DESIGNING INFORMATION TECHNOLOGY ARCHITECTURE BASED ON TOGAF METHODOLOGY AT PADANG KARUNIA GROUP

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Abstract

Padang Karunia Group (PKG) is engaged in four main business areas coal mining, coal trading, mining contractor and infrastructure and has consistently delivered coal product to domestic and overseas market. There are problems in the business processes of PKG's everyday operations, such as: the waiting time for reports is over one day when it should be a few hours, data has more than one version and is not accurate, and demurrage (a charge payable to the owner of a chartered ship in respect of failure to load or discharge the ship within the time agreed). Issues occur because the role of IT is not optimal. The purpose of this study was to design an information technology (IT) architecture suitable for supporting the operation of the PKG. The correct IT architecture design can help companies to achieve their vision and mission. The right IT architecture for PKG will support all of its operations. The design of the IT architecture could be done with the existing framework using: EAP, TOGAF, FEA, DODAF, and Gartner Methodology. For this work the TOGAF was selected because it is open source, systematic, and thorough. Analysis was done using a business processes approach to obtain the IT needs mapped to the principles of business, information systems, applications, and information technology. The results from this study are a business architecture design, an information systems architecture, and a technology architecture appropriate to support the business of PKG.

Keywords: a Business Process, Information Technology, TOGAF ADM.

Abstrak

Grup Padang Karunia (PKG) bergerak di empat bidang usaha utama antara lain: pertambangan batubara, perdagangan batubara, kontraktor pertambangan dan infrastruktur. PKG secara konsisten mengirimkan produk batubara ke pasar domestik dan luar negeri. Terdapat permasalahan dalam proses bisnis operasional PKG sehari-hari, seperti: waktu tunggu laporan lebih dari satu hari, data memiliki lebih dari satu versi dan tidak akurat, dan demurrage (biaya yang dibayarkan kepada pemilik kapal carteran sehubungan dengan kegagalan untuk memuat atau membongkar kapal dalam waktu yang disepakati). Masalah terjadi karena peran TI yang belum optimal. Tujuan dari penelitian ini adalah merancang arsitektur teknologi informasi (TI) yang sesuai untuk mendukung operasional PKG. Desain arsitektur IT yang tepat dapat membantu perusahaan mencapai visi dan misinya. Arsitektur TI yang tepat untuk PKG akan mendukung semua operasional PKG. Perancangan arsitektur TI dapat dilakukan dengan framework yang ada menggunakan: EAP, TOGAF, FEA, DODAF, dan Metodologi Gartner. TOGAF dipilih karena bersifat open source, sistematis, dan menyeluruh. Analisis dilakukan dengan menggunakan pendekatan proses bisnis untuk mendapatkan kebutuhan TI yang dipetakan ke dalam prinsip bisnis, sistem informasi, aplikasi, dan teknologi informasi. Hasil dari penelitian ini adalah desain arsitektur bisnis, arsitektur sistem informasi, dan arsitektur teknologi yang sesuai untuk menunjang bisnis PKG.

Kata kunci: bisnis proses, teknologi informasi, TOGAF ADM.

1. INTRODUCTION

IT that aligns with business needs is one of the main goals in the implementation an IT Architecture in an organization[9][11][13][16].Alignment between IT and business can give significant benefits for the organization[8][10][14][15].

IT in the Padang Karunia Group (PKG) has the role of supporting business processes in everyday operations so that business strategy can be carried out more effectively[3][7][9]. The role of PKG IT in carrying out these business strategies is mapped in IT strategies, namely: provide an integrated system, obtain and maintain a standard and integrated application system, optimizing IT architecture and existing resources, providing automation solutions, ensuring that IT implementation complies with applicable laws and regulations, ensuring that IT services are available when needed, and ensuring that IT services & infrastructure can survive and recovery from failure, attack or disaster.

