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DESIGNING ENTERPRISE ARCHITECTURE USING TOGAF FRAMEWORK IN METEOROLOGICAL, CLIMATOLOGICAL, AND GEOPHYSICAL AGENCY

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ABSTRACT

The Deputy of Instrumentation, Callibration, Engineering and Communication Network (IKRJK) in Meteorological, Climatological, and Geophysical Agency (BMKG) does not have an adequate integrated information system with other deputies to support its activities. The purpose of this research is to produce enterprise architecture design, especially in business architecture. The results of this research, namely a proposed enterprise architecture model using a TOGAF ADM framework whereas this model adapted with the requirement of business process of Deputy IKRJK in BMKG for the development of Information System (IS) or Information Technology (IT).

Keyword: *Enterprise Architecture, TOGAF, BMKG, Information System, Information Technology, Business Architecture*

1. INTRODUCTION

BMKG is a non-departmental state institution, its role is carrying out government duties in the fields of meteorology, climatology and geophysics, including air quality in accordance with applicable laws and regulations. BMKG organizes 18 functions in the form of policy management, data / information service management, coordination and cooperation between agencies, management of state assets, management of human resources, and management of organizations.

Deputy for Instrumentation, Calibration, Engineering and Communication Networks (Deputy IKRJK) have a functions to manage information technology which includes managing databases and IT infrastructure. Management of IT applications at the BMKG has not been centralized or is still managed by each deputy. The function of IT services that provide support for users in the use of applications, databases, and IT infrastructure is not available.

In modern organizations, IT plays a very important and significant role, very large investment funds are spent by organizations in building their IT systems [13]. To realize the great potential of an IT investment, an organization needs to align its IT strategy and business strategy [6, 9]. An organization has a purpose and a series of programs to achieve this goal [13]. The IT development process that is not based on the IT master plan will mislead in planning and implementation. The IT blueprint in terms of information systems is called planning information systems, thinking and the basis for designing and building information systems [15]. The IT Blueprint is the main document to support future IT development. Management of information technology that is not based on information technology strategic planning will produce an investment pattern that is not in accordance with the predetermined phase [28]. Conformity between IT implementation and organizational requirements can be overcome by developing a system that integrates various factors owned by the organization. The purpose of integration is to reduce the gap in the system development process, to reduce the gap needed various paradigms to plan, design, and manage information systems called enterprise architecture (EA) [28].

EA has been used for a long time to solve problems related to the development of Information Systems (IS) [10]. EA is a logical, comprehensive and holistic approach to

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simultaneously designing and implementing systems and components [28]. In general, EA is seen as a form of transformation that is directly inherent or derived from business strategy [32]. The theoretical model of EA often links the relationship between the company's technology subsystem and the elements of strategic management [31]. EA captures values from business, processes and IT [1]. EA explains organizations by using a perspective that integrates business and IT, where organizations can use EA to bridge the gap between the business and IT stakeholders. The application of EA can help companies to improve business and IT processes and will bring many benefits to the company [3], moreover it can significantly contribute to organizational success [30,14]. EA is a critical tool for organizational success and playing important roles that increase demands for speed, agility, synergy, efficiency, quality and complexity [19].

In practice EA has many methodologies used by organizations for the development of IS / IT [26,2]. One of the most popular methodologies today is The Open Group Architecture Framework (TOGAF) [22,7]. Various communities that actively apply TOGAF have conducted in-depth discussions about pattern languages to design, evaluate, and build architectures that are good for the company. The purpose of this pattern is to share successes and solutions in designing among professionals and practitioners, and to provide a common ground for anyone involved in the activities of designing, developing, testing, or using a different system. Some practitioners and designers are interested in formulating various patterns in enterprise architecture with aimed toward organizations [29].

Purpose of this research is design the enterprise architecture planning using TOGAF Framework in Deputy of Instrumentation, Callibration, Engineering and Communication Network, BMKG to obtain a blueprint of information technology that aligned with business, so that it will assist enterprise to achieve target.

