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Enterprise Architecture Using TOGAF ADM To Support Smart Campus At STAI Raudhatul Akmal

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ABSTRACT
The development of an academic information system to support the Smart Campus concept at STAI Raudhatul Akmal requires an effective enterprise architecture approach. This study adopts the TOGAF ADM method to design an enterprise architecture that can accommodate evolving academic and technological needs. The focus is on applying TOGAF ADM to analyze academic business processes and develop an integrated system implementation plan. Primary data sources include analyses of academic business processes at STAI Raudhatul Akmal, covering student admissions, teaching and learning, research, community service, graduation, and alumni services. Using TOGAF ADM's eight phases—including vision architecture, business architecture, information system architecture, technology architecture, and change management—this study aims to develop a blueprint aligned with institutional needs. The analysis results indicate that the architectural blueprint includes a web-based information system, e-learning system, online grading system, and library system. The technology design covers network infrastructure and servers. The implementation governance and change management phases highlight the importance of systematic change management to ensure a smooth transition. This study recommends assessing institutional readiness and implementing all aspects of TOGAF ADM for a comprehensive design to effectively support the Smart Campus implementation at STAI Raudhatul Akmal.

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INTRODUCTION

Higher education is an institution of higher learning that facilitates the acquisition of knowledge and the development of skills and competencies in accordance with individual interests and potential in order to create quality members of society (Iip Syaripudin & Konkon Furkony, 2021). In this case, the integration of information technology becomes imperative for higher education. The development of information technology demands effective and efficient management of higher education resources, so as to compete optimally in the scope of higher education (Bekti et al., 2020). One of the crucial aspects in determining the reliability of Information Technology (IT) services in an institution is its IT infrastructure. However, to have a reliable IT infrastructure, institutions must prepare significant funds. Therefore, many

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institutions experience obstacles in building IT infrastructure independently due to limited budget and resources (Graha et al., 2021).

The development of technology has penetrated into various sectors of life, including education. Education requires the integration of information technology because educating the younger generation does not only rely on the role of educators in the classroom (Usmaedi et al., 2020). Apart from student activities, adequate facilities, including information technology, are also key. Examples of implementation include the use of the internet, LCD projectors, and computers in the learning process (Hernanda & Aji, 2024). Although it has become a standard in many educational institutions, to improve the quality and quality of education, the latest breakthroughs are needed, such as the Smart Campus concept (Ismaredah & Radiles, 2022). Smart Campus is one of the implementation areas of Smart City in the university environment. Smart Campus is expected to optimize the process and output of education through more sophisticated and superior management methods (Ayu K et al., 2023). The Smart Campus concept emerged as a result of an evolution inspired by the Smart City idea, which aims to utilize infrastructure more efficiently (Sukhoco & Lanvino, 2022).

Raudhatul Akmal College of Islam (STAI), located in Deli Serdang, North Sumatra, was established on February 6, 2000, following approval from Dr. H. Husni Rahim. As a private Islamic higher education institution, it currently offers four undergraduate programs: Islamic Religious Education, Madrasah Ibtidaiyah Teacher Education, Early Childhood Islamic Education, and Sharia Economics, with over 500 students, 35 lecturers, and 7 administrative staff.

STAI Raudhatul Akmal faces challenges in optimizing administrative, learning, and archiving efficiency. The Head of General Administration has highlighted the need for an integrated system to manage various campus functions. To support a Smart Campus concept, essential systems include student academic information, lecturer and staff information, library management, financial systems, and new student registration.. In the Smart Campus Concept, these systems must be integrated with each other (Lathifatuddini et al., 2021).

In this regard, a more optimal utilization of information technology is needed to support the learning process, archiving, and work efficiency. In addition to ensuring data synchronization between units and departments, the use of applications or information systems in each unit is expected to facilitate data management, archiving, and improve the quality of services to students and the community. By adopting an integrated information system, STAI Raudhatul Akmal is expected to improve operational efficiency, institutional management, and provide better services to all stakeholders, thereby enhancing the campus image as a technologically advanced educational institution, so as to attract public interest as a place to continue higher education. To handle these challenges, this research designed an enterprise architecture to support Smart Campus based on TOGAF ADM analysis.

