ENTERPRISE ARCHITECTURE APPROACHMENT FOR DESIGNING IT MASTER PLAN BASED ON ERP FOR WATER UTILITY COMPANY

JAM
17, 2
Received, December 2018
Revised, March 2019
April 2019
Mei 2019
Accepted, Mei 2019

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Abstract: A comprehensive planning document that is written in the IT Master Plan has the purpose of addressing the company's need and guiding the implementation process to minimize failure. But many IT master plan was not based on integrated and best practice adoption using ERP. The development of the IT master plan also does not use the proper enterprise architecture (EA) method. This research designed an IT master plan based on ERP using Enterprise Architecture approachment for water utility companies and adopt ERP best practice references model. The Enterprise Architecture's method was TOGAF ADM from a prelim phase, requirement management phase, vision architecture phase, business architecture phase, and information system architecture phase. This research gave the results of 23 system recommendations named IT Integrated Solution for water utility companies which consist of 10 integrated applications, 8 ERP modules, and 5 ERP Industry Solution-Utility (IS-U) modules. To get a comprehensive IT Master Plan based on ERP, the water company needs to pay attention to other stages of TOGAF ADM. There needs to be a study to be able to validate the IT Master Plan, which has been developed.

Keywords: Enterprise Architecture, *ERP*, Master Plan TI, Water Utility

Cite this article as: Fatimah, H. A., Irman H., and Yani N. 2019. *Enterprise Architecture Approachment For Designing It Master Plan Based On Erp For Water Utility Company*. Jurnal Aplikasi Manajemen, Volume 17, Number 2, Pages 336–344. Malang: Universitas Brawijaya. http://dx.doi.org/10.21776/ub.jam.2019.017.02.17

Journal of Applied Management (JAM)
Volume 17 Number 2, June 2019
Indexed in Google Scholar

Corresponding Author: Hilmi Azmi, Institut Pertanian Bogor, DOI: http://dx.doi.org/10.21776/ub.jam.2019.017.02.17

Water utility companies are responsible for serving their customers in providing water resources, processing testing the quality and make sure the water could be consumed, distribute water to customers' homes and help to help payment customers and other services (Carbo 2016). One of the efforts made by companies to support their business processes is by using information technology (IT). IT has an excellent opportunity to improve and strengthen the water governance process, such as creating better accountability, providing accessible and relevant information to reduce the risks, expand networks, and enable to knowledge sharing and develop partnerships between stakeholders (Finlay and Adera 2012).

Bogor water company has built several systems to implement IT in the company, consisting of customer information systems (CIS), employment information systems (EIS), accounting information

systems (AIS), and logistic information systems (LIS). With the existence of these systems, users have expectations that this system can be relied upon and become an enabler to achieve company goals, but in reality, the existing system is still under standard and inefficient to meet the demands of improving the quality and quantity of services. Bogor water company still tends to use a traditional approach in carrying out the essential functions of the company, so it takes a lot of time spent to obtain and verify data that causes data quality to be still minimalist. Therefore the company needs to improve the quality of its information system, by integrating all the functions of the company. Efforts to integrate all company functions are made by implementing Enterprise Resource Planning (ERP) (Karsak and Özogul 2009; Kazemi, *et al*., 2014). ERP is an information system that integrates all transaction processes and data from various departments of the company into a centralized database in real time (Magal and Word 2012).

ERP plays a significant role for companies, but often companies experience problems in implementing ERP (Rupèiæ, *et al*., 2018; Park and Park, 2015). Difficulties in ERP implementation are caused by a lack of comprehensive and holistic planning and guidance. Without a plan, company expenses for implementing ERP such as costs, time, and human resources will increase (Chofreh, *et al*., 2016). Therefore, there is a need for directed and comprehensive planning that contains the company's needs and the mechanism of system implementation (Djufri 2017) in the form of an IT master plan. The IT master plan could help companies to prevent and minimize problems, such as reducing time, cost, resources, and risks during IT implementation and also improving the quality of projects (Chofreh et al. 2016).

