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Information system architecture for healthcare company based on the open group architecture framework

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ABSTRACT

In 2020 COVID-19 cases have entered Indonesia causing public health problems and millions of deaths. To prevent transmission of COVID-19, an air purifier is needed whose function is to remove small droplets that can carry the virus. One of them is a medical device company located in Jakarta. The purpose of this research is to produce a design that can improve business processes in the health sector and achieve company goals. The current business process is not very optimal because it is still done conventionally and the existing system has not been integrated with other divisions. To achieve business goals, it is necessary to integrate business processes with information technology (IT) and technology development that will be proposed based on the design of information system architecture that will produce a blueprint and assisted by the open group architecture framework (TOGAF) framework which is very helpful in the process of analyzing company needs. In this research, data collection through interviews with directors and direct observation of health service companies. The results of this study are recommendations given to help health.

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1. INTRODUCTION

The importance of an attitude of care and concern for the health of individuals, families, or communities regardless of social, economic, or cultural backgrounds [1], especially in the case of the COVID-19 virus [2]. This first case appeared in early December 2019 in Wuhan, China [3]. Experiencing an increase every day has raised concerns around the world, especially in Indonesia in early March 2020 [4]. In Indonesia as of January 7, 2021, the total of confirmed cases of COVID-19 was 114,766, 659,437 recovered, and 23,520 people died from the virus [5]. Therefore, President Joko Widodo took action by implementing the large-scale social restrictions (PSBB) policy starting March 31, 2020, and enforcement of community activity restrictions on January 11-25, 2021 in Java and Bali areas which is increasing in the area implementing this can minimize total of confirmed cases of COVID-19 [6]. To prevent transmission of the virus, it is necessary to use an air purifier because this virus most often appears in the form of aerosols with submicron (<1.0 μm) and supermicron (>2.5 μm) [7]. The virus is 0.3 (μm) in size, and using a high-efficiency particulate air (HEPA) filter air purifier can eradicate small particles/droplets that can carry the virus at least 99.97% [8]. During PSBB and *pemberlakuan pembatasan kegiatan masyarakat* (PPKM) or enforcement of restrictions on community activities, people certainly feel stressed, anxious, and bored at home, because all activities are diverted to online, especially people who like to exercise [9]. To keep their

bodies healthy during the pandemic, of course, people buy fitness equipment such as treadmills, stationary bikes, elliptical trainers, and others [10].

There are now many places in Indonesia that sell air purifiers and fitness equipment, both in metropolitan cities and non-metropolitan cities. One such place is centered in Jakarta. The company has 26 branches spread from Aceh to Lombok. During the pandemic, it experienced a rapid increase in turnover. The more cases that occur, the more people are interested in buying air purifiers and fitness equipment through the website. This company has used information technology (IT) and information system (IS) development [11], but currently only meets the needs of certain divisions, that the existing IS cannot thoroughly manage the needs of other divisions, and there is no integration between systems that will be created to meet the work needs of all divisions [12]. Some healthcare business processes are still lacking, especially the information technology division in terms of data security such as only using passwords to enter the website and Microsoft Excel and Word files as a medium for recording data security reports. This causes problems such as data redundancy. Data redundancy occurs when the same data appears repeatedly in several files that should not be needed it consumes data storage space, and it can also cause data inconsistency. Data inconsistency occurs when the value of a certain attribute changes, the change is only recorded in one data file. The company can develop information technology or information systems in a more focused and integrated manner with the help of emotional availability (EA) in the hope that it can help the company overcome its current problems.

