

Enterprise Architecture SMA ATISA DIPAMKARA

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Abstract

Enterprise architecture (EA) is a framework for designing, building, and managing information systems and information technology (IT) within an organization. This study aims to design EA at SMA Atisa Dipamkara. The research employs the TOGAF ADM method. The results of the study indicate that the design of EA at SMA Atisa Dipamkara can provide benefits for the school, namely improving the efficiency and effectiveness of school business processes, facilitating decision-making by school management, and enhancing customer satisfaction at the school.

Keywords — *Enterprise Architecture, Atisa Dipamkara High School, TOGAF ADM, Efficiency, Effectiveness, Customer Satisfaction*

1. INTRODUCTION

Enterprise Architecture (EA) is a framework used to define, document, and implement the architecture of an organization. EA can be used for various purposes, including enhancing the efficiency, effectiveness, and competitiveness of the organization. One important aspect of EA is business architecture, which depicts how the organization operates. Business architecture can be used to understand how the organization creates value for its customers and how it can improve its performance. A study by Hu et al. (2023) indicates that business architecture can help organizations address various challenges, including:

- Changes in the business environment
- Increasing competition
- The need to enhance efficiency and effectiveness

Another study by Gupta et al. (2022) suggests that business architecture can help organizations:

- Improve collaboration and communication
- Enhance decision-making
- Increase competitiveness

Based on these studies, it can be concluded that business architecture is an important aspect of EA that can provide benefits to organizations. SMA Atisa Dipamkara is a private secondary school in Jakarta with a total of 192 students and 20 teachers and 3 staff. The school implements a "Merdeka" curriculum which is the national curriculum in Indonesia. The facilities available at SMA Atisa Dipamkara are quite adequate, including classrooms, sports fields, laboratories, auditoriums, and sports fields.

Despite having adequate facilities, SMA Atisa Dipamkara still faces several challenges in its business processes. The business processes are still manual, although supported by several existing applications, but the connectivity is considered lacking because some are still manual and there is a need for stakeholder involvement which is done manually, causing the business processes to be less effective and efficient. This causes the completion of tasks to be somewhat slow and sometimes results in issues such as miscommunication.

Enterprise architecture can be a solution to overcome the challenges faced by SMA Atisa Dipamkara. With EA, all processes that occur within it can be well depicted, and the connectivity and support between one process or one application with other processes and applications will be well illustrated. This will improve the effectiveness and efficiency of SMA Atisa Dipamkara's business processes.

The positive impacts of implementing enterprise architecture at SMA Atisa Dipamkara include:

- Business processes become more organized and well-connected
- Task completion processes become faster and more efficient
- Enhancing collaboration and communication between work units
- Improving more accurate decision-making
- Increasing the competitiveness of the school

The results of this research are expected to provide input for SMA Atisa Dipamkara to improve its implementation of enterprise architecture.

2. RESEARCH METHOD

The research methodology employed in this study consists of literature review and architectural design. The literature review was conducted to gather relevant information and supporting data for the research, such as theories, concepts, and previous studies related to enterprise architecture, business processes, and application architecture design (Hu, Wang, & Zhang, 2023; Gupta, Singh, & Gupta, 2022; TOGAF® 9.2, 2020). The collected data were analyzed to gain a deep understanding of enterprise architecture, business processes, and application architecture design.

The architectural design was carried out using the Archimate application, an architectural language used to define, document, and implement the architecture of an organization (TOGAF® 9.2, 2020). Archimate consists of nine elements used to depict an organization's architecture, namely:

- Business
- Application
- Data
- Technology
- Implementation & Migration
- Environment
- Governance
- People

In this study, three architectural designs were produced:

1) Business Model Canvas Design

The Business Model Canvas Design is a visual tool used to depict the business model of an organization. It helps understand how an organization creates, distributes, and captures value for its customers.

2) Core Process / Business Process Design

The Core Process / Business Process Design is a visual tool used to depict the core business processes of an organization. It helps understand how an organization delivers value to its customers.

