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Implementation of Governance in the Treated Water Industry using the Enterprise Architecture Framework

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Abstract: Today, the development of information technology is very sophisticated in supporting the company's operations. It is undeniable that all companies take advantage of this technology, starting from service to customers to the company's internal operations. Water utility companies basically process raw water into clean water that is ready to be used for household purposes, industrial purposes, offices, and many other uses. Therefore, the processing industry is very much needed by the community. Moreover, it is state tax revenue in the non-oil and gas sector. Therefore, information technology is very necessary for controlling and operating at this water treatment company. Before implementing an information system or an ongoing information system, a guide is needed for implementing the system. All aspects of information technology that support the company's business serve as input in building an integrated system. Business process trimming is needed in order to build better performance. In terms of implementing enterprise architecture, the chosen framework is The Open Group Architecture Framework. while the method chosen is the Architecture Development Method. The purpose of this research is to apply an enterprise architecture to a water treatment company to produce a blueprint and an IT roadmap within five years to provide the best service for customers. The focus of the discussion on Governance Implementation in this company's system uses Waterfall-based Project Management. By combining the TOGAF ADM Framework in the domains of Architecture Change Management, Implementation Governance, and Migration Planning with the Project Management Body of Knowledge Method, it produces new methods that complement each other.

Keywords: Architecture Development Method; Enterprise Architecture; IT Roadmap; The Open Group Architecture Framework; Treated Water Industry

INTRODUCTION

The need for clean water for urban communities is very important in everyday life. The government is very concerned about meeting the community's need for clean water (Ahmed, 2020). This prompted the government to establish business entities that provide clean water. In addition, for urban communities, especially Jakarta, it is better to use clean water by not taking ground water. If many people use groundwater for daily activities, it can cause disaster. The disaster in question is the subsidence of the ground level. So that the land is lower than the sea, which results in tidal flooding and the longer the land is waterlogged and sinks. This awareness is not only for the government, but also for the community to be successful in using clean water from companies established by the government. This is what makes the current challenge regarding the use of clean water for the community.

Treated Water Industry is here to meet the needs of the community who use clean water (Xu et al., 2022). This company processes raw water from various rivers in the eastern and western regions. Precisely outside the city. In addition, this company is implementing Digital Transformation (Raza et al., 2023) by trying to change old business processes into new business processes. Where the benefits of implementing a new business process can benefit the company, the government and the people who use clean water services.

There are several factors that this company is not fast in carrying out digital transformation (Gasco-Hernandez et al., 2022). One of them is the problem of corporate culture, where staff from the company try to maintain daily operations. In this situation, management should have the principle to change the old business processes and replace them with new business processes. Digital transformation does not only replace new application systems, new technologies, but is followed by changes to new business processes that are more efficient and effective in accordance with the implementation of the TOGAF Framework-based Enterprise

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Architecture. The purpose of this research is to develop an Enterprise Architecture for a Treated Water company. With this goal, it is hoped that the company will quickly carry out Digital Transformation. So that it can provide benefits to companies, governments and communities as users of clean water. In this research there are research questions that will be discussed in the research sections:
Research Question 1, What framework will be used in this research?
Research Question 2, which Domain Enterprise Architecture will be focused on in this research?
Research Question 3, Can the Project Management and Enterprise Architecture methods be combined in carrying out System and Technology Implementation in Water Treated companies?

LITERATURE REVIEW

There are many studies that have discussed enterprise architecture. These studies have many advantages and disadvantages in discussing the enterprise architecture (EA). Several studies have focused on discussing several domains in the Enterprise Architecture (EA) framework. The following are studies related to the Enterprise Architecture Framework.

Enterprise Architecture Design in the Field of Agroforestry Using the Togaf 9.1 Adm Method (Almunadia et al., 2019), this research discusses the preliminary phase, architecture vision, business architecture, and information system architecture. This research involves doing the design using Modelio 3.7.1 tools. The tool already uses the TOGAF Architect module. The research weakness is that it does not cover any of the other nine TOGAF domains. Domain Technology Architecture, Opportunities and Solutions, Migration Planning, Implementation Governance, and Architecture Change Management have not been discussed.

