Artificial Intelligence Adoption Framework for Business Architecture

Leni Fitriani, Masayu Leylia Khodra and Kridanto Surendro

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Leni Fitriani
[1]School of Electrical Engineering and Informatics
Institut Teknologi Bandung
Bandung, Indonesia
[2]Department of Informatics Engineering
Institut Teknologi Garut
Garut, Indonesia
33221034@std.stei.itb.ac.id

Masayu Leylia Khodra
School of Electrical Engineering and Informatics
Institut Teknologi Bandung
Bandung, Indonesia
masayu@staff.stei.itb.ac.id

Kridanto Surendro
School of Electrical Engineering and Informatics
Institut Teknologi Bandung
Bandung, Indonesia
endro@itb.ac.id

***Abstract*—This research develops a business architecture framework for adopting Artificial intelligence (AI) technology based on the Business Architecture Body of Knowledge (BIZBOK). BIZBOK guides aligning business capabilities, information value streams, and organizational structure with strategic objectives. BIZBOK offers a best practice guide for developing a strong and holistic business architecture, but BIZBOK has not adopted AI in its development. The main motivation is the push from Industry 4.0 and the need to increase organizational competitiveness through AI. This research aims to create a practical framework for adopting AI in enterprise architecture, especially business architecture. This framework is designed to guide organizations in adopting AI to improve business process efficiency, product/service innovation, and optimize resource allocation.**

Keywords— artificial intelligence, BIZBOK, business architecture, Framework.

I. INTRODUCTION

Business architecture provides a structured approach to aligning business strategy with operational processes and technological capabilities [1]. Frameworks such as TOGAF and BIZBOK offer comprehensive methodologies to guide organizations in developing robust business architectures [2]. Best practices from BIZBOK emphasize the importance of aligning business capabilities, information value streams, and organizational structure with strategic objectives [1].

Industry 4.0 requires companies to adapt to rapid technological changes quickly, and AI is a crucial technology that supports digital transformation [3], [4], [5]. Integrating AI is the key to increasing organizational competitiveness in the era of digital transformation [6]. AI can help improve business process efficiency, product/service innovation, improve customer experience, and optimize resource allocation [7], [8]. there is a need for a practical framework to guide the adoption of AI into enterprise architectures [9], [10], [11].

Research on the adoption of AI in business architecture shows significant progress, but several gaps still need to be filled. Trad [12] proposed a mathematical model for business transformation strategies, while Van de Wetering et al. [13] revealed the positive impact of AI on dynamic change and operational agility. Amer [14] Highlighted the efficiency of decision-making in architectural projects with AI, and LeanAI introduced a method for implementing AI in AEC. Chen et al. [15] developed a framework for AI adoption in B2B marketing. These studies have not fully adopted the TOGAF and BIZBOK frameworks for AI adoption in business architecture.

An AI adoption framework based on TOGAF was previously developed to support AI adoption in business architecture to help organizations design, implement, and manage AI integration in EA [16]. This framework will offer helpful direction for individuals like enterprise architects, IT managers, and AI professionals who are confronting the difficulties of adopting AI into enterprise architecture.

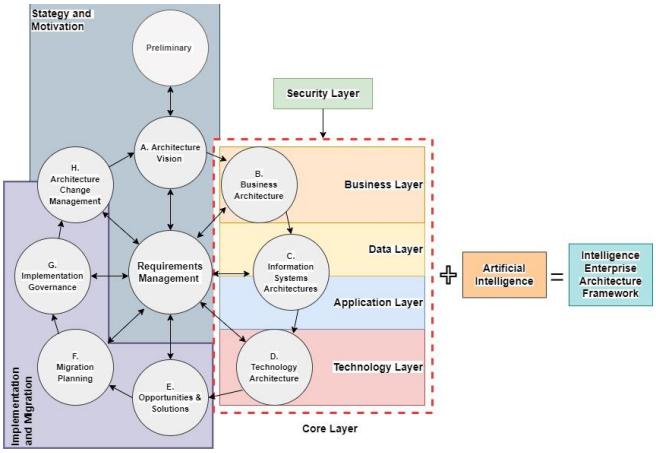

Fig. 1. Togaf-based EA Framework for utilizing AI [16]

Figure 1 above depicts the framework proposed by previous research, which consists of several core layers, namely [16] :

1. Business Layer: This includes the business strategy, business capabilities, and value streams that need to be optimized by AI.
2. Data Layer: Provides the data infrastructure needed to support AI implementation, including data management and analytics.
3. Application Layer: Focuses on business applications that utilize AI to increase efficiency and innovation.
4. Technology Layer: Provides the underlying technology to support AI, including IT infrastructure and networks.
5. Security Layer: Guarantees that AI integration is carried out by paying attention to security aspects and compliance with applicable regulations.