2. LITERATURE REVIEW

Enterprise Architecture (EA)

The EA methodology refers to a repetitive and consistent process by defining the steps that an organization must follow to practice EA and simultaneously the organization must develop EA results [2, 26]. EA literature explains various EA methodologies that have been proposed by various organizations, consultants, and independent experts [2,4,8,11,17,21,25,33], this methodology describes in detail what processes the organization must follow and what documents they must develop to practice EA. The EA methodology developed by Spewak and Hill (1992) has inspired all the EA methodologies currently used by organizations [27]. The various EA methodologies generally recommend following five important steps to practice EA: 1) documenting the current state of the company in detail, 2) explaining comprehensively the desired future conditions, 3) analyzing the gap between current and future conditions, 4) prepare a road map for the transition from the current state to the future, and 5) implement a road map. Some EA methodologies emphasize the importance of the formal EA development process [26], extensive formal modeling [17], or partition the company into an independent unit [2]. However, all of these EA methodologies are conceptually similar because they originate from the same EA paradigm spearheaded by Spewak and Hill [27].

EA documentation must cover current conditions, future conditions, and road maps [2,12] and EA requires a person who is in charge, where the task of in charge person is compiling into certain EA applied during implementation [5,24]. Apart from the existence of several different EA methodologies, the EA literature generally describes the practice of EA as a five-step process that involves the process of documenting the current state of the organization, describing future conditions, analyzing gaps, preparing road maps for transitions, implementing them, and using frameworks to develop EA documentation.

Regardless of the steps that the organization must follow and how they must manage EA documentation, organizations that use this methodology in a direct way often encounter three practical problems [16]: 1) companies need to make unreasonable efforts to develop and maintain EA documentation due to high organizational complexity, wide coverage, and dynamic environment; 2) EA documentation is barely used because of poor quality, obsolescence, wrong level of detail, and incompatibility with real information needs; and 3) organizations accept EA practices

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badly because of their isolation and inadequate integration.

The Open Group Architecture Framework (TOGAF)

TOGAF is an EA framework that enables corporate stakeholders and architects to design, develop, evaluate, and build flexible enterprise architecture that is aligned with business needs and goals [20]. TOGAF is a standard that has been recognized by the business to build corporate architecture. TOGAF allows enterprise architects to describe, analyze, and visualize relationships from domain to domain in business organizations. TOGAF helped achieve this in a very clear way because of the use of the TOGAF standard. TOGAF is a detailed framework and supporting tools for developing EA used by organizations to design, evaluate, and create IT blueprints [18]. The TOGAF framework can produce models and frameworks (blueprints) in developing information systems that integrate annual performance plans that will meet organizational needs [23].

3. METHODOLOGY

This study uses data collection methods and enterprise architecture planning methods. The method of data collection is by conducting observations, interviews, literature studies, and previous research. In the enterprise architecture design method is to use TOGAF. Observations include the history of the organization, the main tasks and functions of the BMKG, the system that is running, the purpose of this observation is to learn and obtain a real picture of instrumentation activities, engineering and calibration, observation, processing, distribution / dissemination, service, planning and control, technology development, secretariat, HR and organization, finance, and procurement and asset management. Interviews were conducted to find information and data relating to business processes and information technology support on the BMKG. Literature studies are conducted to add theoretical references that support research through books, journals, articles, and documents from BMKG related to enterprise architecture, TOGAF, and tools used in designing enterprise architecture. Previous research was conducted by collecting and comparing several results of research on enterprise architecture planning, then studied to obtain a comparison such as the strengths and weaknesses found in the study.

The design method of EA used is TOGAF. There are six stages used in the TOGAF method, namely:

1) Preliminary Phase. The tools used in this phase are the Principle Catalog. The steps taken in this phase are to make the EA design principles as a reference for architectural development, determine the scope of the EA design, determine the actor who is responsible for working on the design of EA, determine the location of EA design, determine the starting time and completion target of EA design, establish the reason for designing EA and determine how to design an EA.
2) Requirement Management. The purpose of this phase is to analyze and manage architectural needs in all phases. The steps taken in this phase are identifying problems from each activity at the BMKG, making solutions to the activities of the problems identified, and making information system solutions to the problems identified.
3) Architecture Vision. This phase aims to create uniformity of views regarding the importance of designing an EA to achieve the goals of the BMKG. The tools used in this phase are Value Chain Diagrams and Map Matrix Stakeholders. The steps that will be taken are defining the vision and mission, determining all activities, defining stakeholders, determining stakeholder relations with the main and support activities with stakeholder map matrix and creating a vision architecture design.
4) Business Architecture. The tools used in this phase are Rich Picture. The steps to be taken in this phase are developing a description of the basic business architecture, developing a description of the target business architecture, conducting gap analysis and creating a business architecture.
5) Information System Architecture. This phase includes Application Architecture and Data Architecture. Purpose of Application Architecture is to identify candidates of application, determine the type of application needed to process data and support activities. The tools used in this phase are the Application Portfolio Catalog and Use Case

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Diagram. The steps for creating an application architecture are identifying the applications that are needed, making application modeling and explaining the benefits of the application designed. Purpose of Data Architecture is to identify all data components used by the application to produce the information needed. The steps for creating a data architecture are identifying the data structure needed for each application and making a data architecture model.