Enterprise Architecture Design of SPBE (e-Goverment) Services in Sukabumi district government (Wulandari et al., 2021), this research discusses the Preliminary Phase, Architecture Vision, and Service Architecture. The weakness of this research is that it is not discussing other domains of enterprise architecture. Domain Technology Architecture, Opportunities and Solutions, Migration Planning, Implementation Governance, and Architecture Change Management have not been discussed.

System Architecture and Information Technology Design using TOGAF ADM (Case Study of the Balikpapan City Transportation Service) (Ardiansyah et al., 2019). This research discusses preliminary and architecture vision, business architecture, data architecture, application architecture, technology architecture, opportunities, and solutions. The weakness of this research is that it has not discussed migration planning, implementation governance, and architecture change management.

Sustainability of Implementing Enterprise Architecture in the Solar Power Generation Manufacturing Industry (Hindarto et al., 2021). This research discusses Enterprise Architecture in Solar Power Generation Manufacturing companies and also discusses all domains in TOGAF, although the explanation is not very detailed. However, the weakness of this research is that it does not fully discuss all TOGAF domains.

Enterprise Resource Planning Study in the Bamboo Processing Manufacturing Industry using Enterprise Architecture (Oroh et al., 2022). This research is on a company processing bamboo into processed wood using Enterprise Architecture. The weakness of this research is that it does not discuss in more detail migration planning, implementation governance, and architecture change management.

None of the previous research that has discussed Enterprise Architecture has discussed in more detail the domains of migration planning, implementation governance, and architecture change management. There is a **Gap** in previous research where the three domains (domain migration planning, implementation governance, and architecture change management) are not discussed in detail. The **State-of-the-Art** research discusses the domains of migration planning, implementation governance, and architecture change management from the TOGAF Framework and links it to discussions on Project Management. Because the focus of this research complements the weaknesses of previous research and there is a relationship with the Waterfall-based Project Management method. So that this research produces **Novelty**, which combines Enterprise Architecture which is conceptually or IT Blueprint and executes application systems, information or data and architectural technology into corporate information systems..

METHOD

This research uses the TOGAF Framework approach with the Project Management Method. Especially in the domain of Change Management, Migration Planning and Implementation Governance. The three TOGAF areas are closely related to the Scope of Work, Time and Cost of the Project. Management, this is what encourages researchers to combine the work processes of the two framework methods. Water-treated companies in carrying out daily operations use standard operating procedures. So in implementing the new system must make the right selection. The right choice is Waterfall-based project management. But in the waterfall management project, it is necessary to add an Agile element in carrying out the implementation. Finally, the project management used also combines Waterfall-based and Agile-based project management. Not all Agile or Scrum methods are used, but only some of them. It is hoped that later in the implementation of completing the water-treated system it will be faster and better.

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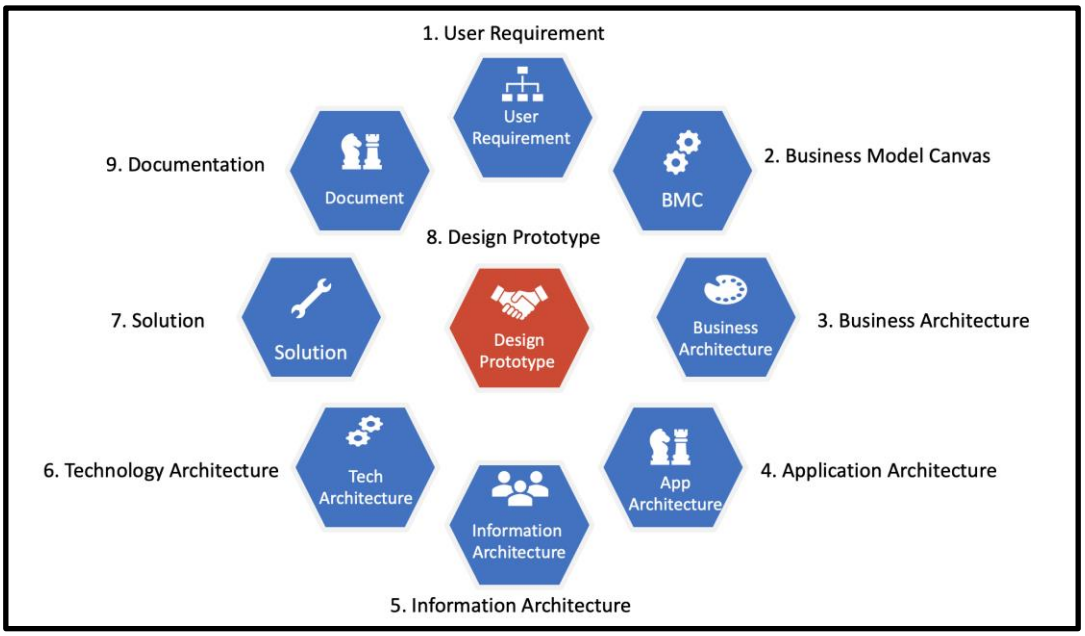