In composing an ERP-based IT master plan, it is necessary to use enterprise architecture (EA) approach as a way for ERP implementation to have a strategic impact for the company (Trinskjaer 2009). EA is a structural approachment of analysis, planning, and development of resources to create a relevant business environment of the company by prioritizing business and information technology (Trinskjaer 2009; Sasa and Krisper 2011; Clark, *et al*., 2012). EA has various frameworks (EAF), which are used as models and methodologies in developing EA. Rouhani, *et al*. (2013), conducted a popular EAF comparison and did an assessment based on three main aspects, namely conceptual, modeling, and process. Based on these comparisons, it was found that TOGAF had the highest accumulated value compared to other EAFs such as DoDAF, FEAF, EAP, and Gartner. TOGAF has the main elements that explain the stages of EA development; these elements are called the TOGAF Architecture Development Method (TOGAF ADM).

The SAP Enterprise Architecture Framework (EAF) is EAF, which refers to the TOGAF Architecture Developed Methodology (TOGAF ADM) (Ebsworth 2007; Sultanow, *et al*., 2016). SAP EAF and TOGAF ADM have similarities in the stages of the methodology (Kirby 2009). The thing that distinguishes between SAP EAF and TOGAF ADM is that SAP EAF has a business model reference best practice, which has often been used in the ERP implementation process for various world-class top companies. This is an advantage, compared to the use of other frameworks, especially in compiling a company's IT master plan based on ERP.

Edward, et al. (2014), developing an IT-based master plan is using the most popular EA framework, TOGAF ADM. Edward, *et al*. (2014), develop an IT master plan in the realm of government. Based on this research, the development of the IT master plan is still not based on ERP integration. Applications that are recommended in the IT master plan are still fragmented and have not yet proposed the integration between applications. As for Chofreh, *et al*. (2016), carried out the development of an S-ERP based master plan with three main parts, namely the roadmap, guidelines, and framework. The framework used by Chofreh, *et al*. (2018), based on literature studies and validated to various experts. But in developing the S-ERP master plan, Chofreh, *et al*. (2016, 2017, 2018), didn't use the EA approach and have not used ERP best practice reference models.

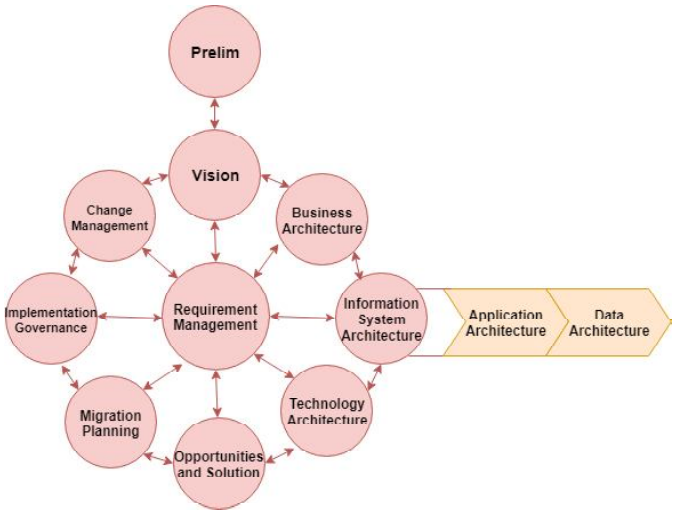

Figure 1 TOGAF ADM Phase

Table 1 Research Methodology (The Open Group 2011; Desfray 2014; Subowo 2015)

No	Steps	Objectives	Output
1	Prelim	Making a preparation of EA	The object of research, problem, and scope of EA
2	Requirement Management for Water Company	Understanding the business processes of water companies, exploring company needs	Primary Data: results of the recap of interviews with internal stakeholders Secondary Data: Company Procedures Operation Standard
3	Vision Architecture	Identify the vision and mission of water companies and stakeholders involved in the Bogor Water Company	Vision & mission and list of stakeholders of the Bogor Water Company
4	Designing Business Architecture	Identifying water company business processes based on the involved stakeholders and the ideal ERP business reference model for water utility companies than making gap analysis between business architecture now and the target business architecture	Bogor water company value chain and gap analysis table
5	Designing Application Architecture	Identify existing applications; understand ERP reference IT solutions for water utility companies, and provide ERP-based integrated IT solutions	ERP-based integrated IT solutions consisting of embedded applications and ERP modules
6	Designing Data Architecture	Identify what data entities are needed by water utility companies and relationships between entities	ERD conceptual level 0

This study uses EA as an approach to developing an ERP-based IT Master Plan for water utility companies with a case study of Bogor Water Company. The EAF used is TOGAF ADM starting from the prelim, requirement management, architectural vision phase, business architecture, application architecture, and data architecture.

