ARCHITECTURAL DESIGN USING THE ZACHMAN FRAMEWORK AT MINING EQUIPMENT INDUSTRY

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Abstract— *The mining equipment industry requires the effective integration of Information Systems (IS) and Information Technology (IT) into its business processes to achieve a competitive advantage. This study focuses on Enterprise Architecture (EA) planning to align IS/IT implementation with the company's vision and mission. The Zachman Framework is utilized to map the organization's systems comprehensively, considering six perspectives and addressing 5W+1H (What, Why, When, Where, Who, and How). The research methodology includes data collection through interviews with key stakeholders and observations of core and supporting business activities. These data are analyzed using the Value Chain to assess the current state of the organization. The findings reveal gaps in the existing business processes and the misalignment of IS/IT initiatives with the organization's goals. Based on these analyses, the study develops an Enterprise Architecture design that proposes a structured approach to IS/IT implementation. The result of this research is a detailed proposal for the development of a tailored application to optimize business processes, improve operational efficiency, and ensure better alignment between IS/IT initiatives and organizational objectives. This study provides practical recommendations for the mining equipment industry to enhance its competitive edge through strategic IS/IT integration.*

Keywords: *Architectural Design. Enterprise Architecture, Mining Equipment Industry, Zachman.*

Intisari—*Industri peralatan pertambangan memerlukan integrasi Sistem Informasi (SI) dan Teknologi Informasi (TI) yang efektif ke dalam proses bisnisnya untuk mencapai keunggulan kompetitif. Studi ini berfokus pada perencanaan Arsitektur Perusahaan (EA) untuk menyelaraskan implementasi SI/TI dengan visi dan misi perusahaan. Kerangka Zachman digunakan untuk memetakan sistem organisasi secara komprehensif, dengan mempertimbangkan enam perspektif dan membahas 5W+1H (Apa, Mengapa, Kapan, Di mana, Siapa, dan Bagaimana). Metodologi penelitian mencakup pengumpulan data melalui wawancara dengan pemangku kepentingan utama dan pengamatan terhadap aktivitas bisnis inti dan pendukung. Data ini dianalisis menggunakan kerangka Rantai Nilai untuk menilai status organisasi saat ini. Temuan tersebut mengungkap kesenjangan dalam proses bisnis yang ada dan ketidakselarasan inisiatif SI/TI dengan tujuan organisasi. Berdasarkan analisis ini, studi ini mengembangkan desain Arsitektur Perusahaan yang mengusulkan pendekatan terstruktur untuk implementasi SI/TI. Hasil penelitian ini adalah proposal terperinci untuk pengembangan aplikasi yang disesuaikan untuk mengoptimalkan proses bisnis, meningkatkan efisiensi operasional, dan memastikan keselarasan yang lebih baik antara inisiatif SI/TI dan tujuan organisasi. Studi ini memberikan rekomendasi praktis bagi industri peralatan pertambangan untuk meningkatkan keunggulan kompetitifnya melalui integrasi IS/IT yang strategis.*

Kata Kunci: *Desain Arsitektur, Enterprise Architecture, Industri Peralatan Pertambangan, Zachman.*

INTRODUCTION

In the era of rapid globalization and digital transformation, the mining equipment industry faces unique challenges that require sophisticated and integrated solutions (Dumitriu & Popescu, 2020; Lee, Hartono, et al., 2024). These challenges include the need for efficient supply chain management, optimization of operational processes, and alignment of business strategies with technological advancements (Alhari &

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Fajrillah, 2022). The industry also contends with issues such as equipment lifecycle management, resource allocation, and regulatory compliance, all of which demand robust information systems and technology frameworks (Lee, Aprilia, et al., 2024)

Enterprise Architecture (EA) offers a structured approach to addressing these challenges by providing a comprehensive view of an organization's IT infrastructure, ensuring alignment between technology and business goals (Santosa & Mulyana, 2023). Among the various EA frameworks, the Zachman Framework stands out due to its ability to provide a fundamental organizational structure that addresses business, information, application, and technology architecture simultaneously (Andry et al., 2023). Unlike other frameworks, the Zachman Framework delivers a detailed mapping of organizational elements through six perspectives and 5W+1H (What, Why, When, Where, Who, and How), facilitating better integration, interpretation, and management of information systems (Putra et al., 2021).