Framework [16] is the first framework to adopt AI into BIZBOK. However, research [16] still discusses the overall framework based on TOGAF and has not discussed the architecture per layer. Because each layer has different process steps, this framework cannot be directly used in designing architecture per layer. Therefore, this research focuses on business architecture and aims to produce a business architecture framework for companies that adopt AI. It is based on the TOGAF ADM methodology and BIZBOK guidelines.

II. Related work

A. Business Architecture

In TOGAF, Business Architecture is a key domain of Enterprise Architecture, providing a structural representation of an organization's essential functions, including goals, processes, roles, and information. Its main goal is to align business strategy and operations with the company's strategic needs and goals [1]. BIZBOK guides this process, offering a structured framework and best practices to address business challenges effectively. Business Architecture is defined as a comprehensive, multidimensional representation of capabilities, value delivery, information, and organizational structure, highlighting the interconnectedness of these components with strategy, products, policies, and stakeholders [2].

The four core domains of business architecture organization, capabilities, value streams, and information, are foundational due to their relative stability compared to other business elements. These domains offer a stable base for business operations. Conversely, the outer rim domains, including stakeholders, policies, strategies, products, initiatives, and metrics, represent business aspects that may change more frequently. For example, stakeholders can be more dynamic compared to the more static nature of capabilities or information. Once established, these business architecture domains can absorb and represent various business perspectives, providing a robust foundation for a highly adaptable and flexible business architecture [2].

B. AI in Business

AI has revolutionized various aspects of business operations, improving efficiency, decision-making, and customer experience. Research shows that AI can dramatically change administrative functions such as finance, legal, and HR by improving business intelligence, analytics, and software development [17].

Research [17] provides a comprehensive framework for understanding and categorizing different stages of AI development. By understanding each stage in the Machine Intelligence Continuum, organizations can plan and implement AI strategies that are more effective and tailored to their needs, thereby improving operational efficiency, innovation, and strategic decision-making. The Machine Intelligence Continuum describes the progression of machine intelligence from basic to advanced capabilities. At the simplest level, "Systems That Act" operates based on predefined rules without complex processing or reasoning. "Systems That Predict" can forecast outcomes using historical or current data analysis. "Systems That Learn" improve performance over time through experience and data. "Systems That Create" generate new content or solutions by leveraging understanding and reasoning. "Systems That Relate" interact effectively with humans, enabling natural communication. "Systems That Master" excels in multiple domains, applying cross-domain knowledge for comprehensive solutions. At the most advanced level, "Systems That Evolve" continuously learn and adapt to new conditions, updating their knowledge with changing environments. Each level provides distinct capabilities applicable across various business and technological contexts.

The use of AI in business can be categorized into two large groups, namely automation and augmentation [18]. The AI Core Areas encompass essential methodologies and technologies driving the development of intelligent systems. Knowledge Representation and Reasoning (KRR) structure information logically and probabilistically for automated decision-making, while Planning, Search, and Optimization (PSO) devise and execute solutions through algorithms. Machine Learning (ML) improves through data pattern identification, and Natural Language Processing (NLP) enables interaction with human language. Computational Perception (CP) interprets sensory data, Robotics, Agents, and Integration (RAI) handle system autonomy and coordination, and Human-Machine Interaction (HMI) facilitates effective communication between humans and machines. Together, these core areas form the foundation for sophisticated AI systems, enhancing learning, reasoning, perception, and interaction capabilities [19].

C. Adoption of AI in the Business Architecture

Research on adopting AI in business architecture has shown significant developments. Trad analyzes the role of Global Business Education (GBE) by proposing an applied holistic mathematical model for GBE (AHMM4GBE) that supports business transformation strategies that organizations without computer science qualifications can easily adapt [12]. Van de Wetering et al. investigated the impact of AI architectural capabilities on enterprise dynamic change capabilities and operational agility with the result that AI architecture positively influences enterprise change capabilities and operational agility [13]. Amer highlighted the role of AI in architectural design, pointing out that AI facilitates more efficient utilization of data and decision-making in architectural projects. This research encourages architects to adopt AI to increase efficiency and achieve design goals more effectively [14]. A new method, LeanAI, was introduced to increase the success of AI implementation in the Architecture, Engineering, and Construction (AEC) industry. This method, developed from longitudinal studies, helps differentiate AI capabilities and engage stakeholders early in the planning process [20]. Chen et al. developed a conceptual framework for AI adoption in business-to-business (B2B) marketing, identifying key drivers, barriers, and outcomes of AI adoption in B2B marketing [15].