METHOD

Requirement gathering was obtained before design IT Master Plan. Requirement gathering was held from March 2018 until August 2018 in Bogor water company. The data of requirement gathering contains primary data (interviews with represented stakeholders of the company and observation to the location) and secondary data (standard operating procedures of the company, organization's structure and IT Master Plan of Malang water company as references).

The design of the IT Master Plan is using the EA approach with TOGAF ADM as a research methodology. The Open Group (2011) define TOGAF ADM into several phases, as seen in Figure 1. conducted through various stages presented in Table 1.

RESULT AND DISCUSSION

Prelim

This Phase identifies XYZ water utility company as the object of this research. The initial problem is there still hasn't a proper and comprehensive IT master plan based on ERP, especially for water utility industries. The scope of EA in this research is from the prelim phase until data architecture on information system architecture.

Vision Architecture Phase

The steps taken at this phase are identifying the company's vision & mission and identifying stakeholders along with their roles and responsibilities in carrying out the company's vision and mission. The vision of Drinking Water Company XYZ is a leading company in the field of drinking water services. The mission carried out is to provide satisfactory drinking water service to the community by existing health standards by considering the affordability of the community and playing a role as supporting regional autonomy and maximizing human resources to the maximum. In carrying out its vision and mission, the company will involve stakeholders who have different parts and cooperate. The stakeholders involved can be seen in Figure 2.

Business Architecture Phase

In this phase, it will explain how the business process of PT XYZ water companies is based on business processes carried out by the stakeholders involved — after describing the current business process, then referring to the reference of SAP business processes of water utility companies to compile a value chain that can be seen in Figure 3. The water company value chain consists of 3 primary activities and 5 secondary activities. Based on the value chain and the review of the business process of the XYZ water company, gap analysis between current business conditions and the target business conditions was then carried out. The description of a gap analysis of business architecture can be seen in Table 2. Figure 3 Value Chain Water Utility Company

Figure 2 Stakeholder Water Utility Company XYZ

Table 2 Gap Analysis for Business Water Utility Company

Current Business Architecture	Gap Analysis	Target Business Architecture
Making various reports is still often late	• The workforce is still manual • Data that is interdependent between departments so that the completion of reports is still waiting for each other	Report generation is easy, fast and results
Employees who work in the field must always come to the office for attendance and input work results	• The attendance process is still manual and rigid·There is no facility for field workers to be able to input work in the field remotely	Employees who work in the area can know their daily tasks and do not need to come to the office every day
The Information Technology Section is under the auspices of the Department of the Secretariat	• Awareness of the importance of IT is still low· The absence of IT leaders who have authority so that IT is less developed • The Secretariat Department that oversees the IT department does not understand the ins and outs of IT	The establishment of an independent IT Department that has an IT Director
The tendency of employee resistance to make changes	• Lack of employee skills training • Lack of employee awareness	Employees are ready to experience change towards better

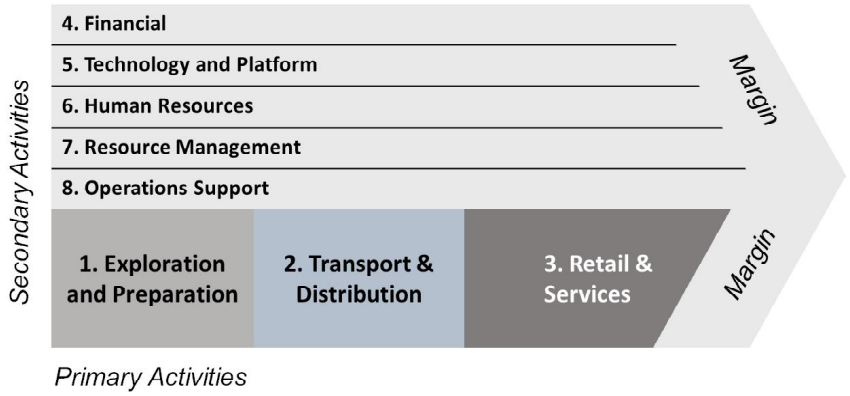

Figure 3 Value Chain Water Utility Company

Application Architecture Phase

The Application Architecture phase produces IT recommendations for water utility companies named IT Integrated Solution (Figure 4). IT Integrated Solution was composed based on the results of the identification of business process the XYZ company, SAP reference solutions for a utility company, value chain, Functional Decomposition Diagram and SAP Hana IT Solutions for utility company (Silvas 2015).