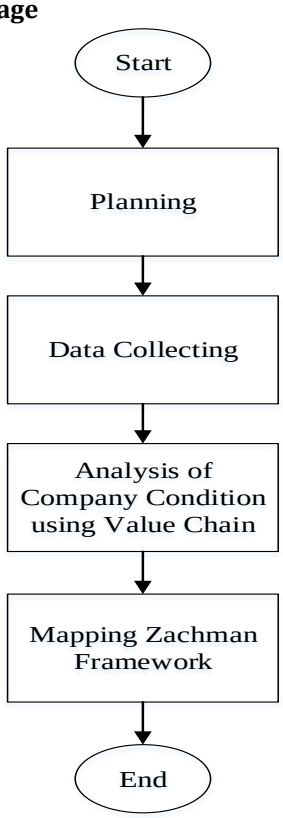
This research focuses on leveraging the Zachman Framework to design an architectural blueprint for the mining equipment industry, addressing its specific operational and strategic needs (Jonathan & Andry, 2024). The study employs data collection methods such as interviews and observations to gather insights on business processes and employee roles, followed by an analysis using the Value Chain to evaluate the organization's current condition (Tannady et al., 2020). The resulting Enterprise Architecture design serves as a foundation for the planning and development of applications tailored to optimize core and supporting business activities, thereby enhancing operational efficiency and competitiveness (Damara et al., 2022).

The significance of information technology lies in its ability to drive innovation, improve operational output, and create competitive advantages (Divayana et al., 2021). However, achieving these outcomes requires seamless integration of software, hardware, and business processes within the organization's ecosystem (Mujahidin & Majid, 2022). Inadequate integration can lead to inefficiencies and disruptions, underscoring the critical role of EA in addressing these issues (Fitriasari, 2020). Moreover, the inclusion of business architecture within the EA framework supports the alignment of business operations, IT governance, and strategic objectives, facilitating organizational transformation (Daoudi et al., 2023).

This study contributes to the understanding of how the Zachman Framework provide actionable solutions to the challenges faced by the mining equipment industry (Widarti & Sudana, 2023). By integrating strategic planning with technical implementation, this research offers a blueprint for optimizing operations, enhancing IT infrastructure, and achieving long-term organizational goals (Jnr, 2020). The findings aim to guide future developments in enterprise architecture within the mining sector, addressing its complex and dynamic business environment (Robl & Bork, 2022).

MATERIALS AND METHODS

Research Stage



Source: (Aprilia et al., 2024)

Figure 1. Research Stages

The steps of the approach utilized in this research are described in Figure 1. The stages of this research are divided into 5 parts, namely:

1. Planning

This stage involves conducting a literature study to gather insights into trust in Enterprise Architecture (EA) design and examining prior case studies of corporate architecture. The selection of case studies focused on organizations with comparable industry challenges to identify best practices and lessons learned. Additionally, this stage defines the scope, vision, and mission to align the EA design with organizational goals. Key stakeholders, including executives and IT managers, participated in discussions to establish objectives and secure commitments for the development process.

2. Data collection

In this stage, multiple methods were employed to gather comprehensive data:

a. Observations: On-site observations were conducted to document workflow, processes, and IT usage within the organization.
b. Interviews: Semi-structured interviews were held with 15 participants, including management, IT personnel, and operational staff. Participants were selected based on their roles and involvement in key business and IT processes.
c. Document Analysis: Internal company documents such as organizational charts, process flow diagrams, and IT infrastructure layouts were reviewed to understand existing practices and systems.

Key interview questions focused on understanding pain points in current processes, the perceived alignment between IT and business strategies, and expectations for future system improvements.

3. Analysis of company condition using value chain

The collected data, particularly from interviews, are analyzed to design a corporate architecture. The analysis also incorporates the value chain to evaluate the organization's current state. Based on this analysis, recommendations for improvements and future steps are formulated.

4. Mapping Zachman Framework

In this stage, the researcher creates an enterprise architecture design using the Zachman Framework. The design is analyzed, and actionable recommendations are provided to the organization. The final output is a comprehensive report summarizing the findings, recommendations, and architectural design, which is then delivered to the business.

5. Reporting and Recommendations

The final stage involved compiling a detailed report that included the proposed Enterprise Architecture design, findings from the Value Chain analyses, and actionable recommendations. The report outlined a blueprint for the development of tailored applications and technology solutions to enhance operational efficiency and align IT initiatives with business goals

Methods

Zachman framework, which was applied in this study, is shown in Figure 2 each line represents the following perspective:

1. The Planner Perspective

A mining equipment company sets long-term strategic goals and a vision it aims to achieve. The company may aim to become a leading provider of mining equipment in the global market, focusing on technological innovation, product reliability, and superior customer service.