Fig 1. Method Proposed
Source: Researcher Property

On fig 1 depicts the recommended research technique. This study is divided into nine pieces. The nine components of the suggested technique are explained in detail below.

User Requirement

User Requirement, this is the first step of developing a company's information system, once all requirements are included in the ultimate strategy for the system to be accomplished. This chapter is crucial since planning is incorporated inside the system that will be planned. One technique for solving customers' requirements for the system to be created is an analysis. The following step is to record the user requirements. The next step is to examine customers' requirements and compare them to those of the system to be constructed. This stage prevents user needs from being duplicated with the system to be implemented (Thomas, 2021), (Lavalle et al., 2021), (Kifetew et al., 2021).

In the preparation of user requirements, accuracy should be required. If the user requirements are not complete, then the side effects of creating the system will feel less than perfect. So in testing with the user, there must be a lot of changes, because the user does not feel involved. The user requirements document will be used as input for the Business Model Canvas (BMC) process. The BMC document is a mapping of the company's business processes. The business process canvas also aids in the execution of an enterprise process's lean production system (Moshood et al., 2022).

Business Model Canvas

The Business Model Canvas is a tool that functions as a way to visually represent ideas, consumers, customers and finances in the form of components. In running a business, a management strategy is needed to achieve goals. In the business model canvas there are nine components to achieve the goal. These components are Key Partners, Key Activities, Value Proposition, Customer Relationships, Key Resources, Channels, Cost Structure, Revenue Streams, and Customer Segments.

Key activities in this company are water production, water distribution to customers, some are used for social activities or non-revenue water, complaint handling. Revenue Streams include sales and customer tariff structures. Channels include piping network, laboratory, fully controlled isolated area - metered, pressurized supply, water tank truck. Cost Structure includes Water production, Plant Maintenance, Network pipe maintenance, application and data comms, technology upgrade, human resources, asset Insurance, network pipe development. Key Partners include partners, local governance, customers, insurance, suppliers (chemical factory, raw water), application providers, pipes & accessories. In table 1, table 2, and table 3 is a complete explanation that discusses the Business Model Canvas for Water Treated companies for the provision of clean water in Jakarta.

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Table 1 Business Model Canvas (BMC)
Source: Researcher Property

Key Partners	Key Activities	Key Resource
Pertners	Water distribution	Asset Assessment
Local Government	Water production	Human resource skills
Customer	Non Revenue Water	Network Design
Insurance	Complaint Handling	Technology assist for operational and decision support
Suppliers Chemical Factory		
Raw Water - xxx	Channels	Revenue Streams
Raw Water yyy	Piping networks	Sales
Electricity -xyz	Laboratory	Cust. Tariff Structure
Data Comm Provider	Pressurized supply	
Application Provider	Water tank truck	
Pipe & Accessories Manufacture	Fully controlled isolated area - metered	

Table 2 Business Model Canvas (BMC)
Source: Researcher Property

Customer Segments	Value Propostition
Institutions	Water delivery based on Government
- who need water to support their activities	Continuity water delivery – 24/7
Business organization	Quantity water delivery based on delivery
- who need water to support the production process and its product	Edequate hydrolic pressure (7 meter) at delivery point
People - who need water to support their live and daily activities	The best service for people of DKI Jakarta (Government)

Table 3 Business Model Canvas (BMC)
Source: Researcher Property

Customer Relationship	Cost Structure
Customer:	Water production
consuming healithy water refers to health standards	Plant Maintenance
water availability at any time	Network (pipe) maintennace
any locations and any quantities	Technology upgrade
Producer:	Application and Data Comms
quick response on Water Deliveri's Complaint	Asset Insurance
	Network (pipe) development
	Human Resources