IT Integrated Solution is recommended to use technology that integrates all business functions of the company into one centralized database. The existence of this integration is expected transaction data and company information to be more accurate, without redundancy and can assist in making

decisions for the board of directors. IT Integrated Solution consists of 23 solutions in the form of 10 integrated applications, eight general ERP modules, and 5 ERP IS-U modules. Information about IT Integrated Solution for Water Utility Company can be seen in Table 3.

Table 3 IT Integrated Solutions Details

System Code	System Name	Descriptions
SCADA	Supervisory Control and Data Acquisition	Monitoring the process of producing and distributing drinking water (including discharge, quality, and water pressure) so that it helps in the "Early Warning System" of its distribution.
GIS	Geographic Information System	Record and display a map of the customer's home location, noting the design of the route of the water pipeline.
SPR	Reservoir Air Recording System	Note the water pressure level, the water discharge in the pipe and its movement can be observed and analyzed from the center.
AMI	Advanced Meter Infrastructure	Record meters automatically and periodically. Then the measurement data will be sent automatically to the customer's gadget or the company server.
CRM	Customer Relationship Management	Providing the latest information to customers personally, whether related to repairs, disruptions, or bill fee promos. CRM is intended to keep customers comfortable subscribing.
OC	Omni Channel	Omni Channel is a web-based information system and an android that connects the information to customers. Customers can use the Omnichannel as a means of submitting services and getting the latest info regarding services.
SSP	Strategic Sourcing Procurement	Strategic Sourcing Procurement is a system that connects companies with suppliers. Companies can procure online and open to all potential suppliers so that the transaction process is transparent.
e-Office	e-Office	As an archive repository and correspondence facilities electronically to speed up the processing
BI	Business Intelligent	Helps make decisions regarding water usage, the number of customers, percentage of water leak per month, company profits, and other information.
Lab-IS	Laboratorium Information System	Record historical data from lab tests regarding water quality, and facilitate analysis and improve the quality of the water tested.
FI	Finance Accounting	Handling the bookkeeping process, accounts payable, cash, banks, fees
CO	Controlling	Control financial related processes
MM	Material Management	Handle the procurement process
SD	Sales and Distribution	Handling the sales process and managing the delivery of goods to customers
PM	Plant Maintenance	Handle the maintenance process
PS	Project System	Optimizing all project business processes, from planning, scheduling,

System Code	System Name	Descriptions
HR	Human Resource	Handle attendance, payroll, recruitment, performance, training, etc.
QM	Quality Management	Helps monitor the quality of processes throughout the logistics chain.
DM	Device Management	Set the Installation, Removal, Replacement, Certification, and Meter Reading processes.
Billing	Billing and Invoicing	Manage the billing process for customers.
WM	Work Management	Take care of all activities along with notice of work in the field.
CS	Customer Service	Take care of all process of the *front office*, like *Creation of New Accounts*, *Closing Accounts*, *Changing Billing Plans*, *Move-in*, and *Move-outs.*
FI-CA	Contract Accounts Receivable and Payable	The function of receiving payments from customers and arranging payments to vendors or suppliers.