3) Application Architecture Design

Application Architecture Design is a visual tool used to depict the application architecture of an organization. It helps understand how applications within an organization interact and support business processes. The research was conducted in two stages:

a) Stage 1: Literature Review

In this stage, data and information were collected from various sources such as books, journals, articles, and websites. The collected data were analyzed to gain a deep understanding of enterprise architecture, business processes, and application architecture design. The reference sources used in this study include:

- Hu, W., Wang, Y., & Zhang, S. (2023). The impact of enterprise architecture on organizational performance: A meta-analysis. *Information & Management*, 50(5), 103267.
- Gupta, A., Singh, R., & Gupta, M. (2022). The impact of enterprise architecture on business agility: A systematic review. *Journal of Enterprise Architecture*, 8(1), 1-16.
- TOGAF® 9.2. Guide to the Architecture Development Framework. (2020). The Open Group.

b) Stage 2: Architectural Design

In this stage, architectural designs were created using the Archimate application. The resulting architectural designs were then analyzed to evaluate and validate them to meet the needs of SMA Atisa Dipamkara.

3. RESEARCH RESULTS AND DISCUSSION

In this section, the results and discussion of the research conducted by the author will be presented. From the literacy study and enterprise architecture design, the author obtained results in the form of a business model canvas architecture, application architecture, and business process architecture of SMA Atisa Dipamkara, which will be elaborated in more detail. The enterprise architecture design aims to optimize existing applications and propose new application designs to support the business processes of SMA Atisa Dipamkara to become more effective and efficient in terms of time, communication, data accuracy, and continuity.

3.1. *Business Architecture*

The business architecture is depicted in the business model canvas, a strategic management template developed by Alexander Osterwalder and Yves Pigneur in 2010. The business model canvas consists of nine building blocks representing the underlying aspects of formulating a business structure. The nine building blocks in the SMA Atisa Dipamkara enterprise architecture are described as follows:

- 1) **Value Proposition:** This section explains the values offered by the business to customers. In the SMA Atisa Dipamkara business model, the values offered, distinguishing it from similar schools, include quality education based on Buddha Dharma principles, extensive cooperation networks with universities at home and abroad accompanied by scholarship programs, competent teachers and adequate educational facilities, character building in line with Buddha Dharma, Mandarin language learning according to Chinese standards, technology-supported learning environment, accreditation as a driving school with excellent accreditation, and development of further studies with good career prospects and life skills. The ultimate goal is for students graduating from SMA Atisa Dipamkara to grow into individuals with noble character and excellent competencies in Mandarin and the ability to continue their further studies well according to their passion.
- 2) **Customer Segments:** This section explains the types of customers targeted by the business. In the SMA Atisa Dipamkara business model, there is essentially only one customer segment, parents, but with seven different characteristics: parents with high school-aged children in the Lippo Karawaci area and surrounding areas, parents interested in quality Buddhist-based education, parents whose children aspire to study at the best universities at home and abroad through scholarship programs, parents whose children want to enter state universities through the SNBP invitation route or PPKB-UI, parents who want their children to focus on character development, parents whose children have an interest in learning with technological support, and parents from diverse ethnic, ethnic, and religious backgrounds who want to apply Buddhist values in their daily lives. With the diversity of characteristics of parents who become the customer segment of SMA Atisa Dipamkara, it becomes an opportunity to increase the quantity of customers in the SMA Atisa Dipamkara business process.
- 3) **Channels:** This section refers to the media or means by which the business can communicate with and reach its target customers. In the SMA Atisa Dipamkara business model, there are eight channels developed: the school's official website, social media and official school platforms, education exhibitions and school events, Parents Teachers Meeting, banners, and other print promotional media, socialization in Buddhist religious communities, and event collaborations with universities and other institutions. These channels are expected to positively contribute to the development of the SMA Atisa Dipamkara business; hence optimization of the available channels is necessary.
- 4) **Revenue Stream:** This section explains how the business generates profits from its revenue. In the SMA Atisa Dipamkara business model, potential revenue streams include registration fees (initial fees), tuition fees, activity fees, purchase of school equipment by students, government grants, and voluntary contributions from external parties. A good revenue stream will ensure that the cash flow of SMA Atisa Dipamkara remains healthy and allows the business process to run smoothly.