EA can help eliminate redundancy and duplication [13] many are applying it in a healthy way as the digital revolution is widely adopted by businesses and understand the benefits of aligning IT strategy, technology, and guidance with overall business performance [14]. This model seeks to build a blueprint [15] and rebuild the right information system design for the company [16]. While existing research has examined the costs, benefits, and opportunities of EA implementations, based on direct observation researchers have a weakness regarding the impacts that affect implementations in business, especially in government [17] where it is used to inform, lead, and set boundaries for decisions, especially those related to investments in information technology [18]. This strategy is used to inform, lead, and set boundaries for decisions, especially those related to investments in information technology [19]. It is for the analysis, design, and execution of strategies, to help the company transition from its current state to its future state. This strategy covers a wide range of issues, such as the adoption of cloud technology, microservices, containerized architecture, data-driven architecture, cybersecurity, and more [20]. This model is useful for providing an overview of information systems architecture and technology [21]. It can categorize the future of the organization, application systems, capabilities, IT infrastructure, and data and can show IT and business leaders how to manage projects and policies to achieve the desired business results [22]. Evaluating this model is indispensable to ensure that the organization gets the expected benefits [23]. In previous research, namely, research conducted by Lee *et al.* [12] enterprise architecture conducted at PT. Electricity Distributor Company discusses designing systems for key business processes. However, in this research, enterprise architecture is carried out on supporting business processes that have not received the expected benefits, namely the data security section which has received less attention even though it also has a major impact on the continuity of the company's business processes.

EA in this study was created using the open group architecture framework (TOGAF). This research uses this framework it has a comprehensive, and flexible nature that focuses on information systems architecture, especially the security section which includes a service catalog, classification, and data quality that can improve data security. This method can strengthen the planning, development, realization, and management of enterprise IT architecture. This framework is used to incorporate modeling, and design the architecture needed to build information systems [24] and describes a systematic process for transforming a technology from an idea, or strategic need into a product, system, or solution that can be implemented and fully recorded [25]. This strategy provides detailed guidance on how to create [26] and organize and implement EA and IS. As a tool, it is expected to be able to produce strategies to overcome these risks [27]. One of the advantages of the TOGAF framework is that it is open source [28]. The framework covers several components within the scope of the architecture consisting of business, information (data), technology, and applications and creates a design to fit the IS/IT architecture [29]. This framework has the ability to provide simple implementation, and an optimal balance between business and IS/IT [30].

Based on these arguments, we focus on the core limitations of the research, namely information system architecture based on TOGAF to design data security systems and strengthen data security compared to traditional methods that do not use the TOGAF framework which may be less organized. The purpose of this research is to produce an architecture design, especially the security part, and an information system blueprint to support business processes. The main contribution of this research is to develop information technology or information systems in a more directed and integrated manner with the help of EA using the TOGAF framework which focuses on information systems architecture, especially the security section which includes a service catalog, classification, and data quality that can improve data security. However, some

limitations need to be considered in implementing this solution, including the challenge of changing existing work.

2. RESEARCH METHOD

The author chooses a methodology for this research. The methodology chosen is TOGAF which focuses on phase C, namely information system architecture. The data was used through interviews with directors and direct observation of healthcare companies, which can be shown in Figure 1.

The research phases: i) Preliminary phase, outlines the initial preparations and actions needed to achieve the business objectives of designing a new enterprise architecture, including defining the architecture framework and architecture principles [26]; ii) Phase A, architecture vision, outlines the proposed vision including business profile, business structure, business processes, bounding the architecture development problem, identifying stakeholders, and obtaining approval from appropriate stakeholders [30]; iii) Phase B, business architecture, outlines creating of an organization's business to maintain that has received approval business vision [24]; and iv) phase C, the information system, outlines the functional security services and their security classification [29].

Security services catalog (SSC), describes a comprehensive documentation of the wide range of services provided by the security team to the organization. This SSC includes identity and access management, describing the strategies used to protect its assets from misuse by verifying which users have the right to access certain applications and types of information [31]. Security intelligence describes risk reduction strategies that incorporate external and internal threat, security, and business intelligence across the organization [32]. Digital forensics describes dealing with any data found on digital devices [33]. Security analytics is a strategy used to identify, protect, and troubleshoot security events that threaten IT systems [34]. Security classification, describes the labels attached to assets, according to a classification scheme [35]. Data quality describes maintaining the quality of data used in information systems [36].

