Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 8, Number 2, April 2024
DOI : https://doi.org/10.33395/sinkron.v8i2.13648
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Integrating TOGAF and Big Data for Digital Transformation: Case Study on the Lending Industry

Andreas Yudhistira[1)*], Ahmad Nurul Fajar[2)]
[1,2)]Information System Management Department, Binus Graduate Program – Master of Information System Management, Bina Nusantara University, Jakarta, Indonesia
[1)]andreas_yudhistira@yahoo.com, [2)]afajar@binus.edu

Submitted :April 18, 2024 | **Accepted** : May 6, 2024 | **Published** : May 7, 2024

Abstract: In today's digital era, the strategic integration of enterprise architecture frameworks with Big Data technologies is crucial in driving digital transformation, especially within the lending industry. This research aims to identify and analyze how The Open Group Architecture Framework (TOGAF) can be integrated with Big Data to enhance innovation, operational efficiency, and decision-making in the lending sector. This study examines Indonesian financial institutions using qualitative case studies, exploring the intricate practices, challenges, and benefits of the combination of TOGAF and Big Data. The qualitative methodology focuses on in-depth interviews and document analysis to gather contextual insights into the implementation dynamics and impacts of these technologies. Findings indicate that integrating TOGAF and Big Data not only streamlines workflows but also significantly enhances data security and risk management—critical elements in the lending industry. A vital outcome of this study is the development of a robust integration model that serves as a blueprint for companies in similar sectors to navigate their digital transformation journeys. Additionally, this research provides strategic recommendations to overcome integration and implementation challenges. These guidelines facilitate the transition to a more cohesive and strengthened digital architecture, equipping financial institutions to manage the complexities of modern digital economies effectively. Ultimately, this study delivers a comprehensive framework that enriches theoretical understanding and offers practical insights for effective technology integration in financial services.

Keywords: Enterprise Architecture; Big Data; Lending Industry; TOGAF; Digital Transformation

INTRODUCTION

Digital transformation is rapid, and the utilization of enterprise architecture frameworks like TOGAF and Big Data technologies have become critical elements in supporting the growth and innovation of the financial industry, particularly the lending sector. TOGAF helps in defining and implementing an effective structure for information technology that supports business workflows, while Big Data offers extensive analytics capabilities to understand consumer trends and behavior. Integrating the two can transform financial institutions' operations, giving them a market advantage. However, combining these two technologies creates complexities that relate not only to technical aspects but also to corporate strategies and policies.

The integration of TOGAF and Big Data in the digital lending industry has yet to be fully utilized. There are challenges in aligning a comprehensive IT architecture framework with the enormous data volume and diversity offered by Big Data. These difficulties include issues such as data security, privacy, and effective data integration. With an appropriate integration strategy, the potential for innovation and operational efficiency that the combination of these two technologies can offer may be maximized. This research identifies these barriers and proposes solutions to address integration issues.

These integration issues are critical to address as they have a direct impact on the ability of financial institutions to make informed decisions based on accurate and real-time data. In the context of enterprise architecture, big data, and digital lending applications, addressing these integration challenges will boost operational efficiency and improve the quality of service to customers and compliance with applicable regulations. The effectiveness of enterprise architecture (Hindarto, 2024) solutions in efficiently managing and processing Big Data can be critical

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 8, Number 2, April 2024
DOI : https://doi.org/10.33395/sinkron.v8i2.13648
e-ISSN : 2541-2019
p-ISSN : 2541-044X

to the success of digital transformation in the lending sector. Therefore, developing an integration model (Amalia & Hindarto, 2024) that companies in similar industries can adopt is crucial.

In the context of enterprise architecture management as a fundamental approach to digital transformation, research conducted by (Werner et al., 2023), highlights the importance of EAM in the transformation of road infrastructure in Germany. Wernera and Lehana revealed that the implementation of EAM facilitates more efficient technology coordination and integration, which significantly improves the adaptability of road infrastructure to digital innovation. The study confirms that without a mature architectural framework, the infrastructure sector could experience significant delays in harnessing the full potential of digital transformation. Investigated how Industrial Internet platforms contribute to the digital transformation of traditional manufacturing enterprises (Liu et al., 2024). They found that these platforms not only strengthen enterprise IT infrastructure but also support broader data and application integration, which is crucial for innovation and operational efficiency. The study shows that the adoption of Industrial Internet platforms enables manufacturing companies to be more responsive to market dynamics and improve their production capabilities. The results show that digital transformation, when implemented with appropriate strategies based on institutional conditions, can significantly improve production efficiency (D. Wang & Shao, 2024). Wang and Shao emphasize that there is a 'threshold effect' where the benefits of digital transformation become apparent only after reaching a certain level of implementation, strengthening the argument that careful planning and execution are critical in digital transformation.

