods shipment will be formed automatically.

Information System Architecture

In this phase we will discuss information system architecture at PT. XYZ includes data architecture and application architecture.

Data Architecture

At this stage, information system planning will be explained regarding data architecture. In planning the data architecture will produce a Conceptual Diagram Model (CDM). Data architecture is a foundation component for implementing information systems, especially when developing applications. So that the data and applications owned can support the company's business needs. In designing data architecture, we will discuss 2 points of data architecture, namely conceptual data diagrams and data gap analysis.

Data Architecture Requirements

*Data Architecture Requirements*is the result of analysis and validation of the catalog principle. A requirements catalog will be prepared to make it easier to determine planning objectives at the architectural data stage. The following are the results of preparing a requirements catalog for architectural data,

1. Data must be validated for security and confidentiality.
2. Data has the capability for overall integration.
3. Data produces information that is reliable, accurate and accountable.
4. Data management must be done centrally

Data Architecture Baseline

For the baseline architecture data, the company PT. XYZ currently has 1 dedicated database for the implemented ERP system. However, because other activities are still managed using sheets, the existing data architecture is explained in the diagram below.

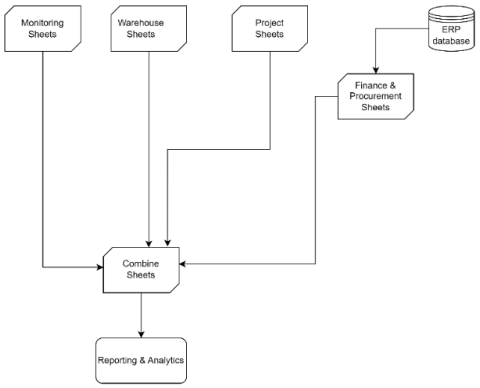


Chart 4.10PT Baseline Data Structure. XYZ

In the diagram, it can be seen that there are several sheets that are used as data centers for the PT company. XYZ. Currently, producing monitoring reports and summaries requires quite time consuming work. Because there is a special effort made to combine all sheets into one source. From the following, many problems arise, such as time inefficiency in processing reports and inter-departmental reconciliation which is also done manually. To minimize undesirable things, PT. XYZ places a dedicated person to combine data every day and compile data every week. Not to mention if undesirable circumstances occur, such as connection problems during the compilation process, the dedicated person is sick and the device used is damaged. Then work related to data and reporting will not be able to be done. Because of this, there is a need for a system that specifically combines data storage and monitoring reporting functions.

Data Architecture Targets

The problem with the data architecture is more towards PT's data structure not being ready. XYZ to be used as a reliable data source. So that in the proposed target data structure, a data warehouse will be built as a single source of truth for the PT data system. XYZ. The diagram below will explain how the target data structure is depicted.

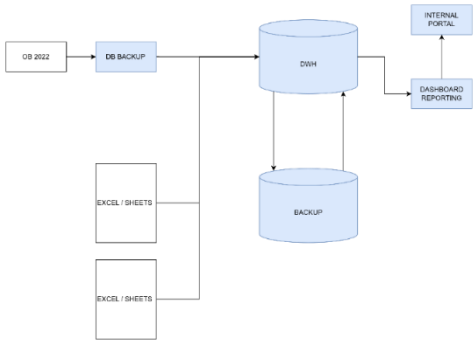


Chart 4.11PT's Proposed Data Structure. XYZ

The data structure described above explains that there will be a data warehouse containing a collection of data managed by PT. XYZ. Existing data will go through the ETL process and will be processed into reliable and easily accessible information. Existing application systems such as ERP data systems will first develop a backup version, then it will be processed using ETL to enter the prepared data warehouse. Then, if there is still source data that comes from Excel or sheets, it will also be processed using ETL and entered into the data warehouse. So that if the user needs information, it will be processed more quickly and the user can access it easily on the reporting dashboard.

Conceptual Data Model Targets

Conceptual data diagram is ERD (Entity Relationship Diagram) model information. The conceptual diagram prepared was obtained from collecting an analysis of the organization's business needs. The entities and relationships modeled in this ERD are determined based on business needs.