Business Architecture

Business Architecture in this research is a method that contains information on company strategy, information system governance, and how to adapt in carrying out the goals of the company. The strategy for implementing an information system is by planning before developing an information system. The company's strategy is to fulfill services to customers, fulfill services from the company's internal (back office). From the company's internal services and external services, it is very much if the company is going to implement or carry out the company's digital transformation. This requires a lot of resources to fulfill the services that will be repaired. Maybe in terms of strategy it is very possible for the company to get customers or increase the market. Because after a change in customer service and making it easier for customers to perform services such as customer complaints can be responded to and resolved quickly. Make payments for the use of clean water at a price that is not too expensive. This is what can increase customer loyalty. From the internal side of the company, with a good back office service change strategy, employee productivity will increase, because work has been done with automation, which is fast and easy. Therefore in achieving company goals, a strategy is needed.

Information system governance in every stage of user requirements, development stage, system testing stage to user acceptance, implementation stage to become an application system. In collecting user requirements, it needs to be done as completely as possible. User needs are analyzed so that later they can become the right information. Not all user needs are met, because the selection of user needs depends on the urgency of the user.

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Given that in meeting user needs, resources are needed in developing the system. The use of resources must also be calculated according to the time of development, testing and user acceptance testing and implementation into the information system.

After the strategy and governance stages have been carried out, the company will adapt to the new system. These changes need to be made standard operating procedures as a guide in running the new information system. Customers with new information systems also adapt to these changes. Therefore, with the existence of digital transformation, a company can carry out operations quickly and it is expected that productivity will also experience a significant increase in terms of work results and until profits continue to increase. Adaptations are made so that the sustainability of the company's operations can last longer. The sustainability of the company's operations is also supported by the sustainability of the company's information system.

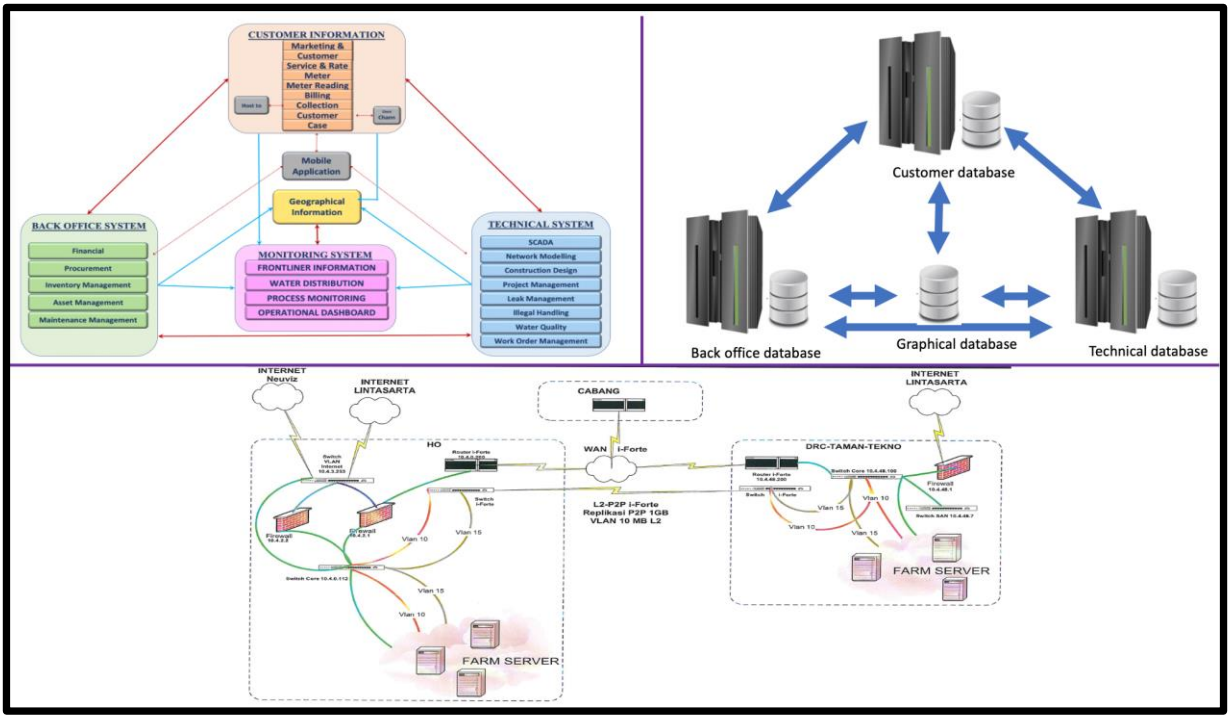

Fig 2. Application Architecture, Database Architecture, and Technology Architecture
Source: Researcher Property