When looking at the implementation of business processes, several problems were encountered in the IT support. Problems that occur include land contract documents that have not been integrated between the site and the Head Office (HO). Lack of integration of documents between site and HO can result in delays in updating documents. Delay of documents being updated causes fines to be paid by the company. Coal data access needed by the Marketing Department is not at the same time. The coal stock sold by the Marketing Department must match the stock in the stockpile managed by the Operations Department. Data needed by Marketing cannot be directly accessed, Marketing telephone or email in advance to find out coal data. Demurrage occurred. The demurrage is a penalty for the waiting time of the ship. Report on Coal Hauling or transportation of coal which takes more than 1 day. There is a pause of report from site to HO. There are 2 coal-stock data. Currently, the coal stock report has 2 versions, namely the version of the application and the version stored in Excel. This causes the admin inventory to be input 2 times, namely in Excel and in the application. The quality of coal has not been well recorded. The quality of coal from the mining process to the consumer may experience a decrease in quality due to various reasons. The quality of the decline that occurs if monitored properly will be useful for determining coal prices.

Problems that occur because of the non-optimal state of IT, were found during the assessment of ITM (Information Technology Management) implementation. The result of the overall ITM assessment for PKG IT in 2015 was 2.60. The root cause of the non-optimal nature of IT support is the absence of an IT architecture. IT architecture is a function that is used to form a process for the alignment of IT and the business.

IT architecture is needed to fulfill the requirement or goals of organization[17][18][19]. IT architectural frameworks are used in both industry and government: Enterprise Architecture Planning (EAP), The Open Group Architecture Framework (TOGAF), The Department of Defense Architecture Framework (DODAF), Gartner Methodology, and Federal of Enterprise Architecture (FEA). The selection of an IT architecture framework is carried out by comparing frameworks such as research conducted by Rouhani, Mahrin, Nikpay and Nikfart (2013). The comparison results show that based on the comparison of the five frameworks above, TOGAF has advantages, including conceptually, TOGAF provides appropriate governance for IT architecture development and TOGAF ADM focuses on IT architecture development. Also mentioned in modeling, TOGAF provides extensive documents about methods and processes even though it takes longer than other frameworks. From the process side, TOGAF has a requirements process that other frameworks don't have. These requirements occur continuously in the process of implementing TOGAF. Thus the researcher chose to use the TOGAF framework for this study.

Previous research was taken with the similarity of a case study, namely the development of information technology architecture in an organization using TOGAF framework. Not only comparing frameworks but also those research confirm that TOGAF is suitable for designing enterprise architecture development on an organization.

The research was conducted by Edward, Shalannanda, Agusdian, and Lestariningati (2014) with the title E-Government Master Plan Design with TOGAF. This study uses the TOGAF ADM (Architecture Development Method) approach which describes methods for developing and managing IT architectures. This research first performs an analysis inside and outside the organizational environment using analysis of strengths, weaknesses, opportunities, threats (SWOT) to serve as guidance in designing IT architecture, so that the IT architecture created can support the organization's business strategy. The difference with research in PKG is that organizationally the research conducted by Edward, Shalannanda, Agusdian, and Lestariningati (2014) is different. They research the city government while PKG is a private company engaged in coal. Designing IT architecture for the city government and PKG

must follow different regulations and business processes.

Research conducted by Chaczko, Kohli, Klempous, Nikodem (2010) utilizes the TOGAF approach to design an enterprise architecture suitable for a hospital that demands efficiency and accuracy. Same with research conducted by Gigih Forda, Tristiyanto, and Didik Kurniawan with the title An Enterprise Architecture Planning for Higher Education Using The Open Group Architecture Framework (TOGAF): Case Study University of Lampung discusses the design of enterprise architecture at the university level using TOGAF.

Solving the problem in this study begins with conducting a preliminary phase analysis with the output of architectural principles used to serve as guidelines in building information technology architecture within the company. This is followed by the Architecture Vision phase, which aims to build an architecture that is in tune with the company's needs. The next phase is Architecture business which aims to build a business target architecture, namely: how the company carries out its operations to achieve business targets and knows the current business architecture and architectural targets and analyzes the gap between the two. The next phase of Information Systems Architecture aims to build application and data architectures that support business processes. Information Systems Architecture phase is carried out by analyzing the current information system architecture, proposed information system architecture, and gap analysis of both. The next phase, Technology Architecture, is carried out by analyzing the technology design that will be built to meet the needs of the information system that has been designed. After analyzing business architecture, information systems and technology as well as analyzing the gap, the results of the analysis are then consolidated to obtain a solution pattern. The results of this study are expected to contribute solving problems faced by PKG.