The proposed solution is to apply the TOGAF ADM framework in the system to support Smart Campus at STAI Raudhatul Akmal. By considering the characteristics of TOGAF ADM, the choice to apply this framework in designing enterprise architecture to support Smart Campus at STAI Raudhatul Akmal is very appropriate. TOGAF characteristics and advantages include: (1) It is the most commonly used architecture design framework, (2) An open

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standard that can be used without the constraints of licenses or restrictions, (3) A broad approach and can be accepted by various parties, (4) Its open source nature allows development according to local needs without dependence on certain vendors, (5) Its ability to be integrated in various systems, and (6) Focus on the implementation cycle (ADM) and the process of implementation (Anam et al., 2023). In addition, the author also found previous research that proposed a Smart Campus design using TOGAF ADM, such as the work of (Sucahyana et al., 2020).

The Open Group Architecture Framework (TOGAF) is a framework that has been developed by The Open Group's Architecture Framework since 1995. Although it was originally used by the United States Department of Defense, TOGAF has expanded to a variety of sectors, including banking, manufacturing, and education, as it has evolved (Pangestu, 2021). The Architecture Development Method (ADM) is a logical methodology that is an integral part of TOGAF (Ikrima et al., 2023). ADM consists of eight main phases designed to develop and maintain an institution's technical architecture. ADM forms an iterative cycle for the entire process, between phases, and within each phase (Putra & Subakti, 2022). At each step in this cycle, new decisions must be made to ensure the smoothness and alignment of the architecture being developed (Angeline & Fibriani, 2021).

Based on the problems and facts above, a research was proposed with the title "Enterprise Architecture Using TOGAF ADM to Support Smart Campus at STAI Raudhatul Akmal". The results of this study are expected to provide solutions related to efforts to implement the Smart Campus concept in the STAI Raudhatul Akmal environment.

METHODS

In this research, the Enterprise Architecture design adopts the TOGAF-ADM model. TOGAF ADM is used as a guide in creating a system blueprint that supports Smart Campus at STAI Raudhatul Akmal. The research framework in this discussion is as follows:

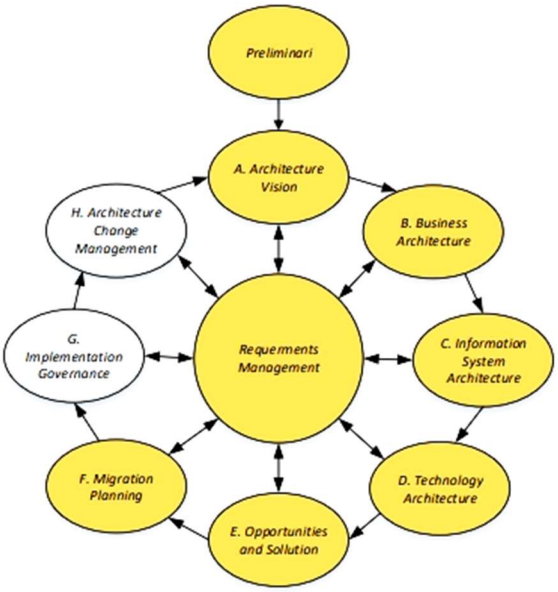

Figure 1. Research Framework with TOGAF-ADM

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Based on the research framework illustrated above, the research stages can be explained as follows:

1. Preliminary Fase
   In this stage, it is necessary to specify who, what, why, when, how, and where the architecture will be implemented.
2. Architecture Vision
   This stage is the beginning of the architecture development cycle, where steps such as defining the scope, identifying stakeholders, developing an architecture vision, and obtaining approval to begin architecture development are performed.
3. Business Architecture
   This stage involves developing an institutional structure that supports the agreed architectural vision. At this stage, there are various common tools and methods for modeling that are required.
4. Information System Architecture
   At this stage, the main focus is on developing the information system architecture. The definition of information system architecture in this stage includes the data architecture and application architecture to be adopted by the institution.
5. Technology Architecture
   At this stage, the main focus is to build the desired technology architecture, starting from determining the type of technology needed through the use of a Technology Portfolio Catalog that includes software and hardware.
6. Opportunities and Solution
   At this stage it will be evaluated, by selecting implementation alternatives, defining implementation strategies and implementation plans.
7. Migration Planning
   At this stage, the order of system implementation is based on a priority scale. Tools used in this phase include, among others, the application implementation roadmap.