2. The Owner Perspective

In a mining equipment company, this may include divisions such as R&D (research and development), production, marketing, sales, customer service, and supply chain management. This structure is designed to ensure efficient workflows and clear responsibilities through out the organization.

3. The Designer Perspective

In a mining equipment company, this could include systems for production management, information systems for inventory monitoring, quality control systems, as well as systems for customer relationship management. (CRM). This model illustrates how the components of the system work together.

4. The Builder Perspective

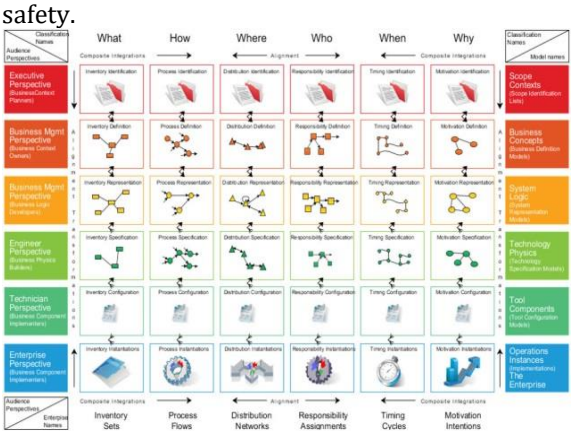
In a mining equipment company, a factory for assembling heavy machinery or facilities for testing product quality may be built according to specifications established from the designer's perspective.

5. The Sub Contractor Perspective

Mining equipment companies require specialized spare parts for heavy machinery produced by external vendors. This specification includes details such as the materials used, dimensions, performance, and quality standards that must be met by the subcontractor.

6. The User Perspective

Understanding their needs helps ensure that the systems and equipment designed meet user expectations in terms of usability, efficiency, and safety.



Source: (Research Results, 2025)

Figure 2. The Zachman Framework

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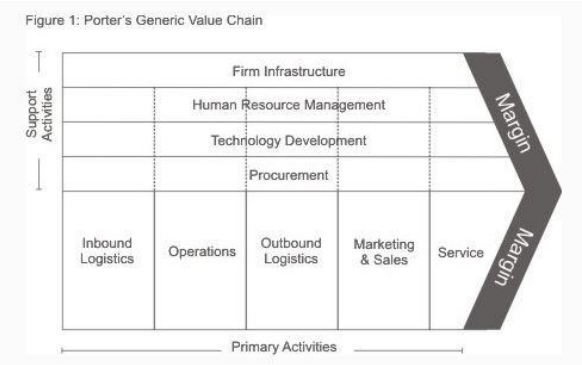
RESULTS AND DISCUSSION

In this case, the author's research approach Using the equipment mining industry as a case study, this study employed a descriptive methodology. The business identified internal issues and spoke with internal directors in order to collect data. This case study's author used the Zachman Framework to develop the company's architecture; the research only develops the architecture; it does not carry it out.

Value Chain



Source: (Research Results, 2025)

Figure 3. Value Chain

Figure 3 show of Value Chain. Value chain analysis is an effective technique for investigating a variety of business facets that can be applied broadly, such as material flows or life cycle analysis. The company's activities are divided into two categories by this value chain, including:

1. Primary Activities

Primary activities are those that are associated with the company's primary business, such as developing, marketing, selling, and providing services for a product.

a. Inbound Logistics, this phase outlines the procedures of the interactions that take place between businesses and suppliers. Buying raw materials, packaging products, and other supporting items are the procedures.
b. Operations, this phase includes an explanation of the steps the business took to get the production process ready before shipping the goods.
c. Outbound Logistics, an explanation of the procedures and activities that take place between the business and the client will be included in this step. Delivering goods in a box car to the destination, unloading them, and giving the recipient a delivery letter to sign are the steps involved in the process.
d. Marketing and Sales, this phase includes an explanation of the company's operations, with a focus on the marketing and sales division. This company has a direct marketing approach, an email-based marketing approach, and a system of connections and trust for its marketing.
e. Service, in order to keep customers loyal to the products produced, this stage explains the services the company has offered for the products ordered.

2. Support Activities

Activities that assist the main activities are known as support activities. Support activities can enhance the value of a company's primary product.

a. Firm Infrastructure, the infrastructure of the company is divided into a number of sections that support the primary functions of the organization, such as management of the resources, information, and finance departments, among other areas.
b. Human Resource Management, operations that facilitate business operations, particularly in the human resources division, such as hiring, assigning, and placing employees.
c. Technology Development, technology support is also required to ensure that the processes included in the primary activity operate smoothly. As of right now, businesses use technology—such as production machines—to aid in the production process.
d. Procurement, production machines are one type of tool used in the production process. All these instruments are essential to support the company's primary operations.