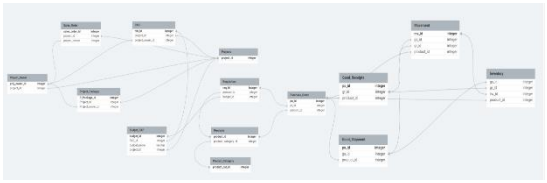


Chart 4.12Entity Relationship Diagram Proposed by PT. XYZ

These tables are the basis of the information that will be stored in the data warehouse. So a set of data that goes through the ETL process will be processed queryly and then classified into which information in which table. In the diagram above there are 14 tables that will be implemented and have several relationships between one table and another. The following is an explanation of the table depicted in the Entity Relational Diagram chart.

Application Architecture

Application Architecture Requirements

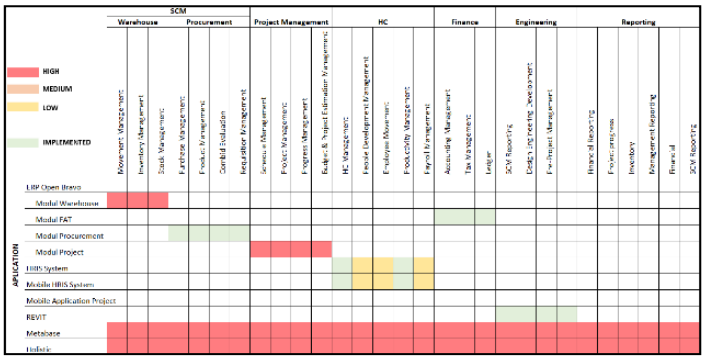
*Application Architecture Requirements*is the result of analysis and validation of the catalog principle. A requirements catalog will be prepared to make it easier to determine planning objectives and prioritize them at the application architecture stage. The following are the results of preparing a requirements catalog for architectural data,

1. The application applies the principles of ease of use and user friendliness.
2. Implement a high security system
3. Provides access to access data and can display a summary

Application Portfolio Catalogue

In this application architecture phase, the application that is being used will be discussed and also suggestions for how to plan the application according to needs. At this point, a list of application portfolio catalogues is explained, as well as a gap analysis of baseline and target applications. In the catalogue below, a list of applications at PT is described. XYZ. Below is a list of applications, some applications have been implemented and some need development according to need and urgency.

Tabel 4. 8 Application Portfolio Catalogue at PT XYZ



In the catalogue above, there are several colours that indicate several statuses. The red colour indicates high, meaning that the application has high urgency to be implemented. Orange indicates medium status, and yellow indicates low status. So application development will prioritize high urgency. In this case, the implementation that will be carried out is the addition of ERP warehouse and project modules. As well as implementing analytical dashboards, namely metabase and holistic.

The ERP system whose development will continue is Open Bravo, which is an open-source ERP system that can be customized by developers. The addition of the warehouse module will be adjusted to the proposed target business process. Meanwhile, for reporting and analytical, the applications chosen are metabase and holistic. Metabase itself was chosen because its character suits reporting needs which can be detailed and easy to use. And the application itself is open source which can be customized by developers. The next choice of reporting application is holistic, this is a tool that will present reports in a more advanced form than metabase, so it is suitable to meet the needs of executive management for monitoring business results.

Apart from building ERP and reporting applications, another thing that needs to be done is implementing a database engine as the foundation for building a data warehouse. For the development of the data warehouse, PostgresQL technology will be used which will be installed on the on-premises server, the needs of which will be discussed in more detail at the next stage.

Technology Architecture

Technological architecture is one of the phases in the design that explains the current technological architecture and the development targets. The result of this phase is a technology portfolio catalogue and hardware and software specifications.

Technology Architecture Requirements

At this stage, the technology requirements will be explained in detail and a baseline. At this stage, the technology that will be targeted must be appropriate and support the application that will be implemented based on the application architecture stage. In general, technology needs must comply with the following principles,

1. Technology has been standardized according to specified standards

2. Infrastructure that supports application function needs
3. Technology is supported by good security functions

After being able to define general technology requirements, the following is a list of technology requirements related to implementation of application architecture.