2. METHOD

When designing IT architectures, a framework approach can be carried out, with different methods for doing this including: Enterprise Architecture Planning (EAP)[1], The Open Group Architecture Framework (TOGAF)[1][12], The Department of Defense Architecture Framework (DODAF)[1], and Gartner Methodology[1], Federal of Enterprise Architecture [1][14].

The selection of a framework was done by comparing the frameworks above, which resulted in the TOGAF framework to be chosen for this research. Based on the comparison of the five frameworks above, TOGAF has advantages including conceptually, the TOGAF provides the right governance for the development of IT architecture and the TOGAF ADM focuses on building IT architecture. In modeling, the TOGAF provides extensive documents about methods and processes, although it takes longer than other frameworks. From the process side, TOGAF has a process requirement that occurs continuously in the process of implementing the TOGAF[2][6][15]. TOGAF was adopted in this study to obtain an optimal IT design.
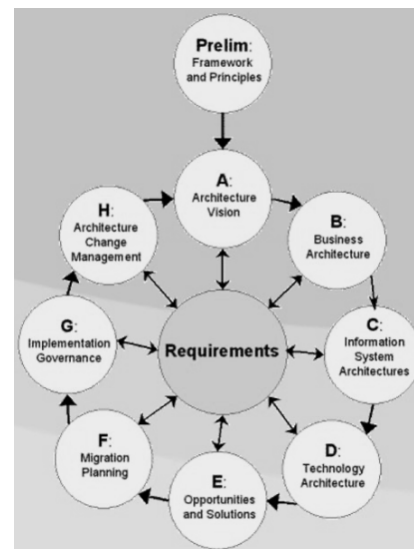

Figure 1 TOGAF ADM Framework

The approach of this research is a case study, analyzing people, events, decisions, periods, projects, policies, institutions or other systems[4]. These are studied as a whole using one or more methods. In the exploratory research, data was collected to identify problems, which was then to get the conclusions[5]. This was done using a type of qualitative research, because it uses assumptions, strategies, and methods to collect data, analysis and interpretation of PKG[4].
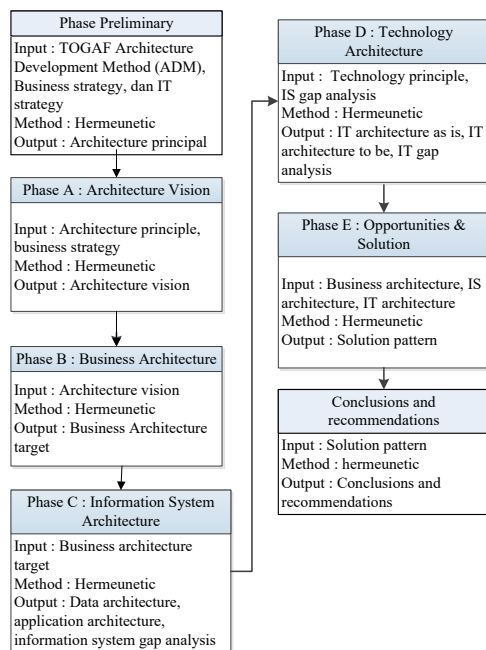
Figure 2 Research Flow

The flow of this research is as follows:

1. Preliminary phase

This phase gets the IT architecture principles to be created. According to TOGAF ADM, architecture is derived into three layers of perspective, namely: business architecture, information system architecture (applications and data) and technology architecture. Thus, 4 principles were generated from this perspective, including business principles, application principles, data principles, and technology principles.

2. Phase A: Architectural Vision

This phase identifies the scope, business requirements so that it can determine the business function. Architecture Vision aims to build an architecture that is aligned with company needs. Inputs to this phase are the company's vision and mission, business strategy and architectural principles.

3. Phase B: Business Architecture

This phase describes the business architecture and produces the target business architecture. Architecture business aims to build a business target architecture, namely: how the company conducts its operations to achieve business targets, analyzes existing business architecture and architectural targets, and analyzes the gap between the two.