6) Technology Architecture. In this phase the technology structure needed by BMKG will be described. The tools used are Communications Engineering Diagram, Platform Decomposition Diagram, and Technology Portfolio Catalog. Steps to create a technology architecture, namely modeling the initial network configuration, creating a network proposal, determining the software and hardware needed, and designing a technology platform.

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4. DISCUSSION AND ANALYSIS

Preliminary Phase

Table 1 shows the principles catalog in the preliminary phase, catalogs are arranged as a reference in architectural development.

Table 1. Principle Catalog

No.	Principle	Purpose
1	The architectural decisions made must be in accordance with the objectives, activities, and main tasks and functions in the Deputy of IKRJK-BMKG	Support activities, main tasks and functions in the Deputy of IKRJK-BMKG and strengthen the relationship between activities and infrastructure to facilitate the alignment of activities to change.
2	Architectural management must be user-friendly	Improve the capabilities in data sharing and other resources in service to users and help cooperation between divisions
3	Developed architecture is required to be safe	Minimizing the impact of disasters, being able to withstand toward attacks from viruses, spyware, hack, worms and so as not to endanger the security and confidentiality of data, and the technology at Deputy IKRJK BMKG
4	Data / information / system security must be protected from parties that not authorized to access	Protect data from access by unauthorized parties and regulate stakeholders for data management
5	Ease of accessing data and development in the future	Simplify responses to keep up with changes in IT trends and cost efficiency in infrastructure development and maintenance
6	Implementation of interconnection technology and data access	Increase work productivity with the use of Personal Computers (PC) and LAN networks for connections between sections in the Deputy IKRJK-BMKG and ease of data processing to improve service quality
7	Using standardized software, hardware and platforms	Prevent data that is not compatible with the technology used, minimize the diversity of software, hardware, and platforms and facilitate maintenance of software, hardware and platforms
8	Application of multi-tiered architecture and component-based architecture	Facilitate replacement of damaged components, upgrading of architectural components and reduce complexity during the process of architectural integration
9	Defining and managing data as an asset must be consistent in all parts	Increase availability of data for those who need and facilitate management and accountability for data quality

Requirement Management

Table 2 shows information system solutions so that existing problems can be handled with the help of the system. Information system solutions focus on developing technology and applications to support business processes and activities in the Deputy IKRJK-BMKG.

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Table 2. Information System Solution

No.	Problem	Information System Solution
1	Equipment maintenance & calibration and security of observation equipment	Design a monitoring and security application for observation equipment that is integrated with the Observation and Processing division
2	Invalid data acquisition	Designing an observation application that is integrated with the Instrumentation, Engineering & Calibration and processing division
3	Data integration, technology infrastructure and human resource capacity	Optimize existing servers and resources
4	Configuration platform	Designing distribution application to distribute information
5	Human resource capacity	Developing recruitment application which integrated with HR and organizations for the addition of human resources
6	Correspondence	Designing secretariat application which integrated with all divisions on each deputy
7	Integration of HR data and lack of human resources	Designing HR application to control HR data
8	Validation of payment terms	Designing finance application to validate requirements of payment needed all of companies that integrated with division of planning and controlling
9	Data management for procurement and asset management has not been integrated with the IKRJK and finance division, thus effect the performance of procurement and asset management	Designing procurement and asset management application to manage data of procurement and asset management that are connected with IKRJK and finance

Architecture Vision

The output of this phase is the design of value chain diagrams and stakeholder map matrix. Figure 1 is value chain diagram of Deputy of IKRJK-BMKG. Value chain analysis aims to mapping and grouping all activities within the BMKG. Grouping activities in value chain analysis is divided into main activities and supporting activities.