TABLE I. SUMMARY OF AI RESEARCH IN BUSINESS ARCHITECTURE

Journal	Strengths	Weaknesses
[12]	Propose a holistic mathematical model that supports business transformation strategies.	Implementation of the model requires significant adjustments in different organizations.
[13]	Demonstrate the positive impact of AI on a company's	This study does not cover all external variables that

Journal	Strengths	Weaknesses
	dynamic change capabilities and operational agility.	influence organizational change.
[14]	Facilitate more efficient data utilization and decision-making in architectural projects.	The primary focus on architectural design does not include other management and operational aspects.
[20]	The LeanAI method helps differentiate AI capabilities and engage stakeholders early in planning.	Implementation of the method requires significant time and resources.
[15]	Identify key drivers, barriers, and outcomes of AI adoption in B2B marketing.	The framework needs to be adapted for industries other than B2B marketing.

Existing research on AI adoption in business architecture has demonstrated many important aspects, but there are still several gaps that this research aims to fill. The following is an analysis of the gaps between existing research and research currently being conducted:

TABLE II. GAP ANALYSIS

Journal	Gaps
[12]	This research focuses on global business education without specifically adopting frameworks such as BIZBOK for AI in business architecture.
[13]	Despite demonstrating the positive impact of AI on organizational agility, this research does not offer a practical framework for BIZBOK-based AI implementation.
[14]	The focus of this research on architectural design and decision-making has not yet integrated the BIZBOK frameworks for implementing AI in the overall business architecture.
[20]	LeanAI offers AI implementation methods but emphasizes less integration with business architecture frameworks such as BIZBOK.
[15]	The developed framework focuses on B2B marketing without providing comprehensive guidance for AI adoption in BIZBOK-based business architectures.

Together, These studies demonstrate that adopting AI in business architecture increases efficiency and agility and requires a systemic and holistic approach to address emerging challenges and ensure successful implementation and broad acceptance across various industry sectors.

III. PROPOSED FRAMEWORK

The AI adoption framework in Business Architecture is proposed to guide organizations with a business architecture in designing, implementing, and managing AI adoption. Figure 2 illustrates AI adoption within business architecture, starting from Business Architecture through the Machine Intelligence Continuum, AI Technologies, and AI Use to form the Blueprint for AI Adoption in Business Architecture

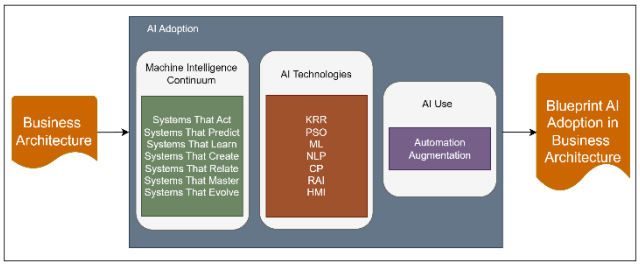

Fig. 2. Blueprint AI Adoption in Business Architecture

From Figure 2 it can be explained as follows :