- 5) **Customer Relationships:** This section explains how the business maintains customer loyalty to its services and products. In the SMA Atisa Dipamkara business model, open and two-way communication between the school and students or parents, support throughout the education process, academic counseling, further studies and career projections, extracurricular activities, and skill development are emphasized. Long-term relationships with alumni, regular feedback and evaluation of education services, school activities, and post-graduate alumni services.
- 6) **Key Activities:** Key activities necessary for the business to remain competitive and continue to develop are listed in this section. In the SMA Atisa Dipamkara business model, there are eight key activities: parents registering their children, students taking entrance tests, students attending classes, students participating in character development, students taking exams, students advancing to the next grade, students graduating, and post-graduate relationships within the alumni family. These key activities will be further elaborated in the SMA Atisa Dipamkara business process architecture to clearly illustrate the interdependence among them, which will significantly affect the pace of the SMA Atisa Dipamkara business process.
- 7) **Key Partnerships:** Partners in the business process that support the achievement of business goals are referred to as key partnerships. In the SMA Atisa Dipamkara business model, several partners support the main teaching and learning processes in SMA Atisa Dipamkara. Some of these partners include state and private universities at home and abroad, Foreign Education Agencies, Education Technology companies, managers of state university invitation lines (SNBP) and PPKB-UI, several Buddhist Education and Religious Organizations, government through Ministries, Departments, BPMP and BGP, and Psychological Institutions. These partners will play a role and synergize with SMA Atisa Dipamkara with the principle of mutual symbiosis that benefits both parties.
- 8) **Key Resources:** Key resources are the company's resources used to carry out its daily operations. In the SMA Atisa Dipamkara business model, the main resources are qualified teachers, modern education technology, comprehensive education facilities, standard curriculum and teaching materials, teacher training, student admission standards, information technology support, relevant regulatory support, and the latest teaching-learning methods. All of these resources are vital to ensure the quality and competitiveness of the education process at SMA Atisa Dipamkara.
- 9) **Cost Structure:** This section outlines the various costs incurred in running the business. In the SMA Atisa Dipamkara business model, the main cost components include teaching and learning costs, such as teacher salaries, classroom facilities, utilities, educational support facilities, and administrative costs. Other costs include costs for educational technology, marketing and promotion, student scholarships, extracurricular activities, and various other educational programs and events.

The business model canvas as described above represents the strategic business model formulation that serves as the foundation for SMA Atisa Dipamkara's business process architecture and application architecture.

3.2. Application Architecture

Application architecture is designed to ensure that applications owned by SMA Atisa Dipamkara can provide maximum benefit to the business and its stakeholders. The application architecture of SMA Atisa Dipamkara is depicted in several components:

- 1) Student and Parent Information System: This system functions to record and manage student and parent data, including personal data, student grades, attendance records, extracurricular activities, and financial records. The Student and Parent Information System should be user- friendly, secure, and easily accessible by authorized users.
- 2) Learning Management System (LMS): The Learning Management System is a platform for managing online learning materials, assignments, quizzes, and student interactions. It should support various content formats, facilitate communication between teachers and students, and provide tools for assessment and feedback.
- 3) Financial Management System: The Financial Management System is used to manage financial transactions, including billing, invoicing, payment processing, and budgeting. It should integrate with other systems to ensure accurate financial reporting and compliance with accounting standards.