Fig. 2 regarding Application Architecture, Database Architecture, and Technology Architecture will be discussed in more detail in the next section. These three pillars are a very important part in the development of digital systems.

Application Architecture

On fig. 3 the design of the company consists of five large application system clusters, where the three can be interconnected between application systems. Where the integration of each application system becomes a must and makes the information system usable the most important tool. The five clusters are as follows: customer information cluster includes Customer Information, Back-Office System, Technical System, Monitoring System, Geographic Information System, Mobile Application.

This Customer Information system consists of Marketing & Customer which is part of a system or marketing tools. This marketing system must be done as well as possible because it is related to company income. Service & Rate Meter is a system that is used to use clean water from customers. Meter Reading is a system that is used to read water discharge based on a cubic meter. Billing application is an application for billing to customers and this system is income for the company. Collection Customer Case is an application system related to services to handle customers, such as customer complaint services, customer loyalty management and others.

The Back-Office System consists of a Financial system that is used to manage financial management. Procurement is a system for purchasing goods which will later be related to vendors and the goods purchased will enter the inventory system. Inventory Management is a management system for incoming and outgoing goods. Asset Management is a tool used in managing, registering company assets. And perform asset maintenance. Maintenance Management is a system used to repair pumping machines, pipes in the network and

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others. This is done to extend the use of a machine. The Technical System is a system that is used to carry out data collection related to technical matters such as technician activities in repairing engines, pumps and other equipment. The performance of technicians can be seen or monitored from the system.

Monitoring System consists of Frontliner Information, Water Distribution, Process Monitoring, Operational Dashboard. These systems are included as part of monitoring and all are collected into the Dashboard management system.

Geographic Information System, functions as an information system for the mapping needs of existing pipelines, between production, water distribution to pipelines, from water distribution to customer pipes. Now there is information whether the system has a water leak in the middle of the road. The leak can reduce the company's profit.

Mobile Application is a system used by customers to obtain billing information and at the same time customers can make bill payments. Customers can take advantage of the mobile application as a payment for bills provided by the company. Besides that, customers can also register for new customer service.

Information Architecture

Information Architecture is used as a tool for storing data into the database system. There are three large clusters, namely the back-office database, technical database and customer database. The database already has to think about database backups, because if a problem occurs, the database must quickly recover quickly. Data recovery is used to deal with data that has been deleted or data that has been lost due to damage by the application system or database itself. In database server design, good infrastructure is needed where the process of creating a database, if a problem occurs, the database can recover quickly without problems. The database needs to be made of good security, so that the database is not vulnerable to sql-injection, where the security of the database system must be strengthened. Must be the greatest of viruses and malware. Any malware (Hindarto & Handri Santoso, 2021), (Hindarto, 2022) must be free from all existing systems. Malware protection and detection can be done with an anti-malware system.

Technology Architecture

Architectural technology is useful for designing from the infrastructure side so that system performance becomes fast. Fatal due to not paying attention to the performance of the hardware or infrastructure of the system. Hardware specifications must be considered, such as server selection is also very important. The use of cloud computing should have started to be considered to improve infrastructure performance. In this company architecture technology uses various kinds of devices, such as server devices, switches, routers, wifi, cabling, rack servers, and security devices such as intrusion detection systems, intrusion prevention systems, system information event management, security orchestration automation and response.