This research develops a model integrating TOGAF (Hindarto, 2023a) and Big Data to enhance efficiency and security in the lending industry. It uses a case study method to explore practical applications and provides a systematic approach to technological integration. This research aims to develop a model that combines TOGAF and Big Data, improving efficiency and decision-making in the lending industry. The model also provides practical guidance to help financial institutions improve performance and information security.

This study's objectives determine its research questions:

1. How can TOGAF and Big Data integration models (Business Architecture, Application and Information Architecture, Big Data Architecture) improve efficiency in the lending industry? (RQ 1)
2. What are the challenges of TOGAF and Big Data integration in lending institutions, and how can they be solved? (RQ 2)

This research creates a practical integration model of TOGAF and Big Data, adding value to the lending industry, unlike previous studies focused on individual digital technologies. It offers new insights into combining enterprise architecture with Big Data, improving efficiency, security, and data-driven decision-making in lending institutions.

LITERATURE REVIEW

A review of the literature in the context of Enterprise Architecture (EA) and Big Data integration, particularly in the lending industry, requires an in-depth analysis and critical synthesis of the existing literature to determine how these two elements have been and can be more effectively integrated. This review examines studies that explore the use of EA and Big Data separately or in combination, placing particular emphasis on their effectiveness in improving decision-making processes and enterprise operations. From the literature reviewed, it is often the case that existing theories and applications show that while many organizations have adopted EA and Big Data technologies, the integration of these two aspects could be more optimal. This indicates excellent potential for improvement through more focused and structured research.

Here's a structured literature review table for the five research studies you are focusing on, based on the integration of TOGAF and Big Data in the lending industry:

Table 1. Previous studies that discuss fintech

No.	Title of Research	Goal	Problems	Gaps
1	A comparison between fintech firms and the banking sector (Onorato et al., 2024)	Compare efficiency levels between fintech firms and traditional banks in lending activities using Stochastic DEA.	Efficiency measurement in fintech vs. traditional banks, technological impacts on lending efficiency.	Previous studies do not deeply analyze fintech's efficiency compared to banks in lending, nor the stochastic approach in efficiency analysis.
2	Impact of digital transformation on production efficiency (D. Wang & Shao, 2024)	Analyze how digital transformation affects manufacturing production	Role of digital transformation in enhancing manufacturing efficiency, threshold levels for	Lack of comprehensive models linking digital transformation directly to

*name of corresponding author

		efficiency through institutional and threshold effects analysis.	noticeable efficiency gains.	quantifiable gains in manufacturing efficiency.
3	Credit risk prediction for small and medium enterprises utilizing adjacent enterprise data and a relational graph attention network (J. Wang et al., 2024)	Investigate whether digital transformation within enterprises reduces their dependency on traditional bank financing.	Dependence on bank credit in digitally transforming enterprises, impact of enterprise digital practices on finance needs.	Insufficient analysis on the direct correlation between enterprise-level digital transformation and reduced bank credit reliance.
4	Exploring the lending business crowdfunding to support SMEs' financing decisions (Stefanelli et al., 2022)	Examine how digital transformation affects labor investment efficiency differently across various stages of enterprise life cycles.	Variation in labor investment efficiency due to digital transformation across different enterprise maturity stages.	Gap in understanding the differential impact of digital transformation on labor investment efficiency at different enterprise growth stages.
5	Integrating Enterprise Architecture (EA) and Big Data for Enhanced Decision Making in Lending (Werner et al., 2023)	Develop an integration model of EA and Big Data to improve operational efficiency and decision-making in the lending sector.	Need for an effective integration of EA and Big Data to enhance lending decisions and operational efficiency.	Previous studies focus separately on EA or Big Data impacts, not on their integrated effect on operational and decision-making efficiencies in financial institutions.

The gaps between the five studies in Table 1 are as follows:
1. Lack of a comprehensive model that links digital transformation directly to quantitative gains in production efficiency, particularly in the lending industry.
2. Lack of understanding of the differential impact of digital transformation on labour investment efficiency at different stages of the corporate life cycle, which also includes lending companies.

The literature review also stressed the need for a solid theoretical framework to integrate EA and Big Data. Most of the studies reviewed needed a solid theoretical framework that covers both aspects. Hence, the results often need to be more consistent or more accessible to apply in real-world scenarios. This underscores the need for the development of a more inclusive theoretical model that not only accommodates the distinctiveness of EA and Big Data separately but also explains the dynamics between the two. The development of such a model can provide new and deeper insights into how best to implement these technologies in business, particularly in the lending industry. The literature review revealed gaps; this research aims to develop and evaluate an integration model between EA and Big Data that is innovative and applicable to the lending industry. The focus of this research will be on how the integration model can facilitate effective and efficient digital transformation by supporting faster and more accurate business decisions and improving operations. The final results are expected to provide significant contributions to both theory and practice, fill gaps that exist in the current literature, and provide helpful guidance for organizations looking to integrate EA and Big Data effectively.