RESULTS AND DISCUSSION

Preliminary Fase

After the architecture principles are established, the next step is to identify the key elements in the design of enterprise architecture at STAI Raudhatul Akmal, which includes aspects of where, what, why, who, when, and how. The purpose of this identification is to determine the objects involved during the architecture design process. The following is a summary of the relevant 5W+1H identification:

Table 1. 5W+1H Identification

Driver	Deskripsi
What	Architecture Scope: Design an enterprise architecture model that includes all the important elements of the information system.
Who	Who is modeling and responsible: 1. Planner: Rizky Rinaldi, S.Kom

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	2. Person in charge: Khairul Fahmi, M.Pd.I (Assistant Head I of Academic Affairs).
Where	Location of the research object: STAI Raudhatul Akmal campus on Jln. Nusa Indah Gg. Melati No. 66 Tanjung Sari Village Kec. Batang Kuis Kab. Deli Serdang - Prov. North Sumatra, 20372.
When	Completion time: September 2024.
Why	Why this enterprise architecture design was made: To align the technology used, both hardware and software, with the institution's business strategy. This alignment will be the foundation in developing the implementation of information systems and technology, as well as producing catalogs and architectural diagrams that integrate the necessary modules.
How	Determine how the design is created: The design will be created using the TOGAF ADM framework, which provides a structured methodology for enterprise architecture development.

Architecture Vision

At the Architecture Vision stage, input is obtained from the institution's profile, which includes the institution's vision and mission, institutional goals, and business strategy. STAI Raudhatul Akmal's value chain is an input for the business architecture phase which has two functions, namely: main function and supporting function.

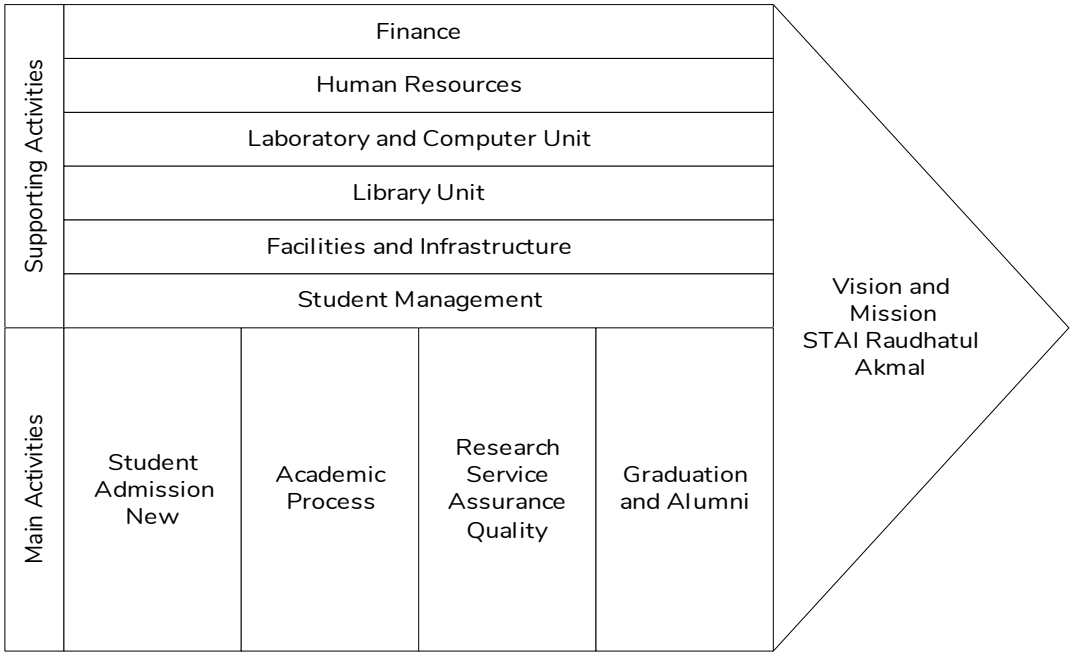

Figure 2. Value Chain Diagram

The value chain at STAI Raudhatul Akmal Deli Serdang, as shown in the figure above, consists of two categories of activities, namely main activities and supporting activities with the following explanation:

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1. Main Activities
   The main activities in the Value chain diagram above include several important elements, including:
   a. New Student Admission
      This activity is the core of every university, including STAI Raudhatul Akmal Deli Serdang. The admission process is conducted through promotions and presentations at high and vocational schools, especially in peripheral areas, due to the greater market potential there. This is done to avoid competition with well-known universities located in the city center.
   b. Academic Process
      Most of the academic processes at STAI Raudhatul Akmal Deli Serdang are still done manually, such as for the KRS system which has been implemented manually and systematically.
   c. Research, Service, and Quality Assurance
      Research and community service are two important activities in the tri dharma of higher education, where lecturers conduct research and community service involving students. In addition, quality assurance serves to maintain the quality of education at STAI Raudhatul Akmal Deli Serdang in accordance with the vision and mission of the institution.
   d. Graduation and Alumni
      The graduation process is an integral part that cannot be separated from college activities. STAI Raudhatul Akmal Deli Serdang also has an alumni association managed by student affairs to support alumni activities.
2. Supporting Activities
   Supporting activities at STAI Raudhatul Akmal Deli Serdang include several aspects, such as:
   a. Human Resources
      Managing educators and education personnel who support campus activities.
   b. Finance
      Manage the finances needed to support all activities at STAI Raudhatul Akmal Deli Serdang.
   c. Library and Computer Unit
      Providing facilities for students to use laboratories and libraries to support the academic process at STAI Raudhatul Akmal Deli Serdang.

Each activity in this value chain contributes to achieving the vision and mission of STAI Raudhatul Akmal Deli Serdang.

Business Architecture

This phase has the main objective to establish the right perspective on business architecture, and to select appropriate techniques and tools to describe the current business architecture and its future development targets. In the business architecture phase of TOGAF ADM, the identification of business services, business processes, and business functions is depicted in

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the form of process diagrams. This mapping has a hierarchical structure with business services as the highest level, which is then elaborated into several business processes and business sub-processes. Each business process further consists of several business functions and business sub-functions, which are the smallest units of activity.

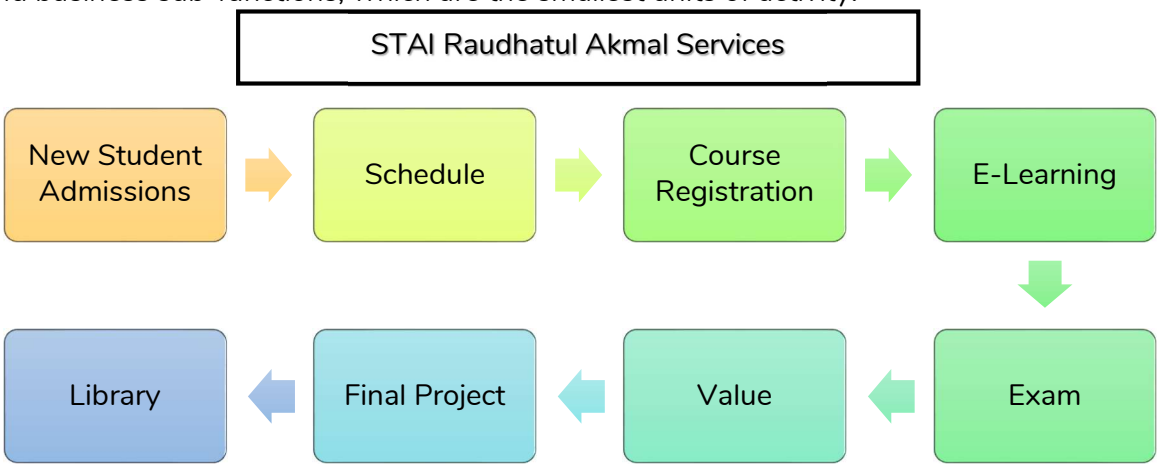

Figure 3. Business Process of STAI Raudhatul Akmal

Information System Architecture

In this phase, the main attention focuses on developing the information system architecture required to support the institution's needs. The information system architecture developed includes two main components: application architecture and data architecture. A detailed description of each application design can be found in the Application Portfolio Catalog table below.