Technology Portfolio Catalogue Baseline and Target

At this stage the catalogue will explain the target technology that will be used and what technology is currently used at PT. This catalogue can be a guide in planning PT technology and infrastructure. XYZ. For the column coloured yellow, the status is target, namely additional technology proposed to support the implementation of previously proposed applications.

Table 4.9Technology Portfolio Catalogue Baseline and Target

Hardware/Software Catalog	**Type**	***Technology Component***	**Status**	**Notes**
Servers (Software)	Mail Server	Zimbra	*Baselines*	
	Web Servers	Apache	*Baselines*	
	DHCP Server	Windows	*Baselines*	
Performance and Availability (hardware)	UPS	APC	*Baselines*	
Barcode System(hardware)	*Handheld*	Zebra	*Target*	As supporting hardware for warehouse ERP implementation with additional barcode tagging for asset management
Data System (Software)	*Database engines*	PostgreSQL	*Target*	Supporting the implementation of database engines and data warehouse
Operating system (Software)	*Server Operating System*	*Windows Server Standard*	*Baselines*	
Security (Software)	*Firewalls*	Shopos	*Target*	Additional system security so that the company's information system has a higher level of security
	Antivirus (Protection)	Kaspersky	*Target*	
Servers (hardware)	*Server on Premise (Tower Server)*	Dell	*Baselines*	

Opportunities and Solutions

Based on the analysis that has been carried out, there are solutions proposed for each model architecture developed. The solution described is expected to make operational activities at PT. XYZ is more efficient.

Project Context Diagram

After formulating the proposed solution which has been described per the relevant architecture previously, the author will explain a diagram that covers the scope of the proposed information system implementation for the PT company. XYZ. The project context diagram below shows how enterprise architecture planning will be implemented. There will be 2 interfaces that will be developed in planning, namely a dashboard for monitoring reports and an Android application for interface for project progress and schedule management whose data will later be thrown into the ERP system. The ERP system that is built will use the Open Bravo ERP system in accordance with previous implementations in the company, so that all processes will be perfectly integrated with Open Bravo and can be continued with building a data warehouse as a solution for data monitoring and analysis.

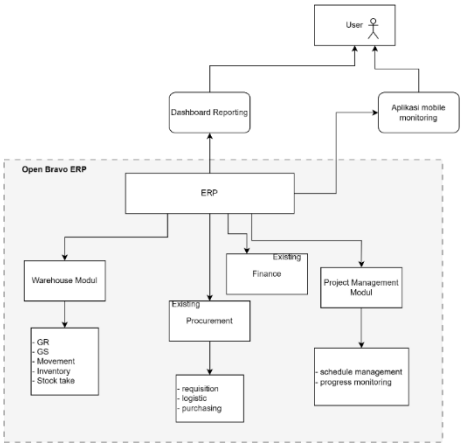


Chart 4.13Project Context Diagram - PT Application. XYZ

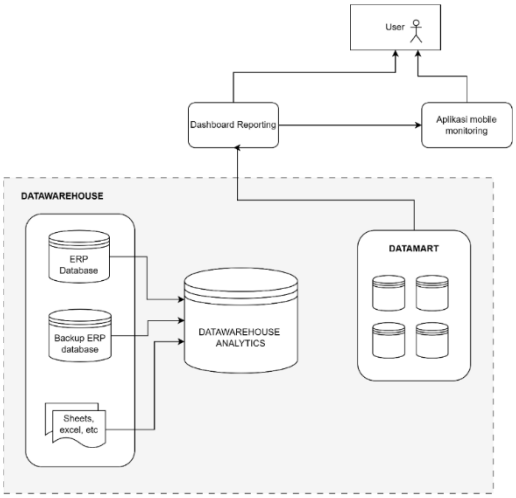
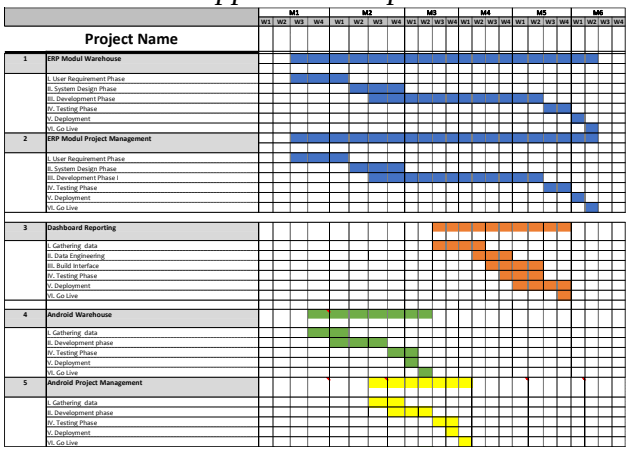