Solution

This solution (Qeliaja et al., 2019), (Marius & Alexandru, 2007) is a recommendation for management to carry out planning of Information Systems and Technology in clean water service companies. The company has implemented an information system without using proper planning. Before carrying out system repairs or adding to the system, planning must be carried out using the Enterprise Architecture Framework, where later changes can be made correctly according to the standards of the framework used. The goal is between business and information technology to work well. Discussion about the company's business already exists in the business architecture, where later the business architecture can adapt to the company's business architecture. The company also carries out digital transformation by changing all standard operating procedures that are not optimal, changes are made according to current conditions. Therefore change management and all of that is carried out in accordance with the TOGAF Framework in the Architecture Change Management domain. This includes migrating from an old system to a new system, but it is better if migrating to a new application system does not create bridging applications that make the system run slower. This is one of the biggest mistakes of companies that carry out digital transformation partially. Incomplete digital transformation, causing companies to incur large costs. The large cost is due to the creation of an intermediary program or bridging program. In carrying out the governance implementation stage, combining it with the Waterfall-based Project Management method. The waterfall method was chosen because this company still uses the company's Standard Operational Procedure.

Design Prototype

Information system prototypes really need to be done where the prototype is an imperfect information system model. From this prototype, if additions or modifications are made, it can be easily carried out. Many software tools are provided for free or paid. So that with these tools the design of a prototype or mockup can speed up the development of application systems. On fig. 3 is an example of a prototype that will be developed

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by the IT department and in collaboration with a third party. An example of a dashboard for monitoring technicians. The top right is an example of a geographic information system that is used to monitor pipelines in the Jakarta area. The lower left is an example of a water distribution monitoring prototype. There are graphs for the flow from various customer points. The bottom right is a prototype display for data entry. It can be seen that the prototype already represents the application architecture development. By displaying the prototype, management already has an overview of the application system that will be implemented throughout the company.

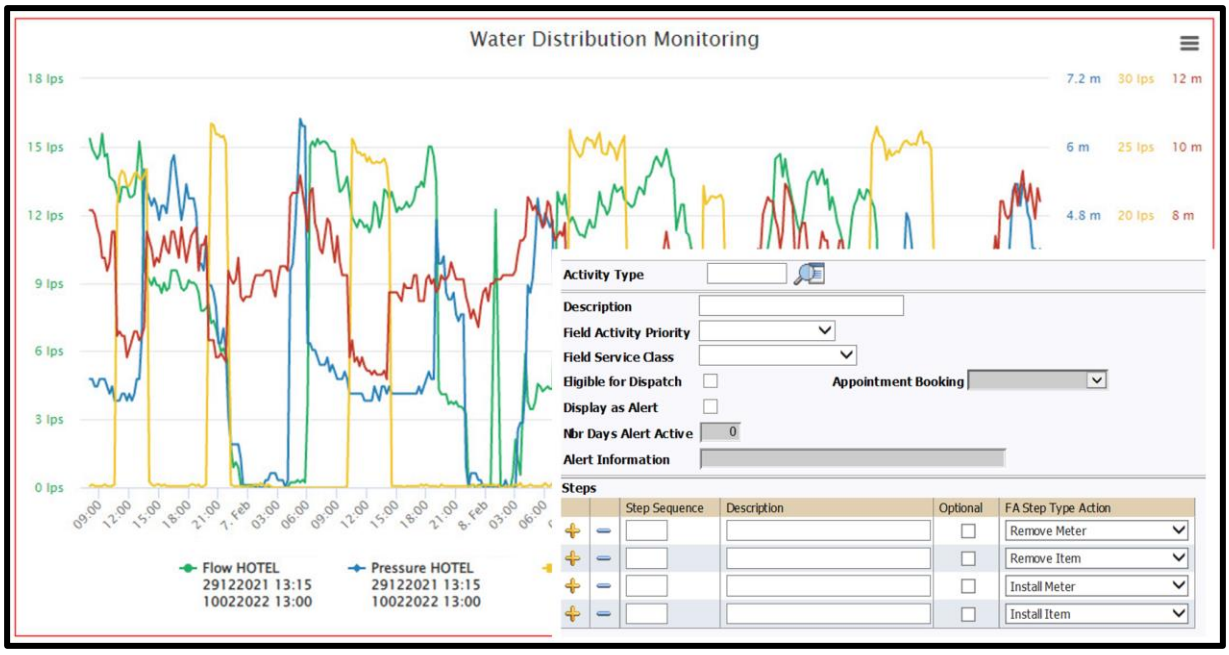

Fig 3. Prototype for the application system to be developed
Source: Researcher Property

Documentation

All activities in creating a system, it is better to use documentation as part of the process of making the Enterprise Architecture framework. Documentation has a very important role, because this documentation can be used as a reference for operations if there are problems, application system development and resolution. Companies cannot ignore documentation, and proper documentation starts from the time the system is being designed or even the system is being carried out in its early stages. User requirements, making architectural applications, architectural information, architectural technology, testing, user acceptance, system implementation, to system maintenance. The more complete the documentation, the more application system developers, application system operators to the audit system will use it as reference material for both technical and operational users. Documentation must be revised frequently so that the results of problem findings will later complement the application system.