1. Business Architecture:
   This is the starting point of the framework, encompassing core elements such as organization, capabilities, value streams, and information that are stable and fundamental to business operations.
2. AI Adoption:
   The Machine Intelligence Continuum encompasses various levels of AI capabilities, each with distinct functions. **Systems That Act** operate based on predefined rules, providing automated responses to specific situations. **Systems That Predict** leverage data analysis to make accurate forecasts, enhancing decision-making processes. **Systems That Learn** continuously improve through data and experience, adapting to new information. **Systems That Create** can generate new content or solutions, driving innovation. **Systems That Relate**, understand, and respond to human interactions, facilitating more natural and effective communication. **Systems That Master** excels across various domains, applying cross-domain knowledge to achieve superior performance. Lastly, **Systems That Evolve** adapt to changing conditions, ensuring they remain effective and relevant in dynamic environments. This continuum illustrates the progression of AI capabilities from basic rule-based systems to advanced adaptive systems.
   AI technologies encompass various methodologies and tools that drive intelligent systems. **Knowledge Representation and Reasoning (KRR)** involves structuring information logically and probabilistically to enable automated decision-making. **Planning, Search & Optimization (PSO)** includes methods for devising and executing solutions through advanced search and optimization algorithms. **Machine Learning (ML)** utilizes algorithms that learn from experience, identifying patterns in data to improve over time. **Natural Language Processing (NLP)** focuses on collecting and processing text, enabling systems to understand and generate human language. **Computational Perception (CP)** interprets sensory data, such as images and voice, to facilitate recognition and understanding. **Robotics, Agents & Integration (RAI)** involves intelligent systems' coordination, cooperation, and autonomy within their environments. Lastly, **Human-Machine Interaction (HMI)** encompasses technologies that enable effective and seamless interaction between humans and machines.
3. AI Use:
   AI can be applied in two primary ways to benefit businesses and organizations. **Automation** involves using AI to automate routine and operational tasks, streamlining processes, and increasing efficiency by reducing the need for human intervention in repetitive activities. **Augmentation** refers to using AI to enhance human capabilities, particularly in decision-making and innovation, by providing advanced tools and insights that support more informed and creative problem-solving.

4. Blueprint AI Adoption in Business Architecture:
This is the outcome of integrating AI into business architecture, providing a comprehensive guide for AI adoption that encompasses all aspects, from the machine intelligence continuum and AI technologies to AI use in automation and augmentation. This blueprint helps organizations effectively implement AI to achieve operational efficiency and enhance human capabilities.

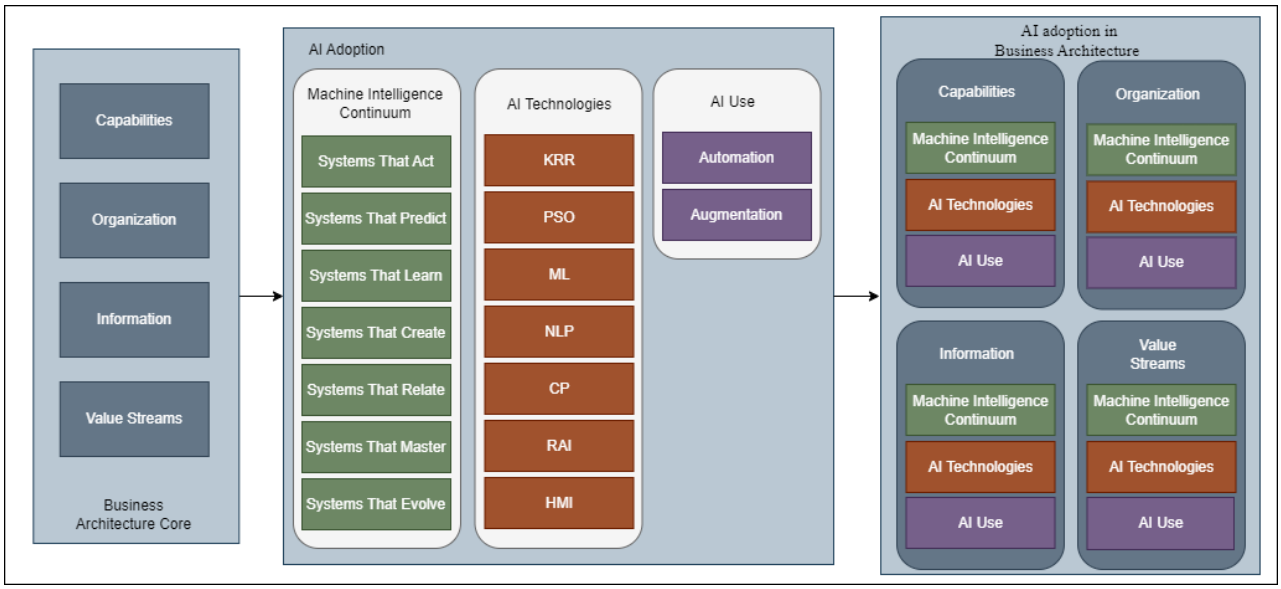

Fig. 3. AI adoption framework in Business Architecture

Figure 3 illustrates a comprehensive framework for integrating AI adoption within the core elements of business architecture, which include capabilities, organization, information, and value streams. This framework leverages the Machine Intelligence Continuum, AI Technologies, and AI Use to form a cohesive AI adoption strategy.