Business Process Model

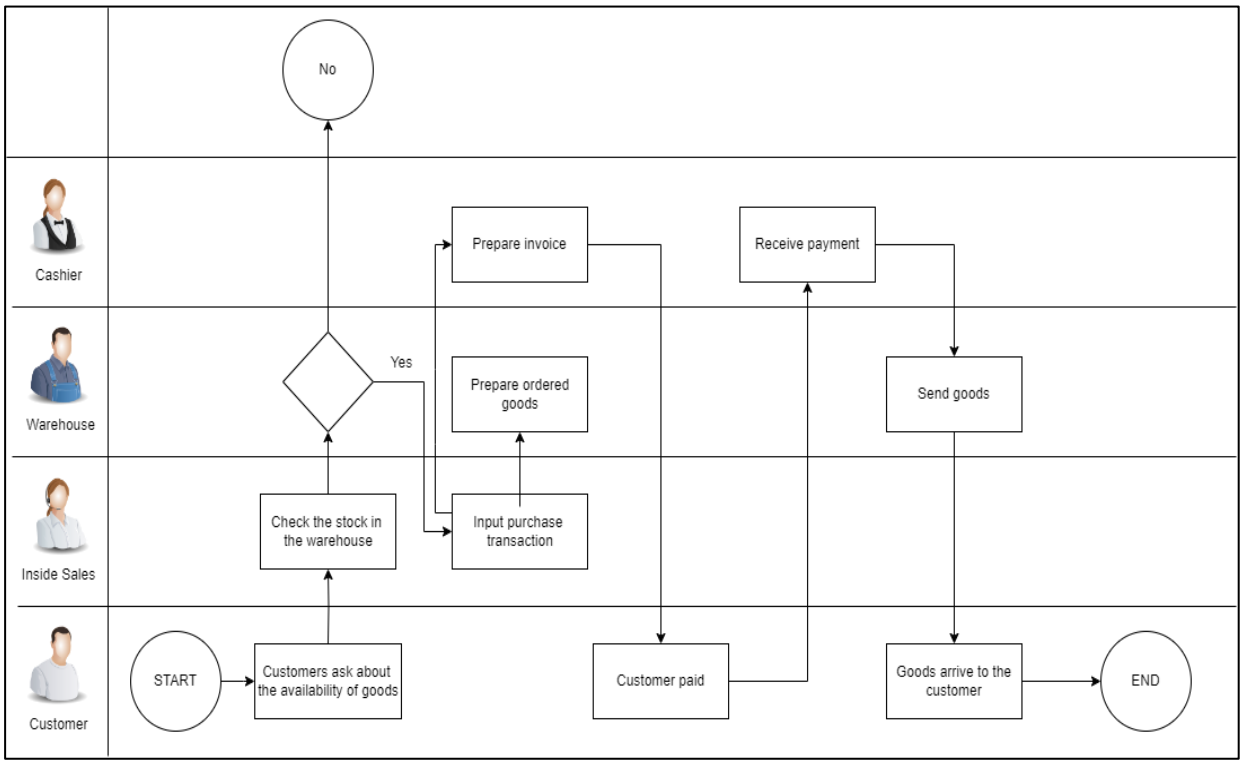
Diagram model of business process show in Figure 4. This section explains the scenario of business processes from Equipment Mining Industry:

1. The customer asks Inside Sales for the availability of the product they want to order.
2. Inside Sales will check with the Warehouse (Inventory) whether the product ordered by the customer is available or not, if it is not available then it will be finished.
3. If the product is available, Inside Sales will input the purchase transaction which will be given to the Warehouse (Inventory) for preparing, packing and so on.
4. When an agreement is reached, the goods will be shipped straight to the client's address. Prior to shipment, the administration will arrange for a driver's travel authorization; upon delivery, the driver will need to present this authorization and provide their signature as confirmation that the goods have been sent; the travel document will then be returned to the administration and forwarded to the

accounting department so that a client bill can be created.

5. Inside Sales will also convey to the Cashier that the order has been made, the Cashier will create an invoice for the product price that will be paid to the customer.
6. Invoice from the Cashier will be handed over to the customer for processing to the customer to make payment.
7. Customers who have paid for their data will be confirmed by the Cashier and the Warehouse (Inventory) will send the product to the customer.

Proceed with the value chain and SWOT analysis of business processes after becoming familiar with the company's current procedures.