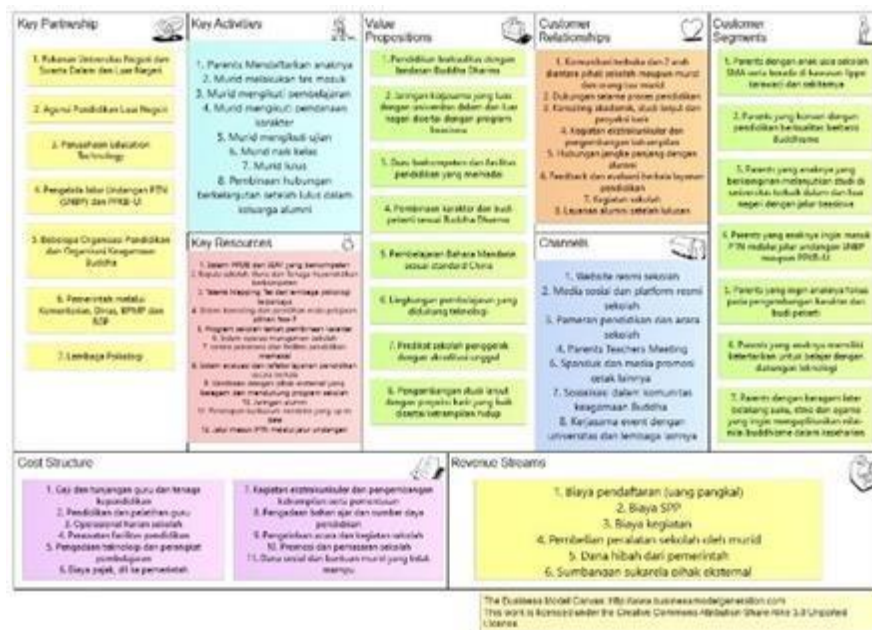


Figure 1. Business Architecture

3.3. Application Architecture

The application architecture encompasses the applications used by various parties within the company. The application architecture is divided into five parts: customer, product, supplier, management, and resources. These parts determine the code of each application, which is written in square brackets before the application name. The implementation of artificial intelligence (AI) in education has become an increasingly popular trend in recent years. AI has the potential to enhance the efficiency and effectiveness of the education process, as well as to provide a more personalized and relevant learning experience for students.

Adaptive learning systems use AI to tailor learning materials to the abilities of each student. This can help students learn more effectively and efficiently. According to Chen and Zhang (2021), adaptive learning systems can significantly improve students' learning outcomes. Machine learning can be used for various tasks in education, such as plagiarism detection, facial recognition, and data analysis. For example, a plagiarism detection system can be used to detect content copied from other sources. This system can help schools prevent plagiarism and ensure that students learn honestly.

Natural language processing can be used for tasks such as automatic translation, language recognition, and text analysis. For example, an automatic translation system can be used to translate learning materials into various languages. This system can help students who are not fluent in Indonesian to understand learning materials. Computer vision can be used for tasks such as object recognition, motion tracking, and image classification. For example, a facial recognition system can be used to check students' attendance. This system can help schools improve the accuracy of student attendance data.

Data science can be used for tasks such as data exploration, statistical modeling, and data visualization. For example, a data analysis system can be used to understand student behavior. This system can help schools provide more relevant services to students. At Atisa Dipamkara High School, AI can be applied in various applications that support the school's business processes, including:

- a) Adaptive learning systems that can be used to adjust learning materials to each student's abilities.
- b) Automatic assessment systems that can be used to objectively assess students' learning outcomes.
- c) Recommendation systems that can be used to suggest relevant learning materials or resources to students.
- d) Plagiarism detection systems that can be used to detect content copied from other sources.
- e) Facial recognition systems used to check students' attendance.
- f) Data analysis systems used to understand student behavior.
- g) Automatic translation systems used to translate learning materials into various languages.
- h) Virtual assistant systems used to assist students in the learning process.
- i) Text analysis systems used to understand text content, such as books, articles, or essays.

The application of AI in applications supporting the business processes of Atisa Dipamkara High School can provide several benefits, including:

- a) Improving operational efficiency and effectiveness. AI can help schools reduce costs and increase productivity.
- b) Improving the quality of learning. AI can help students learn more effectively and efficiently.
- c) Increasing the personalization of learning. AI can help schools provide a more relevant learning experience for students.