4. Phase C: Information System Architecture

This phase results in the information system architecture and its gaps. The Information Systems Architecture phase aims to build application and data architectures that support business processes. Inputs for this phase are the results of the business architecture phase, application principles, and data principles. Furthermore, the current information system architecture analysis, the proposed information system architecture, and gap analysis of both are carried out. Outputs for this phase are application architecture, data architecture, and gap analysis.

5. Phase D: Technology Architecture

This phase produces an IT architecture following the needs of the information system. This phase defines the technology design that will be built to meet the needs of the information system that has been designed. Input to this phase is the principles of IT architecture and the gap analysis phase C: Information Systems Architecture.

6. Phase E: Opportunities and Solutions

This phase produces solution patterns based on the analysis of the previous phases.

7. Conclusions and Suggestions

Conclude the discussion results and suggestions for further research.

This research was conducted at PKG to design an IT architecture based on TOGAF framework using a hermeneutic data processing methodology. Hermeneutics is an interpretive approach text translation, text analysis, reading text, and meaning of data, and especially about the meaning of text or analog text[7]. The discussion in this study was carried out by interpreting existing data in the company, such as data from IT department and other departments. Data source in this discussion also the results of interviews with key users from all departments in PKG.

3. RESULT AND DISCUSSON
Result

The proper enterprise architecture preparation for PKG is carried out in the following phases: preliminary phase, Phase A - architecture vision, Phase B - business architecture, Phase C - information system architecture, Phase D - technology architecture, and Phase E - opportunities and solution. The result is a pattern of the solution includes:

A. New Information System

Analysis of information systems architecture produces 6 new information systems. The 6 new information systems include:

1. Mining Control Center (MCC), a new module: plant management is a new development module from MCC that manages truck activity data. From these data it will be known the productivity of the truck, how many hours the truck is transporting, how many hours are damaged and how many hours standby. Then it can display the report desired by management to decide or to predict the truck's needs.

2. MCC, module: costing is a new development module from MCC that records data on coal production costs. The result of this application is to monitor whether or not the cost required for production is efficient, which in the future can be a prediction of production costs.

3. Project Management System is an information system for managing IT projects. This system will record the system development schedule so that it can monitor project schedules so that the project can be completed on time.

4. Improvement Management System, this system will manage company improvement data consisting of SS, QCC / P, PPS, and TEXT. At the moment each improvement is still recorded separately, it is hoped that this system can record everything so that reports are easily obtained with accurate data.

5. Excellence Business System, this system will record the problems that exist in the operational process of PKG and can provide notification to related parties so that it can be immediately followed up. Furthermore, it can become learning if the same problem occurs.

6. Document Management System, this system will manage PKG document data, especially for the Legal and External departments. The document will be recorded when it has to be updated and can be shared with other employees who need it.

B. Unification of Information Technology Platforms

Unification is done so that it is more efficient and easy in maintaining IT infrastructure. Unification is carried out on information technology platforms including integrating applications that have the same characteristics.

C. New Network Design

A new network needs to be built to connect the location of the port and office site. If both locations are connected, data obtained from the port can be sent directly to the head office or site office. Report waiting times can be real-time.

D. Mapping Architectural Design and Business Process Problems

The problems mentioned in the identification of problems can be given an IT solution as a result of the IT architecture design. The following is a mapping between IT design and problems that exist in the business process at PKG.

Table 1 IT Architecture Design

No	Problems	Design Results	Description
1.	Land contract documents that have not been integrated between the site and Head Office (HO).	Document Management System	This information system can be accessed by both the site and HO together.
2.	Waiting time to access coal data is needed by the Marketing Department.	Build a network that connects ports with office	The existence of this network will allow reports to be provided quickly so that a solution can be quickly found if there is the coal stock stored in the port is low.
3.	Demurrage is a penalty for ship waiting time.	Build a network that connects ports with office	Demurrage can occur because coal data is not updated quickly, making it hard to give accurate predictions.
4.	The coal hauling and coal transportation reports require more than 1 day.	Built a network that connects ports with office	Data at the port can be directly stored and accessed by the user, so the waiting time is reduced.
5.	There are 2 coal-stock databases, so the coal stock report has 2 versions, the version from the application and the version stored in Excel.	Project Management System	The existence of a project management system will help improve the quality of applications built so that the resulting data is more accurate.
6.	The quality of coal has not been recorded properly.	MCC-Quality	Build an information system that records coal quality, so that quality data is available and accurate. The quality of coal will affect the price of coal.