Table 2. Application Portfolio Catalog

App Name	App Function
Online Admissions System	The online Admissions System is a module within the existing website application, serving as a portal for prospective students to register and access their admission results. Successful applicants are automatically accepted as new students. Additionally, the system functions as a promotional tool for the marketing team, with features that enable effective promotion.
Online Course Registration System	The developed Online Course Registration System is an upgrade from the previously used manual system. It allows students to plan their studies for each semester online. Additionally, the system is integrated with the online grading system and e-learning platform, streamlining coordination and access to academic information.
Online Grading System	The Online Grading System is an improvement over the previous system, addressing feature and module limitations. Integrated with the course registration system and e-learning platform, it enables efficient data synchronization. A key feature is its ability to directly export grades to the Feeder Dikti, allowing real-time updates.

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E-Learning	E-learning serves as a key component in the campus academic system, providing a platform for interaction among various stakeholders. This application includes complex modules, such as an online lecture module that allows instructors to share materials, assign tasks, and conduct online classes. Students can access downloadable materials, participate in live lectures, and complete assignments. Additionally, the system supports online examinations. Grades from e-learning activities can be directly exported to the online grading system, ensuring smooth integration and real-time data updates.
Final Project Management System	The Final Project Information System is used by the campus to manage the final project process for students. This system facilitates students and faculty throughout various stages, from proposal submission and approval to supervision. All these processes can be conducted online, enabling more efficient final project management and easier access for all involved parties.
Library Management System	The Library Application is an academic support tool developed for offline use due to limited digital resources, making it more effective for library administration processes. The application allows students and faculty to borrow and return books or learning CDs. This system involves two main stakeholders: students and faculty, focusing on providing administrative support that aids the academic process.

Technology Architecture

At this stage, the basic principles that will form the foundation for the technology platform needed to support a shared data environment are identified. The outcome of this identification includes technology components such as hardware, software, and communication devices, which must align with the designed technology architecture. By following these principles, it is expected that the proposed technology architecture will efficiently and effectively support the operationalization of the system.

Table 3. Proposed Technology Architecture

Type	Principle
Hardware	1. Supports client-server technology. 2. Independent of specific vendors and brands. 3. Able to adapt to future technological developments. 4. Based on the needs and business objectives of STAI Raudhatul Akmal Deli Serdang.
Software	1. Capable of adapting to all work units. 2. The operating system must support the use of the hardware and software applications built. 3. Support a reliable network performance. 4. Must have official licenses for all software components used. 5. Use open standards to ensure interoperability and flexibility.

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Type	Principle
	6. Multiplatform, enabling operation across various hardware and software platforms. 7. The DBMS must efficiently and effectively accommodate data transaction needs. 8. Data should be created once, not redundant, and consistent across the system. 9. Data is considered a shared asset owned by the entire institution, not by specific units. 10. Data access must be restricted by user access rights. 11. Data should be easy to maintain and backed up regularly to prevent loss of critical data. 12. The programming language used should be capable of generating applications with interfaces. 13. The programming language should support object-oriented development techniques. 14. The system must provide guarantees for application data security to protect against the risk of data loss and misuse.

Opportunities and Solution

The Opportunities & Solutions phase aims to assess and select implementation methods for the architecture, as well as to consolidate gap analysis conducted in previous phases. The input for this phase comes from the outputs of earlier phases, which include various relevant information and findings. The result of this phase is the development of solution patterns based on the architectural principles established in the Preliminary phase.

The gap analysis in this phase focuses on two main aspects: information systems and Information Technology (IT) infrastructure. The assessment of the information system is conducted by considering both current and future needs integrated into the enterprise plan. The results of this gap analysis will serve as the foundation for IT infrastructure planning, ensuring that the proposed solutions meet the identified needs and support the achievement of the institution's strategic objectives.

The proposed IT infrastructure includes various components, such as the operating system, database management system, client applications, middleware, routing protocols, communication protocols, and network technologies. The list of recommended components and implementation activities for the IT infrastructure is designed based on the results of a thorough gap analysis. This analysis examines the differences between the current state and the desired state, with the goal of identifying areas for improvement. The details of this analysis are presented in the following table, which outlines the concrete steps to be taken to address the existing gaps and achieve an optimal infrastructure that supports long-term objectives.