Project Management

This research proposes a method proposed to water utility companies. This research is a concept-based research in presenting enterprise architecture and project management methods. Project is an activity that has a scope of work and has a certain time to achieve the goal. Management means managing the project that will be delivered to stakeholders. There are various kinds of project management, such as Waterfall-based project management, Agile-based project management and many other existing project management. There are project management that have international standards such as the Project Management Institute, Project Management, Project Management Agile, Project Management Scrum, and Project PRINCE2. The PRINCE2 (Matos & Lopes, 2013) method is a process-based method for project management to produce effective performance, and success in managing project-based activities.

Prince means Project IN Controlled Environments, worldwide usage and success in managing activities or projects. PMI/PMBOK (Brioso, 2015) stands for Project Management Institute/Project Management Body of Knowledge. The Project Management Institute (Takagi & Varajão, 2019) is a project management which discusses Project Scope, Project Time, Project Communication, Project Procurement, Project Cost and

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Budgeting, Project Human Resources, Project Quality, Project Risk. Meanwhile, PRINCE2 Project Management discusses Project Assurance, Project Support, PRINCE2 Scope, Controlling Change.

The discussion in this research uses project management based on the Project Management Institute or the Project Management Body of Knowledge. Which is focused on the discussion on the domain Scope, Time, Quality and Cost Budgeting.

RESULT

Project management in research is used for Enterprise Architecture which focuses on the Architecture Change Management, Implementation Governance, and Migration Planning domains. Project Management is focused on Project Scope, Project Time, Project Quality. Architecture Change Management in making changes will produce a scope of work. The scope of work will produce several requirements which means it will change or add new features that are tailored to the needs of the company or stakeholders. Of course the scope of work, translated in project management is the project scope, and translated into Work Breakdown Structure.

Implementation Governance (Ansyori et al., 2018), (Nikpay et al., 2017) is translated into implementing application systems. In implementing the system takes time to implement. So that the implementation governance will use Project Time from the Project Management method based on the Project Management Body of Knowledge (PMBOK). Project time can be seen in fig. 4 which explains all the scope of work is made into Work Berakdown Structure and produces a Gantt Chart which aims to display the stages of completion of the scope of work.