E. Mapping Architectural Design and Architectural Principles

Mapping of architectural designs and architectural principles is carried out to ascertain whether IT architecture designs are in accordance with architectural principles.

Table 2 Mapping Architectural Design and Architectural Principles

Evaluation	Architectu	Design Results

Area	re Principal	
Business	Ease of Access	Ease of access to operational data by building information systems that are easily accessed and build new networks to support information systems.
	Business Sustainability	Perform data backups and build Disaster Recovery Center (DRC).
	Integration between divisions	Build an Excellent Process System information system that records problems involving business processes. Change email service from PKG mail server to Google mail.
Application	Ease of use	Create information system that can manage project IT properly, so that users can easy to use the application.
	Open Standard	Developing information systems using standard programming languages.
	Automation	Build information systems that provide reports and dashboards that can be seen by management.
Data	Data an as Asset	Uses RAID 5 technology to store data and IT backups are performed daily by IT
	Availability	
	Reliable	Applications verify the data before the data enters the report.
	Secure	Install antivirus on every PC and firewall on the network.
Teknologi	Technology can be used together	Unification of information technology platforms
	Standard Technology	Using technology that has many references and can be supported by vendors.

Discussion

PKG is a company that is engaged in four business areas: coal mining, coal trading, mining contracting, and infrastructure. Coal mining operation started from land clearing, top soil remover, drilling and blasting, and removing overburden to reach coal. Then mining coal and transport it to stockpile. The PKG operational processes can be seen in Figure 3 and 4.
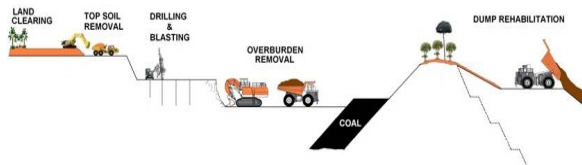

Figure 3 Coal Mining Operation 1

Figure 4 Coal Mining Operation 2

PKG has 4 locations that should be connected, namely the head office in Jakarta, site office, workshops, and ports in Muara Teweh, Central Kalimantan. Between the head office and the Site is connected to the internet network then the office is linked again to the workshop. At present, the port is not yet connected to another location because the network has not yet been built.

Enterprise architecture for PKG is carried out in the following phases:

Preliminary Phase
This phase defines the principles of IT architecture to be built, including:
a) Business Principles: Ease of Access, Business Sustainability and Integration between divisions
b) Application Principles: Ease of use, Open Standard, and Automation
c) Principles of Data: Data an as Asset, Availability, Reliable, and Secure
d) Technology Principles: Technology can be used together and with other standard technology

Phase A: Architecture Vision
The vision of the IT design architecture is IT architecture will be built such that it can support the PKG business strategy, so that achieving the company's vision and mission, and IT solutions will be designed that can overcome the problems that exist in the PKG business process.

Phase B: Business Architecture
The resulting business architecture from an analysis of the PKG business process is shown from organization function. The organizational function is divided into 2, namely the main function and supporting function.
Main functions of the organization, including Mining, Infrastructure, Contractor Services, and Trading. Mining has functions: geological mapping, drilling, making geomodeling, carrying out geological calculations, making mining plans, and making infrastructure plans. Infrastructure has functions: choosing a contractor; and caring for haul roads. Contractor Services have functions: move overburden (OB), mining coal, transporting coal, and managing coal storage. Trading has functions: managing coal sales, checking the legality of the sales contract, make an offer, reviewing contracts, and shipping coal.
Supporting functions include Finance & Asset, Accounting, Tax, Budget, Human Resources &

General Affairs (HRGA), IT, Improvement Management, Legal, Procurement, and External Relations & License. Finance & Asset has functions: manage finance data and manage company assets. Accounting has functions: manage accounting data. The tax has a function: manage corporate taxation. The budget has functions: manage budget data. HRGA has functions: managing employee data management company needs in general. IT has functions: managing information technology, manage IT infrastructure, and manage IT operations. SIM has functions: controlling SOP, IK, standard documents; and manage improvements made by employees. Internal Audit has functions: carry out internal audits. Legal has functions: manage matters relating to the law. Management Development has functions: monitoring company performance. Procurement has functions: managing the purchase of goods. External Relations & License has functions: manage to license, manage relationships with outsiders, and corporate social responsibility (CSR).