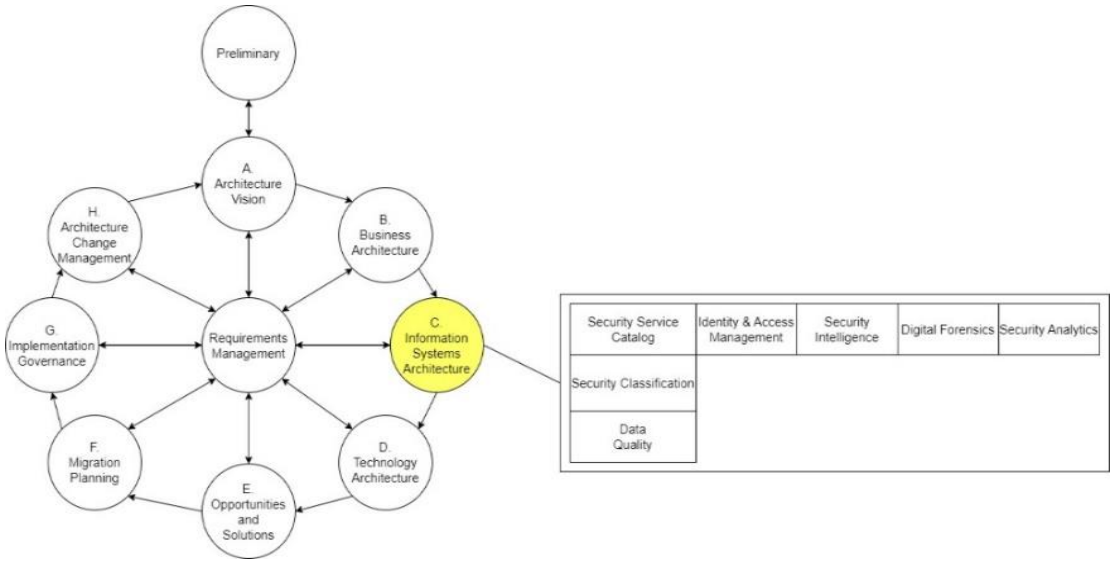

Figure 1. Research method [30]

3. RESULTS AND DISCUSSION

This context discusses security sections such as security service catalog, security classification, and data quality. This discussion refers to the findings found and collected during the research process through interviews with the director and direct observation. This context covers phase C information systems.

3.1. Security service catalog

SSC will be the documentation needed to ensure that the security needs of the information system have been properly identified and that appropriate security controls have been designed and implemented [31]. SSC includes identity and access management, security intelligence, digital forensics, and security analysis. This is important because it helps in managing and regulating data security more optimally.

3.1.1. Identity and access management

Identity and access management (IAM) is important for healthcare organizations to protect their assets from wrongful use. IAM includes authentication, authorization, and a central user repository [31].

i) Authentication

Authentication is one of the key components in the enterprise, especially protecting user privacy from unauthorized access. The company only uses passwords on the website, it has experienced data leaks, hence the need to incorporate multi-factor authentication (MFA) and single sign-on (SSO). Combining these two can help improve security while increasing user productivity, as well as business continuity.

MFA works is that users enter primary credentials such as username and password. After that, they must go through a second-factor verification process, which could be a one-time password (OTP) sent to their device, a physical token that generates a unique code, or a biometric method such as fingerprint or facial recognition. If both factors are successfully verified, access to the system is granted.

SSO works is that users enter their credentials (username and password) into the SSO system, this system will generate a valid authentication token. This token is then used to access other connected applications or systems without the need to enter credentials again. The system uses the provided authentication token to grant access.

Implementation of MFA and SSO in the enterprise not only improves security but also significantly affects user experience. With MFA, enterprises can ensure that access to critical systems does not rely solely on a single authentication factor such as a password, which is vulnerable to attack. Meanwhile, SSO becomes faster and more consistent, allowing administrators to centrally control and audit access to various systems and create a more secure working environment.

ii) Authorization

Identity management process, access control is applied to identities to regulate access to documents, applications, or other information, requiring the application of access control models, such as attribute-based access control (ABAC) to protect sensitive data, regulate user access, comply with regulations, and manage security risks.