The core of business architecture consists of four essential elements that form the foundation of any organization. **Capabilities** refer to a business's fundamental abilities to operate effectively, encompassing the skills, competencies, and processes that enable performance. **Organization** describes the structural setup of a business, defining roles, responsibilities, and hierarchies that ensure efficient management and coordination of activities. **Information** includes the data and knowledge that support business operations and decision-making, providing the necessary insights and facts to guide strategic and operational actions. **Value Streams** represent the activities that deliver value to customers and stakeholders, outlining how products and services are created and provided to meet their needs and expectations. AI adoption in business architecture involves three key components: the **Machine Intelligence Continuum**, **AI Technologies**, and **AI Use**.

The AI Adoption Framework in Business Architecture integrates the core domains of Capabilities, Organization, Information, and Value Streams with the Machine Intelligence Continuum, AI Technologies, and AI Use. This framework ensures that AI is strategically applied to enhance business capabilities, optimize organizational structures, improve information management, and refine value streams. Businesses can achieve higher operational efficiency and drive strategic innovation by leveraging the full spectrum of AI capabilities, technologies, and use cases.

Figure 3 provides a comprehensive framework for businesses to adopt AI across their core domains, ensuring that AI technologies are adopted seamlessly to support automation and augmentation efforts. This holistic approach enables businesses to harness the full potential of AI to drive growth and competitiveness.

The example of the relationship between Business Architecture Core, Machine Intelligence Continuum, AI Technologies, and AI Use can be clearly understood in the table. This table shows how core elements of business architecture can be enhanced through various AI technologies and their use, both through automation and augmentation.

TABLE III. RELATIONSHIPS BETWEEN BUSINESS ARCHITECTURE CORE, MACHINE INTELLIGENCE CONTINUUM, AI TECHNOLOGIES, AND AI USE

Business Architecture Core	Machine Intelligence Continuum	AI Technologies	AI Use
Capabilities	Systems That Act	KRR	Automation
	Systems That Learn	ML	Augmentation
	Systems That Create	NLP	Automation
Organization	Systems That Relate	CP	Augmentation
	Systems That Master	RAI	Automation
Information	Systems That Predict	PSO	Automation
	Systems That Learn	ML	Augmentation
Value Streams	Systems That Evolve	HMI	Augmentation
	Systems That Create	NLP	Automation

The adoption of AI into business architecture enhances various core domains, including capabilities, organization, information, and value streams. In terms of capabilities, AI improves business operations through rule-based systems and automated decision-making, identifies patterns in data for enhanced performance, and generates new content to support business functions. For organizational optimization, AI enables better understanding and response to human interactions and coordinates and automates systems to boost efficiency. In information management, AI facilitates predictive planning using search and optimization algorithms and enhances decision-making by learning from data.

Regarding value streams, AI ensures effective interaction between humans and machines and automates processes by generating new content, ultimately refining and improving value delivery to customers and stakeholders.

Furthermore, AI adoption in the Outer rim domain categories can be seen in Figure 4.

Fig. 4. Outer Rim Domain and AI Adoption

Figure 4 illustrates the integration of AI within the outer rim domains of business architecture, which includes stakeholders, strategies, initiatives, policies, products, and metrics. Each domain incorporates a Machine Intelligence Continuum, AI Technologies, and AI Use elements to facilitate comprehensive AI adoption.

For stakeholders, AI systems that act, relate, and evolve manage dynamic interactions, using NLP and ML to analyze sentiment and predict trends, thus improving engagement through automation and augmentation. In strategic planning, AI systems predict, learn, and master strategies using PSO and KRR for planning and decision-making, automating development processes while augmenting human decisions. Business initiatives benefit from AI systems that create, predict, and act, with CP and RAI technologies enhancing execution and monitoring by automating routine tasks and supporting complex decision-making. For policy compliance, AI systems that act, relate, and evolve ensure governance through Expert Systems and ML, automating compliance checks and policy enforcement. In product development, AI systems create, predict, and learn to innovate and manage products, employing NLP, ML, and CP for development, market analysis, and customer feedback, automating lifecycle management, and fostering innovation. Finally, performance metrics are enhanced by AI systems that act, predict, and learn, using ML, PSO, and KRR for advanced analytics, automating data collection and analysis, and providing augmented insights for decision-makers.