Phase C: Information Systems Architecture
This phase analyzes information systems that currently exist to determine the needs of any new information systems.

Table 3 Information System Architecture

No	Process Business	Information System
1.	Create mining plans and geomodeling	Minescape, Dashboard Management System
2.	Manage coal inventory data, manage coal quality data, manage coal temperature data	MCC module : inventory, quality, temperature
3.	Manage production cost data	MCC, module : costing (new)
4.	Perform hauling road and port maintenance	MCC, module : vehicle activity
5.	Manage coal transportation data, manage fuel consumption data	MCC, module: vehicle activity
6.	Manage truck repair data	MCC, module : plant management (new)
7.	Manage coal shipping data	MCC module : shipment
8.	Manage finance and asset data	ERP module : General Ledger, Bank, Account Receivable, Account Payable
9.	Manage accounting data	ERP module : General Ledger, Account Receivable, Account Payable
7.	Manage tax data	Pajak Indonesia
8.	Manage financial planning data	ERP module : General Ledger

9.	Manage employee data	HRIS
10.	Manage data extension list, manage meeting room bookings	Portal Intranet
11.	Manage IT asset data, manage to lend of IT tools, maintaining the network, recording downtime, and manage email	Service Desk IT
12.	Manage projects related to IT application development	Project Management System (new)
13.	Manage improvement data in the form of recording improvements, including: SS, QCC / P, PPS, and TEXT data.	Improvement Management System (new)
14.	Manage internal audit data on SOP, IK, Form and Standard documents	QMM System
15.	Manage Key Performance Indicator (KPI) data for all departments, record problems, and KPI progress	KPI Monitoring System
16.	Record the problems that occur at each point in the business process	Excellence Business System (new)
17.	Manage purchasing data	ERP module : Requisition and Purchase Order
18.	Manage contract and licensing documents	Document Management System (new)
19.	Manage land acquisition data and manage relationships with external parties	Document Management System (new)

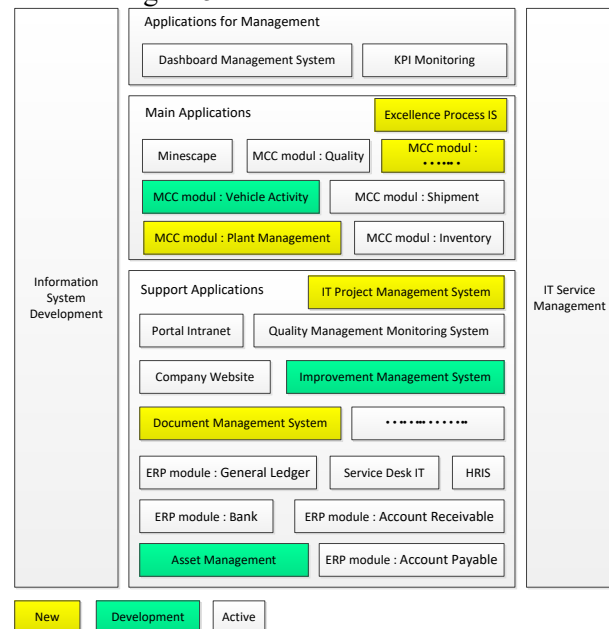The result of this phase is landscape application shown in figure 5.

Figure 5 Landscape Application

Phase D: Technology Architecture
This phase defines the design of the technology that will be built to meet the needs of the information system that has been designed. This

phase analyzes the technology needed for the IT architecture.