METHOD

In this study, a design and development approach were used to understand the integration of The Open Group Architecture Framework (TOGAF) (Afarah et al., 2024), (Hindarto, 2023b) and Big Data technologies in the lending industry. This qualitative research was designed to develop and evaluate an effective integration model that could be implemented to improve operations and data-driven decision-making in the lending sector. The chosen methodology allows this research to be not only theoretical, but also practical, by producing solutions that can be directly applied by organizations in the lending industry.

*name of corresponding author

e-ISSN : 2541-2019
p-ISSN : 2541-044X

The data sources used in this research include journal reviews, documentation, and literature relevant to Enterprise Architecture (Afarini & Hindarto, 2023) and Big Data. Data was collected through a systematic search of existing literature in databases and digital libraries that index international scientific journals. This data collection aims to gain a comprehensive understanding of the status quo and latest frameworks related to TOGAF and Big Data, as well as their applicability in the lending industry. Data analysis was conducted through inductive methods, where the collected data was analyzed to identify patterns, relationships, and emerging theories. This process involved extensive data organization, initial coding, focus coding, and category formation that enabled the development of data-driven theories. Using this method, the researcher developed a reflective and adaptive integration model that supports the specific needs of the lending industry.

Furthermore, the development of this TOGAF and Big Data integration model was tested through a series of evaluations involving experts and practitioners in the field of Enterprise Architecture and Big Data analysis. This evaluation aims to test the validity and effectiveness of the proposed model, considering the criteria of practicality, effectiveness, and ease of implementation in the real context of the lending industry. The results of this evaluation are then used to revise and improve the model, resulting in a robust framework that is ready to be used by organizations in the lending industry.

Methodology

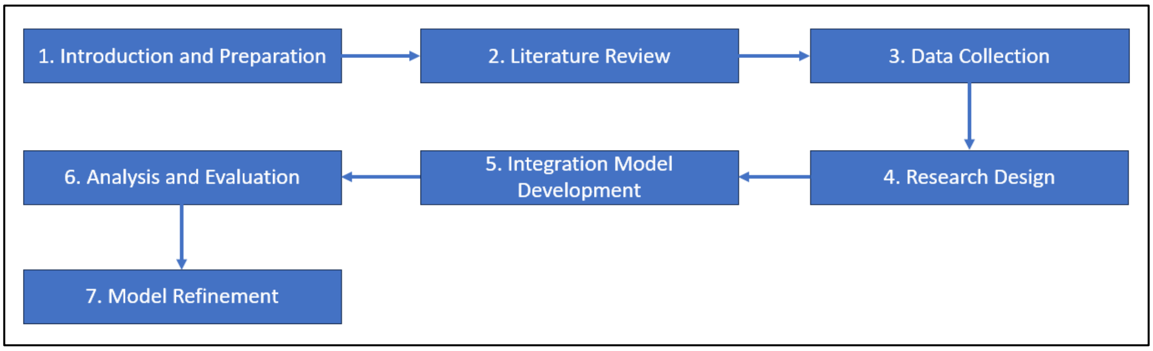

Figure 1. Methodology
Source: Property Researcher

In the preliminary and preparatory phase, this research aims to develop an integration model that combines Enterprise Architecture principles and Big Data capabilities to support digital transformation in the lending sector. This objective involves formulating a clear strategy for integrating structured enterprise architecture with dynamic big data processing and analysis, lending institutions can use the latest technologies to improve operational efficiency and the accuracy of strategic decisions. To achieve this objective, the research will require the collection of comprehensive resources. Such resources include data from financial transactions, customer interactions, and operational logs that will be analysed using advanced Big Data analysis software. In addition, the need for technical expertise, including data specialists, system architects, and business analysts, all of whom must have a deep understanding of EA and Big Data, will be identified. Availability and access to these resources will be consolidated through collaboration with participating financial institutions, IT solution providers, and relevant academics and industry practitioners. This collaborative approach not only ensures the adequacy of resources but also enriches the research with multiple perspectives and expertise, thus maximizing the potential for innovation and successful implementation of the proposed integration model.

In the literature review phase, this research conducted an in-depth systematic review of the concepts of Enterprise Architecture, Big Data, and digital transformation processes, with a particular focus on applications in the lending industry. The review included the analysis of various scientific journals, conference publications, and industry documents to gather current data describing the applications and challenges associated with these technologies. Through this process, the research aims to identify significant knowledge gaps between existing theory and actual practice, particularly in the context of integrating EA and Big Data inefficient lending operations. Based on the review results, this research develops a robust theoretical framework, integrating critical theories from the relevant literature to guide the design and development of the integration model. The framework is designed to not only address the gap but also to provide a solid methodological foundation to support practical implementation. With this theoretical framework, the research hopes to make a meaningful contribution to academic literature and industry practice by revealing innovative ways to optimize the use of EA and Big Data in supporting successful digital transformation in the lending sector.