IV. Discussion

AI in business architecture significantly enhances operational efficiency, product and service innovation, and organizational competitiveness in the digital transformation era. This research proposes a framework integrating BIZBOK guidelines, offering a structured and comprehensive approach to developing robust and adaptive business architectures. BIZBOK ensures the integration of business capabilities, information value streams, and organizational structure with the business strategy, enabling organizations to build strong, holistic architectures that adapt quickly to technological and market changes [2]

The application of AI in business architecture offers numerous benefits, including increased business process efficiency, product and service innovation, and optimized resource allocation by automating routine tasks, analyzing large data sets quickly, and providing deep insights for better decision-making [7]. This research demonstrates that integrating AI in business architecture can help companies swiftly adapt to the demands of Industry 4.0, characterized by rapid technological changes [3]. The proposed framework guides organizations through each stage of AI adoption, from needs assessment and strategic planning to developing and scaling AI solutions, ensuring alignment with strategic goals, operational support, and sustainable value creation [9]. However, AI implementation in business architecture presents challenges, such as the need for organizational culture changes, structural adjustments, and early stakeholder involvement in the planning process [20]. Additionally, it is crucial to ensure that adopted AI solutions are both efficient and ethical, complying with relevant regulations [15].

Framework evaluation can be carried out using the Framework Evaluation for Design Science Research method, the evaluation strategy chosen is artificial, that is, the evaluation is carried out in a controlled or artificial environment [21].Validation is carried out with case studies and/or expert feedback. This research is still in the development process. To evaluate one example of a case study in higher education, the primary activity part of the value stream is taken, which can be seen in Figure 5.

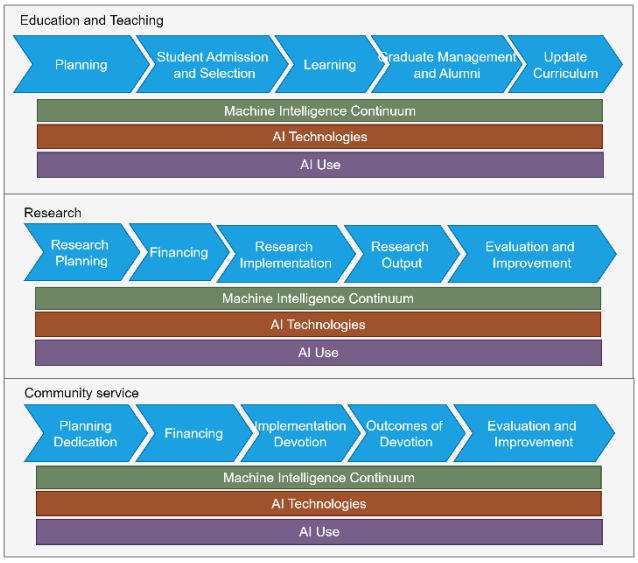

Fig. 5. value stream with AI adoption

When applying the AI adoption framework in business architecture, planning how AI adoption occurs in stages is important. Regular evaluation and improvement to ensure organizational goals are achieved. At the same time, the integration of Machine Intelligence Continuum, AI technologies such as KRR, ML, NLP, CP, and HMI, as well

as automation and augmentation, can increase efficiency and innovation. Early involvement of stakeholders in the process is critical to successful implementation.

This research has several limitations. Implementing this framework may require significant resources in terms of time, costs, and labor, which may not be available in all organizations, especially small or medium ones. Successful AI adoption also depends heavily on an organization's readiness for cultural and structural change. This research does not deeply explore strategies for overcoming resistance to change from internal stakeholders and requires further adjustments based on the specific conditions of each organization.

Future research could focus on in-depth empirical studies of the implementation of this framework in various types of organizations and industries to provide practical insights into challenges and solutions. Additionally, integration with new technologies such as IoT and blockchain and developing additional tools and methodologies to support changing organizational culture and structure can strengthen this framework. Ongoing evaluation of ethics and compliance in the use of AI also needs to be considered to ensure that the AI solutions adopted are effective and socially responsible.

V. Conclusion

This research develops a TOGAF and BIZBOK-based business architecture framework for AI adoption. This framework provides comprehensive and structured guidance that helps organizations face the challenges of digital transformation. Although beneficial, AI adoption also faces challenges, such as changes in organizational culture and resource allocation. This framework needs to be adapted to the organization's specific conditions and emphasizes the importance of ongoing evaluation of ethics and compliance in the use of AI. Future research is expected to strengthen this framework through empirical studies, integrating new technologies such as IoT and blockchain, and developing tools to support organizational change. In this way, this framework can become more robust and practical, helping organizations adapt to technological changes and increase competitiveness in the digital transformation era.

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