The following will outline the 5 parts of the application architecture within the Atisa Dipamkara High School application architecture:

1) Core Process Application Architecture

The core process application architecture includes applications that form the core of the services offered by Atisa Dipamkara High School, which include:

- [AP1] Learning Management System (LMS): LMS is a system used to manage learning. LMS at Atisa Dipamkara High School is used to provide learning materials, manage assignments and exams, and monitor student learning progress.
- [AP2] Academic Information System (AIS): AIS is a system used to manage academic information. AIS at Atisa Dipamkara High School is used to manage student, teacher, and subject data, including report card grades.
- [AP3] Students Information System (SIS): SIS is a system used to manage student information. SIS at Atisa Dipamkara High School is used to manage student personal data, academic data, and non-academic data, as well as document graduation and alumni data.

These core process applications are integrated with each other. LMS can access student and subject data from AIS, and AIS can access student data from SIS. This integration allows core process applications to work effectively and efficiently.

2) Customer Application Architecture

Customer Application Architecture is a collection of applications used only by customers, in this case, buyers and sellers. The applications in this architecture are:

- [AC1] Student registration application: This application is used by prospective students to register with Atisa Dipamkara High School. This application can be used to enter personal data, fill out registration forms, and upload required documents.
- [AC2] Customer Relationship Management (CRM) System: The CRM system is used to manage customer relationships. The CRM system at Atisa Dipamkara High School is used to manage customer data, including student, parent, and alumni data.
- [AC3] Feedback and Survey Tools: Feedback and Survey Tools are used to collect feedback from customers. Feedback and Survey Tools at Atisa Dipamkara High School are used to collect feedback from students, parents, and alumni.

These customer applications are integrated with each other. The student registration application can access student data from the CRM system, and the CRM system can access feedback data from the Feedback and Survey Tools. This integration allows customer applications to work effectively and efficiently.

3) Supplier Application Architecture

Supplier Application Architecture is used by suppliers and partners of Atisa Dipamkara High School in carrying out their operational activities related to the operational activities of Atisa Dipamkara High School. The applications contained in this architecture are:

- [AS 1] Supplier Relationship Management (SRM) System: The SRM System is used to manage relationships with suppliers. The SRM system at Atisa Dipamkara High School is used to manage supplier data, including product and service data, and contract data.

- [AS 2] Collaboration and Communication Tools: Collaboration and Communication Tools are used to collaborate and communicate. Collaboration and Communication Tools at Atisa Dipamkara High School are used to facilitate communication between the school and suppliers and partners.
- [AS 3] Alumni management application: The alumni management application is used to manage alumni data. The alumni management application at Atisa Dipamkara High School is used to manage alumni data, including contact data, education data, and employment data.

These supplier applications are integrated with each other. The SRM system can access contract data from Collaboration and Communication Tools, and Collaboration and Communication Tools can access alumni data from the alumni management application. This integration allows supplier applications to work effectively and efficiently.

4) Management Application Architecture

Management Application Architecture is used by school management leaders and stakeholders to help them evaluate, monitor, and see the big picture of company performance. The applications in this architecture include:

- [AM 1] Enterprise Resource Planning (ERP) System: The ERP System is used to integrate various business processes within an organization. The ERP system at Atisa Dipamkara High School is used to integrate various business processes, such as financial processes, academic processes, and operational processes.
- [AM 2] Project Management Tools: Project Management Tools are used to manage projects. Project Management Tools at Atisa Dipamkara High School are used to manage school projects, such as building projects, curriculum development projects, and extracurricular activity projects.

These management applications are integrated with each other. The ERP system can access data from Project Management Tools, and Project Management Tools can access data from the ERP system. This integration allows management applications to work effectively and efficiently.