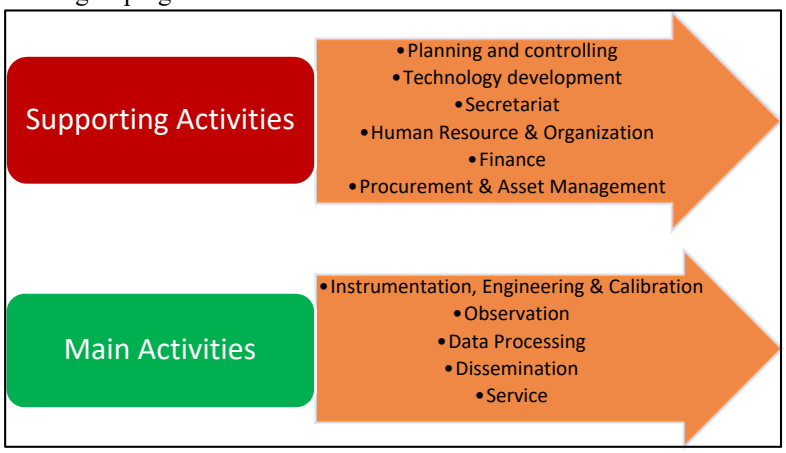

Figure 1. Value Chain

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Table 3. Stakeholder Map Matrix

No.	Stakeholder	Main Activities					Supporting Activities					
		Instrumentation, Engineering & Calibration	Observation	Data Process	Dissemination	Service	Planning & Controlling	Technology Dev.	Secretariat	HR & Org.	Finance	Proc. & Asset Mgmt.
1	Society					X						
2	Database Management		X	X								
3	General Database Management		X	X								
4	Database Maintenance		X	X								
5	General Database Maintenance		X	X								
6	Database Development		X	X				X				
7	General Database Development		X	X				X				
8	Instrumentation and Geophysics Tools	X					X					X
9	Geophysics Tools Calibration	X					X					X
10	Instrumentation and Climatology Tools & Air Control	X					X					X
11	Climatology Tools Calibration	X					X					X
12	Instrumentation and Meteorology Tools	X					X					X
13	Meteorology Tools Calibration	X					X					X
14	IT Operation		X	X	X	X				X		X
15	Communication Technology Operation		X	X	X	X				X		X
16	IT Development							X		X		X
17	Communication Technology Development											X
18	IT Management						X			X		
19	Communication Technology Management						X			X		
20	Centre of Learning and Training Adm.								X	X		
21	Centre of Research and Development Adm.							X	X			