Chart 4.14 Project Context Diagram - PT Data. XYZ

IT Road Map

At this stage, the road map for proposed planning for the implementation of an integrated operational system at PT.XYZ will be discussed. Before going into a detailed explanation regarding solution development, we will explain the development and implementation schedule. Below is the detailed construction schedule:

Table 4.10PT.XYZ Application Implementation Schedule



In the IT roadmap above, it is explained that for each development there are several phases such as, User Requirement Phase, System Design Phase, Development Phase, Testing Phase, Deployment and Go Live with different work time spans for each project. To build an ERP module, the estimated time required for the process is around 5 – 6 months until the application is ready to use. Meanwhile, for the Android application, it is estimated that the work will take 3 months. And finally, the construction of the database engine and reporting dashboard took 3 months.

Migration Planning

Implementation of Factor Assessment and Deduction Matrix

Before carrying out migration planning, it is necessary to analyze several factors that will be of special concern. The following factors have been summarized from the results of observations made and analysis of previous phases.

Table 4.11Implementation of Factor Assessment and Deduction Matrix

Factor Type	Factors/Aspects	Description	Losses/deductions
Risk	Decreased hardware quality	Hardware is damaged or has decreased quality due to delivery quality or factory defects	- Inhibiting business processes in the implementation of technology and information systems - losses to the company due to obstruction of several business processes or using previous manual processes
	Hardware damage	Damage caused by humans or disasters	

	Server connection network disruption	Disruption of network connections on the server	
	System security compromise	Vulnerable security system	
	Application error	There are errors or bugs in the application or ERP	
Issues	Development of operational system integration	Development of operational integration system planning company for supports performance efficiency and achieves the company's vision and mission	Planning development operational systems integrated with technology information company based on the results analysis that has been done previously (with a focus on the project and warehouse divisions
Dependencies	The relationship between business, data, technology and applications in companies	The relationship between PT XYZ's business processes and the planned implementation, namely mobile applications, dashboards and ERP warehouse and project modules	Alignment between business, data, technology and applications in the company
Action	- Data recap and integration - Application development (ERP) and supporting applications	- Database automation - Integrated application - ERP efficiency	- Use of database engine - Mobile interface and dashboard - ERP (open bravo)
Impact	Integrated systems and databases are centralized and structured	- developing ERP modules for projects and warehouses - developing interface applications for monitoring progress on projects	- Increased work efficiency in warehouses and projects - Improved database system

CONCLUSION

The conclusion of the study fund that PT XYZ continues to grow following the development of existing technology. For the accounting, financial and procurement recording systems, PT XYZ has implemented ERP (Enterprise Resource Planning) technology with the implementation of ERP software that helps PT XYZ in managing the activities mentioned above. However, in its development in the implementation of information systems, it turns out that some of the main processes at PT XYZ are still carried out manually. So that problems arise and disrupt the business processes of PT. XYZ. These problems include problems with data integration, communication and loss of information due to certain things. Especially in

processes that are still done manually such as warehouse and project management. Of course, this problem raises concerns from executive management where this problem ultimately has an impact on the performance of project work completion, and the company's financial problems. So in this case the existing ERP implementation still does not have a direct impact on the company. From this problem, an analysis will be made that will identify the problem in detail with company XYZ. So the idea of developing an integrated operational system emerged that would be built according to the Enterprise Architecture (EA) method. EA can be analogous to when building a building, a model, design and design of the building is needed. These things are needed as models and foundations for the design. Similar to the implementation of information systems, before its development, the basis and foundation of the design are needed in the form of information system models or architectures. In this research, the EA method that will be used is TOGAF-ADM. This method was chosen because TOGAF ADM is a complex method that can meet all EA development needs, so it is used based on organizational needs.

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