The proposed IT architecture is based on established architectural principles, namely: integration between divisions is to change e-mail servers to Google mail. Changes to Google are based on the downtime mail server records and the feasibility study conducted by PKG IT team. It is described by the IT taxonomy in figure 6.
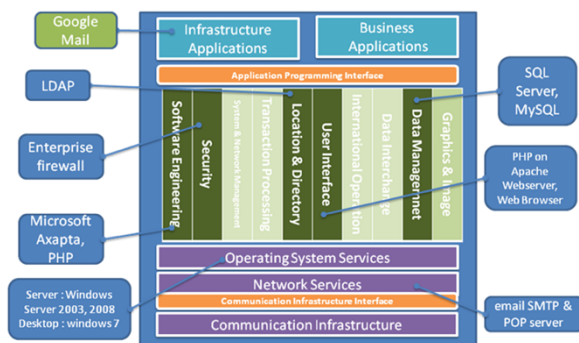

Figure 6 Information Technology Taxonomy

Based on the principle of architecture technology, namely: technology can be used together and standard technology, then technology unification is carried out which is a step to uniform technology so that it can be used together and easy to maintain. Platform unification is carried out by bringing together similar information technology platforms so that they are easy to maintain. The unification platform is shown in Figure 7.
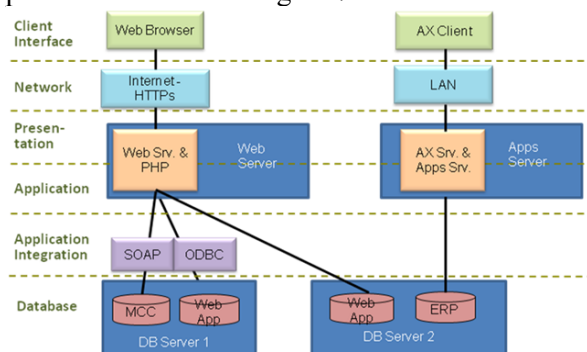

Figure 7 Information Technology Platform

The network at PKG connects HO with the Site using the Indosat network, but currently, there is no backup network, if a network down, data communication cannot be carried out. Currently, PKG does not have a Disaster Recovery Center (DRC), therefore based on architectural principles, namely: business continuity, it is proposed to build a DRC. The proposed network includes connecting the location of the port to the site office with a network tower, building a network backup, and building a DRC. The new network design is shown in Figure 8.
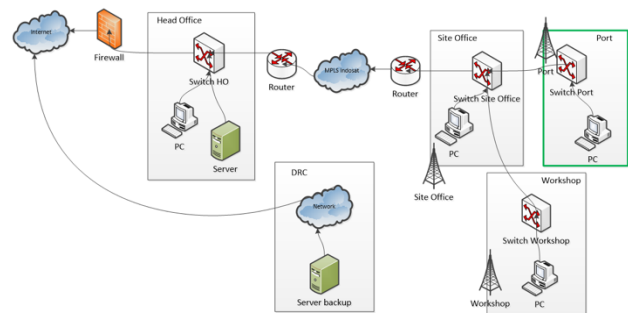

Figure 8 New Network Topology

Phase E: Opportunities & Solution
In this phase, the problems mentioned in the introduction are mapped with the results of the new IT architecture design.

Design results can be summarized as follows :
1. New Information System that needed by PKG
   - MCC, module: plant management
   - MCC, module: costing
   - Project Management System
   - Improvement Management System
   - Excellence Business System
   - Document Management System

2. Unification of the Information Technology PlatformThis unification converts the system from 7 servers into 6 servers.

3. New Network Topology Design
Create a connection of the port location and Site Office.

4. CONCLUSION
Based on the research, the information technology architecture that fits best with PKG'S requirements is as follows:

Business architecture in a clearly defined 4 main functions: mining, infrastructure, contractor service, and trading and produce supporting functions including finance & Assets, Accounting, Tax, Budget, HR, GA, IT, SIM, Internal Audit, legal, management development, procurement, and external relations & licenses. Functional decomposition diagrams are used to determine the IT architecture to be built. Information system architecture produces new information system proposals: Process IS, MCC Costing Module, MCC Plant Management Module, IT Project Management System, System Improvement Management, and Document Management

System. The new application is designed to meet the information needs in PKG.

Information system architecture also produces information systems that have been grouped (unification). With these groupings, it will be easier to maintain the existing technology architecture. This research also results in the design of a new network infrastructure connecting the port location with the site office. The new network will support the operation of PKG business processes.

The resulting solution patterns include new information systems, a unification of information technology platforms, and the design of new networks to support PKG business processes. IT architecture can be used to overcome the problems currently occurring in the organization's business processed, allowing the organization to achieve its vision and mission.

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