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Migration Planning

The migration planning phase aims to plan and manage the transition process from the existing technology system to the new system. This phase is crucial as it ensures a smooth technology transition, minimizes the risk of operational disruptions, and maximizes the benefits of the new system. In this phase, the detailed sequence of information system application implementations will be outlined based on the application development roadmap, which will guide the transition process.

The application roadmap serves as a strategic guide for the development and implementation of information system applications at STAI Raudhatul Akmal Deli Serdang. This roadmap is designed to ensure that each application is implemented according to the priorities and operational needs that have been determined, considering technical capacity, available resources, and the institution's long-term goals.

The roadmap not only functions as a plan for application implementation but also as a tool for monitoring progress and adjusting strategies in line with changing needs and technological developments. The sequence of application implementations is detailed in the following diagram, which illustrates the key stages and timeline planned to achieve the desired system transition.

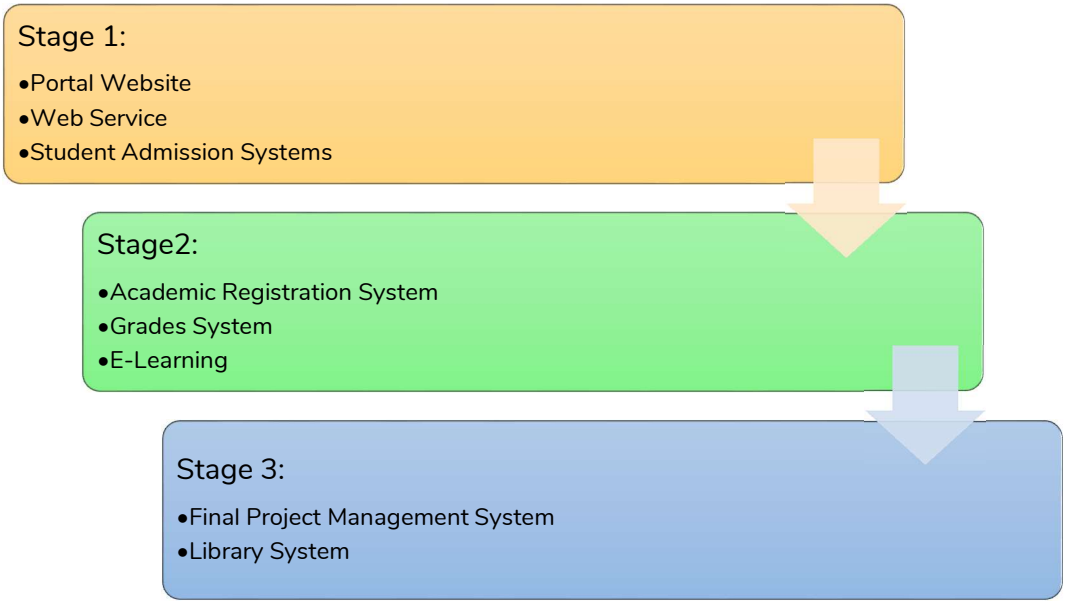

Figure 4. Application Development Roadmap

CONCLUSION

Based on the analysis conducted in accordance with the research stages, the study concludes that the academic business process at STAI Raudhatul Akmal includes four main activities: new student admissions (PMB), the learning process, research and community service, and graduation and alumni management. The academic information system was analyzed using the TOGAF ADM framework and value chain technique. In developing the Enterprise Architecture (EA) model, the research followed the eight phases of TOGAF ADM, ranging

from the vision architecture phase to change management. The research resulted in a blueprint for the vision architecture, outlining the need for a web-based information system. The business architecture and information system architecture blueprints led to a design for an academic information system that supports PMB, E-Learning, the online grading system, and the library system. Additionally, the technology architecture blueprint included the design for the infrastructure, networks, and servers used. The opportunities and solutions blueprint identified gaps between the old and new systems at STAI Raudhatul Akmal, while the migration planning blueprint provided guidance for the structured and sequential development of the project.

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