5) Resources Application Architecture (Back Office)

The Resources Application Architecture includes applications used by staff to support the smooth running of activities and business processes at Atisa Dipamkara High School. It can be said that the applications listed in this architecture are mostly backend. These applications are:

- [AB 1] Accounting and Financial Management Software: Accounting and Financial Management Software (AFMS) is software used to manage finances. AFMS at Atisa Dipamkara High School is used to manage school finances, such as income and expenses, assets and liabilities, and financial reports. AFMS should help school finance staff manage school budgets and expenditures, produce accurate and timely financial reports, and conduct financial analysis for decision making.
- [AB 2] Inventory Management System: The Inventory Management System (IMS) is a system used to manage inventory. IMS at Atisa Dipamkara High School is used to manage school inventory, such as goods, materials, and tools. IMS should help school

logistics staff manage inventory stock and materials, place orders for goods and materials, and track goods and materials.

- [AB 3] Document Management System: The Document Management System (DMS) is a system used to manage documents. DMS at Atisa Dipamkara High School is used to manage school documents, such as academic documents, financial documents, and operational documents. DMS should help school administrative staff store documents securely, easily search for documents, and archive documents neatly.
- [AB 4] Human Resource Management System (HRMS): The Human Resource Management System (HRMS) is a system used to manage human resources. HRMS at Atisa Dipamkara High School is used to manage employee data, such as personal data, education data, and performance data. HRMS should help school HR staff manage employee data, process payroll and benefits, conduct performance appraisals, and develop employees.

These resource applications are integrated with each other. For example, AFMS can access inventory data from IMS, and DMS can access employee data from HRMS. This integration allows resource applications to work effectively and efficiently.

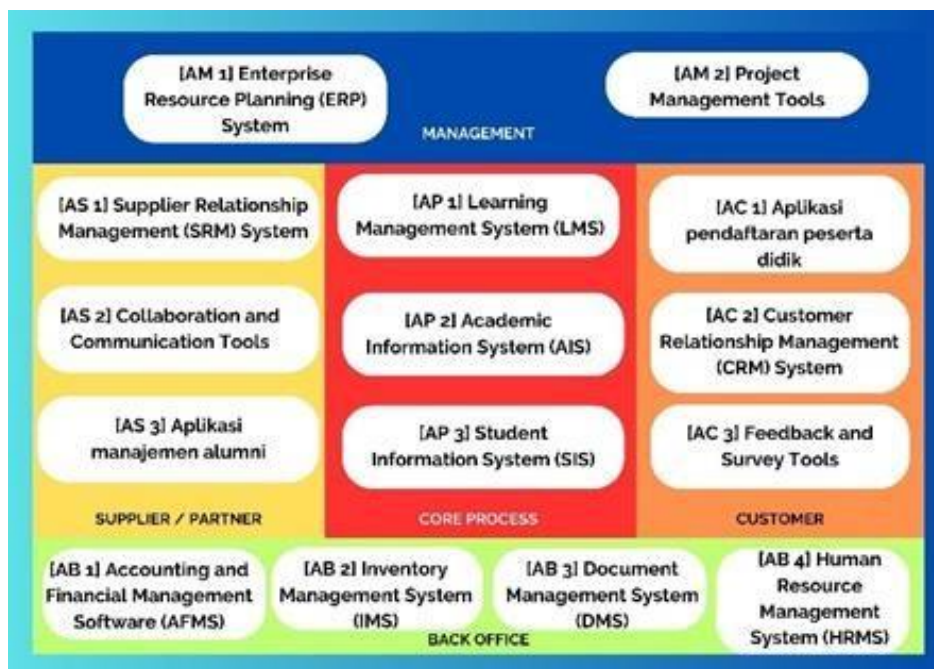


Figure 2. Application Architecture

3.4. Business Architecture / Core Process

The core business processes of the enterprise architecture of SMA Atisa Dipamkara are depicted as follows in the ArchiMate diagram. In this chapter, the author will explain the interconnection of architecture components in the diagram above sequentially. Each application and database is given a code name according to its respective code. In the first layer (yellow color), the square with a stick figure in the bottom right corner represents a business actor, while the rounded-corner squares are business processes. The squares with sharp corners without stick figures represent business objects. In the second layer (cyan color),

the rounded-corner squares represent application systems consisting of applications. These application systems group applications based on their functions and roles in the core business process. Meanwhile, other cyan- colored squares are applications or databases. The last layer (green color) is the technological infrastructure used to host databases. In this case, the technology used in servers.