The way it works is if an employee wants to access customer data it may be restricted based on their role in the organization, such as a customer relationship management (CRM) application the function is to visit a customer site to change a water filter ABAC will evaluate the employee's role, their current task and only employees who have been evaluated by ABAC can access the CRM application.

ABAC can improve security by considering various attributes before granting access. Such attributes include user roles, environmental conditions, data sensitivity, and specific actions requested companies can maintain overall control over who accesses customer data, thereby improving data protection and ensuring compliance with privacy laws.

iii) Central user repository

A central repository of users assigning identities to other resources and confirmation of credentials submitted by different users such as Sailpoint will help companies to manage the digital identities of all users involved in the company's operations, including employees, and vendors. This works when a new employee joins the healthcare organization, Sailpoint can automatically grant access that matches their roles and responsibilities. Similarly, when an employee leaves or moves, the Sailpoint can automatically remove or restrict their access. This can help in detecting suspicious behavior or potential security threats by monitoring user activity and access patterns if a departing or moving employee wants to do something detrimental to the company, it will be automatically detected by Sailpoint thus saving time but also reducing the possibility of human error that can occur if access is updated manually.

Sailpoint also increases visibility and control over user access through comprehensive auditing and reporting features. With the ability to monitor and track all user activity, Sailpoint helps organizations detect and respond to security threats in real time. For example, if a user tries to access data that does not match their role, the system can issue alerts or take automated actions to prevent unauthorized access. This ensures that companies always have a clear picture of who has access to what, and can quickly identify and address potential security risks.

Sailpoint can integrate with various applications and systems used by the enterprise. This integration ensures that any suspicious or unusual actions can be immediately identified and addressed before they become serious threats, allowing organizations to develop more proactive security strategies. Mitigation measures can be implemented as soon as a threat is indicated, preventing further potential loss. Thus, Sailpoint serves not only as an identity management tool but also as a critical component in a company's cybersecurity strategy.

3.1.2. Security intelligence

Security intelligence is critical to addressing the many complex data security risks that healthcare organizations face today [32], hence the need for security information and event management (SIEM) to

protect user data, helping to monitor and analyze events that occur within an enterprise's network and IT systems. This includes activities such as suspicious login attempts, unauthorized access to sensitive data, or other events that could signal a security threat.

3.1.3. Digital forensics

In the current era, technology is increasingly sophisticated which can increase the number of crime cases such as cases of data theft, online fraud, and, company defamation [33]. Healthcare companies have experienced cases of online fraud on behalf of the company to investigate these cases digital forensics is needed. Digital forensics focuses on investigating digital evidence and methods for finding, obtaining, and securing that evidence. The steps to handle online fraud cases using digital forensics are: i) When a company receives a report or suspects online fraud, follow up quickly. Seek help from the digital forensics team immediately; ii) Document all available evidence, including fraudulent emails, text messages, or suspicious transaction information. Make sure to collect complete and accurate electronic evidence; iii) The digital forensics team needs to be immediately notified and involved in investigating the case. They will lead the effort to collect, analyze, and interpret the digital evidence found; iv) The digital forensics team will collect electronic evidence from various sources, including emails, transaction logs, or network activity records, relating to the online fraud case; v) Analysis of forensic digital data will involve searching for suspicious traces, recovering lost or deleted information, and identifying patterns of possible fraud; vi) The digital forensic team will reconstruct the chronology of events, understand how the fraud occurred, and identify the perpetrators and methods used; vii) Engage an internal or external legal team to provide legal advice on the next course of action to be taken based on the digital forensic findings; viii) If needed, the evidence found by the digital forensics team can be used in the law enforcement process to prosecute the perpetrators of the fraud and bring them to justice; ix) Based on the findings from the digital forensics investigation, the company should take steps to improve system security and prevent similar incidents from happening in the future; and x) make sure to inform customers and business partners about the fraud that occurred and the actions taken by the company. This can help reduce the risk of future fraud and build customer trust.