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Business Architecture

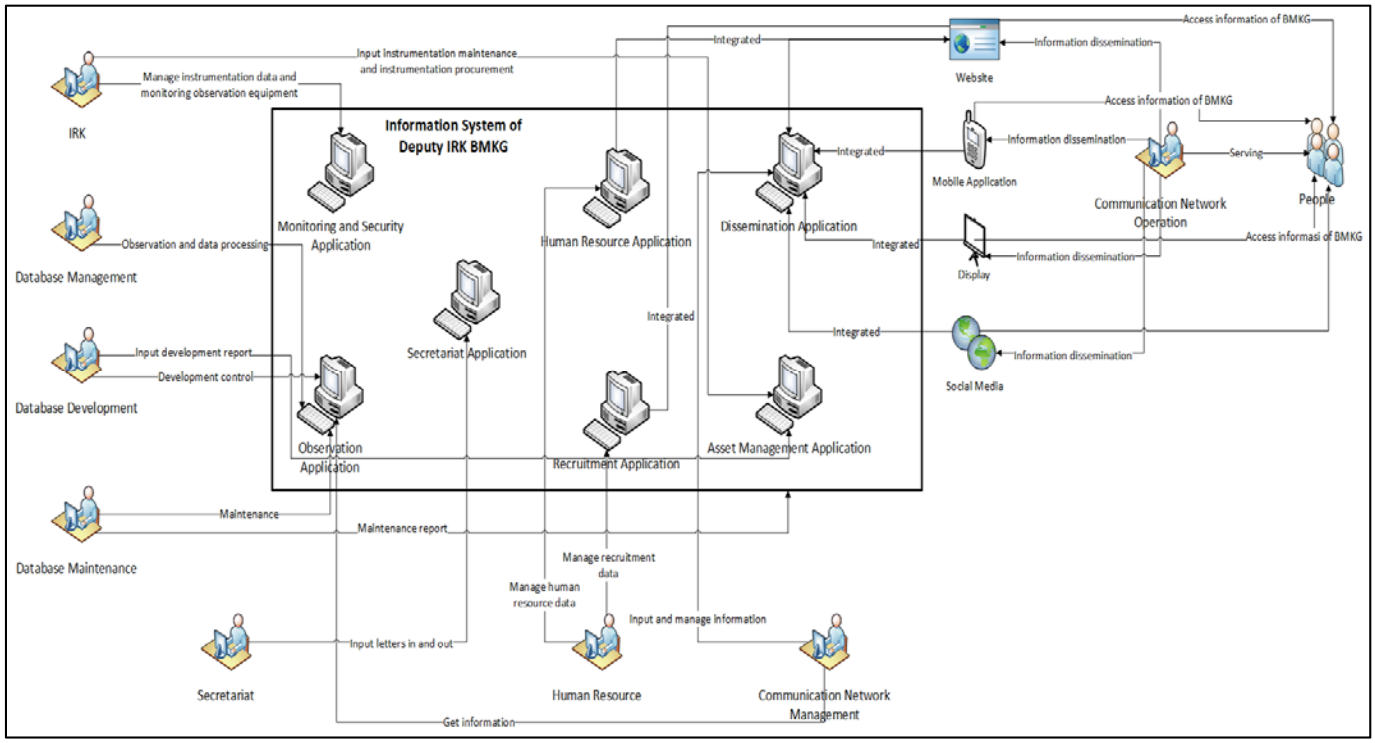

Figure 2. Design of Business Architecture

The business architecture design (Figure 2) is made in the form of a rich picture to make it easier for users to understand the design of the business architecture. The business architecture design is made for each activity in the Deputy IKRJK-BMKG.

Information System Architecture

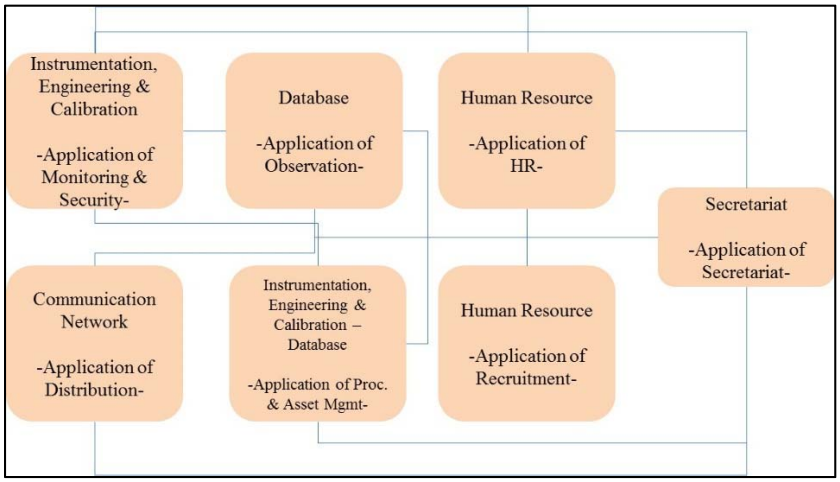

Figure 3. Application And User Location Diagram

Figure 3 shows seven applications and five locations of users. The seven applications are monitoring and security, observation applications, distribution / dissemination, procurement and asset management, human resource, recruitment and secretariat. The location of users involved is the Instrumentation, Engineering & Calibration Section, Database Section, Communication Network Section, Human Resource Section, and Secretariat Section. The monitoring and security

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application will be used on the Instrumentation, Engineering & Calibration Section and will integrate with observation, procurement and asset management, human resource and secretariat. Application of observation will be used in the Database Section and will integrate with monitoring and security, distribution, asset procurement and management, and secretariat. The application of dissemination / distribution will be used in Communication Network Section and will be integrated with the observation and secretariat. The procurement and asset management application will be used in the Instrumentation, Engineering & Calibration and Database Section and will integrate with monitoring and security, observation, and secretariat. Application of Human resource will be used in the Human Resources and will integrate with recruitment applications, monitoring and security, and secretariat. The secretariat application will be used at the Secretariat Section and will integrate with all applications.

CONCLUSION

Enterprise architecture design uses the TOGAF framework and produces a blueprint of the main architecture. Deputy IKRJK uses several applications in its business processes such as procurement and asset management applications, as well as secretariat applications (e-Office), but data is still scattered and not integrated. Therefore, this study designs EA by maximizing the use of IS / IT and using applications that are mutually integrated in each part so that the Deputy IKRJK business process is expected to be more optimal. Current conditions show that there is no data center that functions as a disaster recovery center (DRC). The DRC is only implemented by Deputy of Geophysical in Denpasar, Bali. In this study, network infrastructure was developed with the placement of DRCs at the center of the BMKG, especially for Deputy of IKRJK. Suggestions from the research are that the system design that will be built is made in stages according to the priority needs, and the implementation of EA for the development of processes and systems must receive support and commitment from all elements, so that the design of EA in Deputy of IKRJK can meet the expectation.

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