The Core Business Process of SMA Atisa Dipamkara consists of 3 parts of business processes where business process 1 will focus on the registration process, business process 2 will focus on the learning process, and business process 3 will focus on after graduation. The author will elaborate on the processes and interactions that occur in each business process.

In business process 1, it starts with parents as stakeholders, namely customers of SMA Atisa Dipamkara registering for their children. Inside, there is the [AC1] student register application that will process starting from filling out registration forms, submitting registration document files, conducting entrance exams, to producing entrance exam graduation data which is then stored in the student registration data database to later become input for the [AB1] accounting and financial application to issue education fee invoices that must be paid by parents, until issuing payment receipts and validating students whose parents have completed payment administration to then be entered into the SMA Atisa Dipamkara student database which will become input for business process 2. Both applications are processed in student register management using server 1.

The next process is business process 2 which starts with the learning process and character development, and exams served by the [AP1] learning management system supported by AI related to the learning process. All learning processes, character formation, and exams are carried out continuously and periodically, the results of which are then stored in the student appraisal data database to be used as input for the student report data processing process which is then sent to the [AP2] academic information system application and stored in the ledger of student report database.

In this business process 2, there is also a periodic survey process both for students and parents and other stakeholders deemed necessary for the education service improvement process at SMA Atisa Dipamkara. The periodic survey process is served by the [AC3] feedback and survey application, where the survey results are then processed and stored in the resume of survey data database for upgrading the learning process at SMA Atisa Dipamkara. All applications and databases that occur in business process 2 are served by server 2.

Business process 3 will focus on the after-graduate process which starts with the graduation process served by the [AP3] students' information system application and produces a student certificate as its graduation document located in a student graduation management domain. After the graduation process, there is then a process for alumni services within the alumni management system, which includes 2 related applications namely the [AS3] alumni management application and the [AC2] customer relationship management system which then produces a database in the form of relationship data for processing and developing sustainable partnerships as the extended family of SMA Atisa Dipamkara. All of these processes are supported by server 3.

3.8. *Implications*

The results of this study have important implications for further research. The findings indicate that the design of enterprise architecture can provide significant benefits to schools. However, further research is needed to examine the benefits and challenges of implementing enterprise architecture in schools more deeply. Based on the results of this study, it is recommended to conduct further research using different methods and approaches, as well as involving a wider range of research participants. Research can be conducted to examine the benefits and challenges of implementing enterprise architecture in more specific educational fields, such as mathematics, language learning, and science education. Research is also needed to assess the long-term impact of implementing enterprise architecture. Research can be conducted to examine how enterprise architecture can affect school performance, such as educational quality, school competitiveness, and community satisfaction.

4. CONCLUSION

Based on the results of the research conducted, it can be concluded that the design of enterprise architecture at SMA Atisa Dipamkara can provide benefits to the school. These benefits include improving the efficiency and effectiveness of school business processes, such as managing student, teacher, and staff data, as well as the learning and assessment processes. It also facilitates decision-making by school management by enhancing data and information accessibility for school management, as well as ease in data and information analysis. Additionally, it enhances customer satisfaction among school stakeholders, such as students, teachers, and parents, towards school services.

The enterprise architecture model resulting from this research can serve as a reference for SMA Atisa Dipamkara to improve the efficiency and effectiveness of school business processes, facilitate decision-making by school management, and enhance customer satisfaction at the school. However, this research has several limitations, namely, it was conducted on a small scale involving 50 students, 10 teachers, and 1 school principal, and it was conducted over a short period, namely one semester. Therefore, it is recommended to conduct further research involving a broader range of participants and over a longer period. Further research can be conducted to examine the benefits and challenges of implementing enterprise architecture in schools more deeply, as well as to assess the long-term impact of implementing enterprise architecture.

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