Source: (Research Results, 2025)

Figure 4. Business Process Model

Mapping Data to Zachman Matrix

Once the company's business processes have been well-documented, the next step is to map each process into the Zachman Framework matrix. Just two rows and three columns—owner and planner rows, as well as the columns for what, how, and where—from the Zachman framework make up the matrix that is used. The outcomes are as follows:

1. Planner
   a. What

This information system contains data about marketing (company information, message to us, delivery of goods, client, driver, and truck data), daily cash (in and out transaction data), paying off debt or installments (company debt or installment data, significant event data), payroll (permanent employee, employee performance, payroll data), truck maintenance (truck information, damage and repair data, truck repair costs), and account information.

   b. How

The processes that take place are as follows: marketing (introduction to the company, services provided, and question and answer sessions with potential customers); delivery of goods (client data recording, order scheduling, order tracking); daily cash (keeping track of cash in and out each day); payment of debt or installments (documenting information on debt or installments, recording significant events, monitoring payments); payroll (keeping track of employee data, employee performance, salary management); truck maintenance (collecting truck data, documenting damage or repairs), and the reporting process.

   c. Where

This line discusses the location of themain business location on Equipment Industry in Jakarta, Indonesia.

Implementation Plan

There will be four applications integrated into the company's business processes as a consequence of the business process planning outcomes. Following a sequence determined by the application portfolio, this application will be implemented. One can see if the application will be divided by looking at Table 1 Portfolio Application. The explanation is as follows:

1. Strategic, which is a critical application for the sustainability of business strategies in the future?
2. Key operations, i.e. applications that are currently used or relied upon by the enterprise for success.
3. Supporting, a valuable but not critical application for success.
4. High-oriented, applications that may be important in achieving success in the future.

Applications contained in key strategic and operational categories will be implemented first. After that, only followed by applications that are categorized in high-oriented and supportive.

Tabel 1. Application Planning

Application	Category
Truck Maintenance	Strategic
Employee Recruitment	Key Operational
Field Service	Support
Goods Delivery	High Oriented

Source: (Research Results, 2025)

Table 1 show of three applications that would be integrated into the company's business processes based on the outcomes of the business process planning process. According to the application portfolio, this application will be implemented in the following order.

The implementation of the proposed applications, as outlined in the business process planning outcomes, is essential for optimizing the mining equipment industry's operations and aligning them with strategic objectives (Prieto, 2022). The categorization into Strategic, Key Operational, Supporting, and High-Oriented applications provides a clear roadmap for deployment, ensuring critical systems are prioritized (Widarti & Sudana, 2023).

For instance, the Truck Maintenance application, classified as Strategic, will address the essential need for equipment reliability and operational continuity. Similarly, the Employee Recruitment application, falling under the Key Operational category, is vital for streamlining workforce management and ensuring the company has the talent required to meet its goals. Applications like Field Service and Goods Delivery, categorized as Supporting and High-Oriented, respectively, will enhance operational efficiency and prepare the organization for future market demands (Tannady et al., 2020). Implementing these applications in a phased manner minimizes risks while addressing immediate business needs (Jonathan & Andry, 2024). However, challenges such as employee adaptation, system integration, and resource allocation require attention, with training and stakeholder engagement playing crucial roles (Jayaraman et al., 2023). This structured approach not only improves internal processes but also sets a benchmark for innovation and strategic alignment in the mining sector.

CONCLUSION

This research highlights Zachman Framework in structuring and organizing the planning of corporate architecture development for the mining equipment industry. By applying the framework, four new application designs were developed to enhance critical business processes: hiring, shipping, payroll, and fleet management. These applications aim to improve operational efficiency, streamline workflows, and better align information systems with the company's strategic objectives. The benefits of implementing the proposed architectural design include improved coordination across departments, enhanced decision-making through better data integration, and reduced inefficiencies in core and supporting activities. However, potential challenges include the need for substantial organizational change, employee adaptation to new workflows, and the risk of underutilizing the developed systems due to insufficient training or resistance to change.

To address these challenges, it is recommended that the company invest in comprehensive training programs to ensure that employees can effectively adapt to new business procedures and fully utilize the developed applications. Moreover, ongoing evaluation and refinement of the enterprise architecture should be conducted using alternative methodologies to identify areas for improvement and validate the outcomes of the Zachman Framework-based approach. Beyond the immediate implications for the company, this research provides insights into the broader mining industry. The findings underscore the value of employing structured Enterprise Architecture planning to address complex operational challenges, paving the way for enhanced productivity and competitiveness across the sector. Future studies could explore the scalability of this approach to related industries, offering a pathway to wider adoption and innovation.

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