3.1.4. Security analytics

Security analytics is essential to address the various complex data security risks that healthcare organizations face today [34], hence the need for SIEM to perform risk analysis by identifying areas vulnerable to security attacks and prioritizing necessary security measures because SIEM uses sophisticated algorithms and analysis rules to identify suspicious or important security events. For example, SIEM can detect suspicious login attempts, unusual user activity, or malware attacks.

3.2. Security classification

Security classification is a marking assigned to an asset, according to a classification scheme. Assets can be any appropriate architecture component [37]. The security classification defines the security requirements applicable to the asset. Assets include business services, capabilities, information system services, and physical technology components. This is relevant to security policies. The security classification can be shown in Table 1.

3.3. Data quality

In operational risk management, data quality is critical. Several essential attributes influence data quality including accuracy, relevance, timeliness, completeness, and accessibility [36]. It is crucial in ensuring the operational success and security of information systems. The data quality can be shown in Table 2.

Table 1. Asset

Asset	Description
Business service	Data loss prevention (DLP) applications prevent data leakage by monitoring, detecting, and preventing the transfer of sensitive data inside and outside the corporate network encrypting sensitive data, as well as providing reporting on potentially suspicious user activity.
Capability	IAM applications only authorized users can access sensitive data or critical systems. People who are really IT security experts are needed. If act wrongly, the company's reputation is destroyed.
Information system services	intrusion detection system (IDS) applications to protect information system services from external and internal attacks. If the IDS detects suspicious activity, the system will generate an alert to the administrator or enterprise security team. These alerts notify them of potential threats and enable quick response actions to stop the attack and protect the system.
Physical data component	DLP applications monitor and control data traffic to prevent leakage or unauthorized use of confidential or sensitive information. By examining data that is being sent over the network, stored on mobile devices, or shared via email, and implementing policies to ensure data security.

Table 2. Attributes

Attributes	Description
Accuracy	Data quality monitoring (DQM) tools assist in the continuous monitoring of data quality by providing metrics and reports on data accuracy, suitability, completeness, and reliability.
Relevance	DQM tools help in monitoring, managing, and improving data quality across the organization. It offers features such as real-time data monitoring, automated data cleansing, anomaly detection, and data quality reporting.
Timeliness	Data quality tools to manage data quality, including data error detection and correction, monitoring and reporting, and automated data cleansing. Integration of these tools into the enterprise architecture can help in improving timeliness in data quality by detecting and fixing problems quickly.
Completeness	DQM Tools to identify, assess, and correct data quality issues, including incompleteness. DQM tools can provide automated monitoring and processing to improve data completeness and ensure compliance with established data quality standards.
Accessibility	Master data management (MDM) helps in managing and integrating important and frequently used master data across the organization, such as customer data, product data, and partner data. By providing a single source of truth for master data, MDM helps improve data quality and accessibility.

4. CONCLUSION

From the results of the research analysis described in the previous chapter, it can be concluded that the business processes of healthcare companies still have shortcomings, especially the information technology division in terms of data security. This research will develop enterprise architecture with the TOGAF method, especially the information system architecture of the data security section. The resulting enterprise architecture design is a blueprint. Based on the design results, there are several designs of information system architecture, especially the security service catalog section, namely combining MFA and SSO to reduce the risk of phishing attacks and unauthorized access to user data, ABAC to protect sensitive data, sailpoint to help companies manage the digital identities of all users involved in company operations, security SIEM to analyze events that occur in the company's network and IT systems. The security classification section, namely DLP to prevent the movement of sensitive data inside and outside the company network, IAM, application, and IDS to protect information system services from external and internal attacks. The data quality section, namely DQM assists in monitoring, managing, and improving data quality throughout the organization, MDM integrates important and frequently used master data throughout the organization, which distinguishes previous research is research on PT. Electricity Distributor Company which discusses system design in key business processes, namely requirements management, application architecture, technology architecture, migration planning, and business architecture. If implemented, the development of IT/IS is expected to help business processes in carrying out the continuity of the company. The findings of this research have an important meaning in helping business processes and strengthening data security.

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