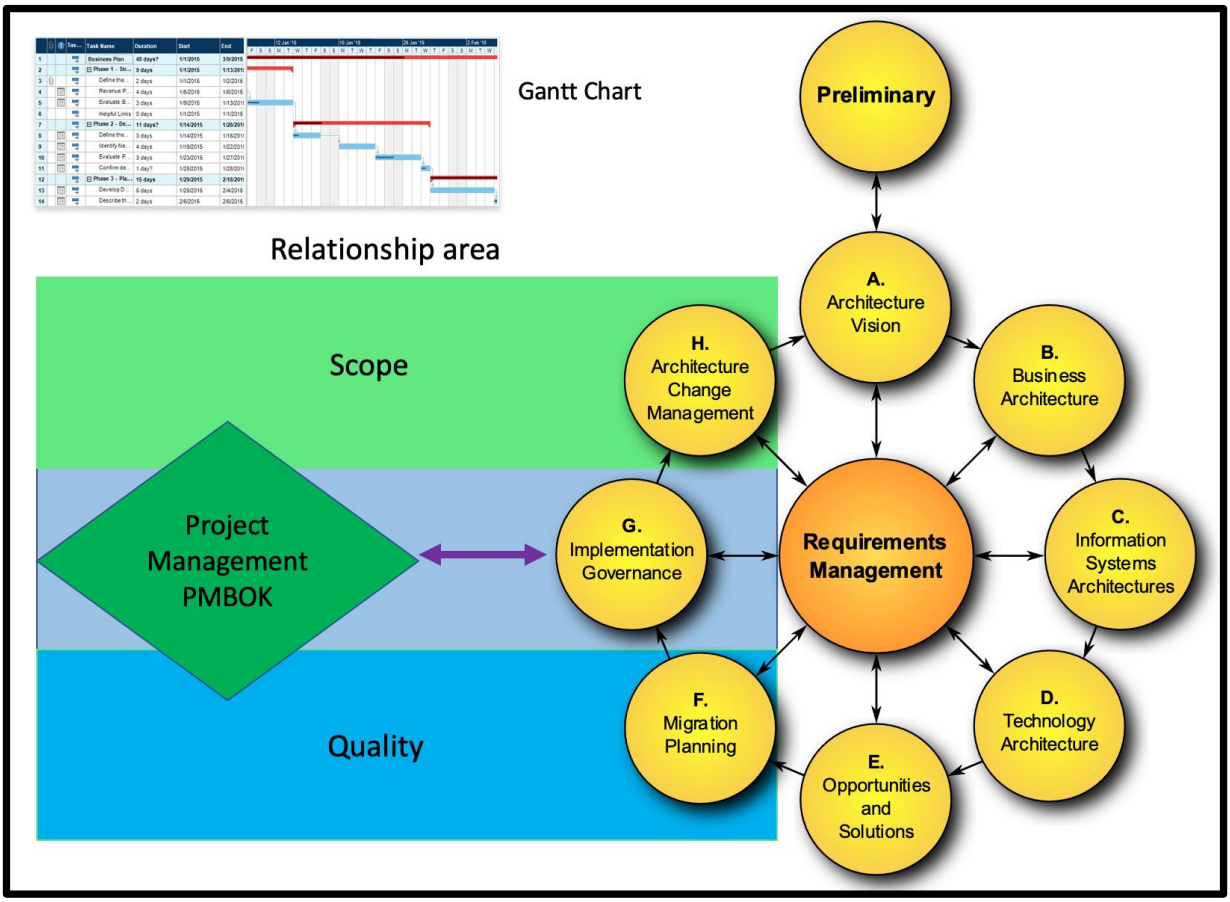

Fig 4. Relationship Area for Project Management PMBOK and TOGAF Framework
Source: Researcher Property

Migration Planning is the stage of changing or adding new features, changing or adding new application systems. In fig 5, after implementing new systems, how to implement them into the server infrastructure. Migration planning is a plan to migrate a new system and not affect existing old systems. This requires good quality in the development of new systems. In project management, it is necessary to ensure a new quality system and what is more important is to mitigate risk if a problem occurs. If a problem occurs, then the roll-back process is carried out, returning the system to its original state before the new system migration step was carried out.

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DISCUSSIONS

Research Question 1, What framework will be used in this research? This research has discussed the Framework used in Enterprise Architecture with the TOGAF Framework. The reason for using the TOGAF Framework is because this Framework is open source and is a common or trending topic in using this method. Can be used for government, and private companies, both on a small, medium, and large business scale. The framework used is open source which does not require a license to implement the TOGAF Framework.

Research Question 2, which Domain Enterprise Architecture will be focused on in this research? In TOGAF, the focus is on Architecture Change Management, Implementation Governance, and Migration Planning. Because these three domains are mapped into PMBOK-based Project Management, they are very appropriate for Project Scope, Project Time, Project Quality and Project Cost budget. The combination of these two methods produces complete documentation and if implemented, the correct and complete method will be obtained.

Research Question 3, Can the Project Management and Enterprise Architecture methods be combined in carrying out System and Technology Implementation in Water Treated companies? Discussions regarding the combination of project management with the TOGAF framework have been discussed and indeed the two methods are suitable and complementary.

CONCLUSION

The two methods can be combined to produce complementary documentation. But the most important thing is in implementing enterprise architecture in water treated companies equipped with project management. Action in implementing an application system that has been planned with enterprise architecture can be more realistic using project management, including steps for completion if it is implemented into the company's infrastructure. Broadly speaking, Enterprise Architecture is towards the concept and project management in terms of its implementation. The benefits are the ideas and concepts contained in the IT Blueprint and implemented using project management. Thus producing a more complete and precise guide.

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