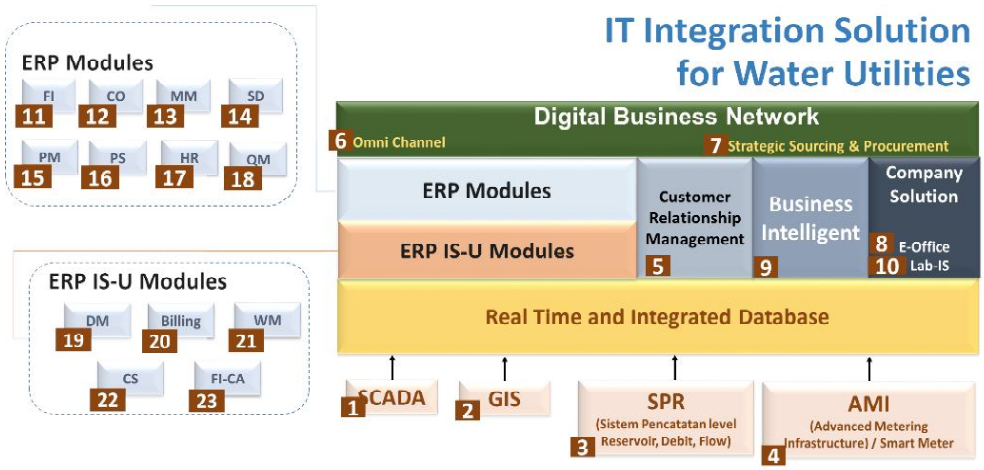

Figure 4 IT Integrated Solution for Water Utility Company

Data Architecture Phase

After designing the application architecture, it is necessary to create a data architecture to find out what data is involved in the application. Because EA is created based on ERP, at this stage, it is necessary to identify what data is required in the ERP module that has been recommended in the previous phase. The data entities that havebeen identified are then made conceptual ERD which can be seen in Figure

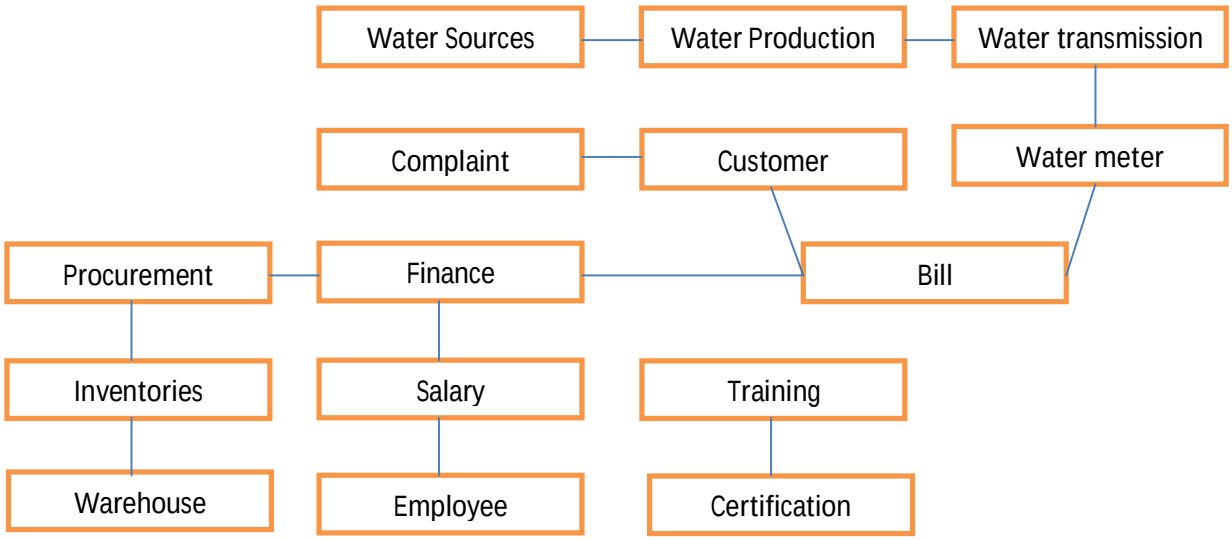

Figure 5 ERD Conceptual

CONCLUSIONS AND RECOMENDATIONS

Conclusions

An ERP-based IT master plan has been developed using the Enterprise Architecture approach with Preliminary stages, Vision Architecture, Business Architecture, Application Architecture, and Data Architecture. The IT master plan development resulted in 23 integrated ERP-based solutions consisting of 10 applications, eight general ERP modules, and 5 ERP IS-U modules.

Recomendations

This study has limitations, namely developing the IT Master Plan only until the development phase of Data Architecture. There are still stages of Technology Architecture, Opportunity and Solution, Migration Planning, Implementation Governance, and Change Management. Need to pay attention to other phases so that the IT Master Plan can be implemented in a water utility company. There needs to be a study to be able to validate the IT Master Plan that has been developed.

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