The data collection phase for this research, the design and development method has been chosen as the primary approach. This approach allows researchers to systematically design, develop, and evaluate a prototype integration

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 8, Number 2, April 2024
DOI : https://doi.org/10.33395/sinkron.v8i2.13648
e-ISSN : 2541-2019
p-ISSN : 2541-044X

model that combines Enterprise Architecture and Big Data in the context of the lending industry. This process involves continuous iteration between theory and practice, where an initial model is designed based on the theoretical framework that has been developed and then tested in a realistic operational environment. To assess the effectiveness of the resulting integration model, specific evaluation metrics were established, covering aspects such as improved decision-making speed, credit risk prediction accuracy, operational efficiency, and user satisfaction. These metrics were chosen to ensure that the model evaluation could generate valid and reliable data, which would later be used to refine the model before further implementation. This evaluation process not only demonstrates the practicality of the developed model but also provides insight into areas that require improvement, ensuring that the result can be effectively integrated into actual lending industry practices.

Data was collected through two primary sources to ensure the depth and richness of information. First, a systematic review of academic journals, relevant project documentation, and other literature related to digital lending applications, Enterprise Architecture, and Big Data integration was conducted. This review aimed to gain a theoretical understanding and identify current trends and practices in the lending sector that could serve as a basis for the development of the integration model. Second, lending industry stakeholders, including EA architects, data analysts, and product managers, were interviewed in depth. These interviews were designed to gain practical insights and first-hand experiences from professionals who are actively involved in the digital transformation process. The information from these interviews was crucial in tailoring the developed integration model to the real needs and operational challenges faced by lending institutions, thus enabling this research to produce solutions that are not only theoretical but also applicable and relevant to current industry practices.

In the development of the integration model, an initial prototype was created utilizing the principles of the previously identified enterprise architecture, as well as the application of relevant big data technologies. The prototype was designed to effectively integrate big data within the enterprise architecture framework, thereby facilitating digital transformation in the lending sector. The development involved the use of architectural design tools and data analytics platforms to create a system that not only manages large volumes of data but also generates actionable operational insights. Once the initial prototype was completed, a series of iterations were conducted based on feedback obtained from the initial performance evaluation. This feedback was obtained through field tests and panel discussions with relevant stakeholders, including engineers, product managers, and end users. Each iteration aims to refine critical functions of the model, correct weaknesses, and improve integration between EA and Big Data components, thus ensuring that the final model is genuinely responsive to the needs of the lending industry and can be implemented successfully in actual operations.

Analysis and evaluation: The data collected during the design and development phases were examined using inductive methods to determine the effectiveness of the integration model. This process involves organizing the data, categorizing, and developing hypotheses underlying the data patterns. The analysis checks how well the integration model meets goals, such as increased operational efficiency and accuracy in decision-making based on Big Data analysis. Once the analysis is complete, the model is then empirically tested through a series of tests involving real operational situations in the lending sector. Feedback from end-users and relevant stakeholders was also collected to assess the market acceptance and practical applicability of the model. This evaluation not only tests the technical and functional reliability of the model but also its effectiveness in a natural business environment. This whole evaluation process ensures that the developed model is not only theoretical but also practical and ready for further implementation in the lending industry.

After the evaluation phase, the integration model entered the refinement stage, where revisions and adjustments were made based on feedback received from empirical testing and stakeholder criticism. These revisions include architectural modifications, enhancements to Big Data analytics capabilities, and sharpening of the user interface, with the aim of maximizing the usability and efficiency of the model. Any aspect of the model that did not meet operational expectations or that represented a potential risk in practical application was identified and improved. This refinement process is highly critical and is conducted through iterations, allowing the model to evolve based on real-time inputs from the actual operational environment. To ensure the changes work, the revised model is tested again. These tests focus not only on the technical stability of the model but also on its functional adaptability in diverse business scenarios. This stage is essential to ensure that the developed integration model can operate stably and efficiently under dynamic and frequently changing market conditions, ready for full-scale deployment in the lending industry.

Big Data

Big Data refers to extensive, complex data sets that traditional database management systems cannot handle in size, speed, or format. The main characteristics of Big Data (Zuo et al., 2024) are often described through three 'V's: Volume, which indicates the magnitude of data being generated and stored; Velocity, the speed at which data flows and must be processed; and Variety, the variety of structured, semi-structured, and unstructured data like text, video, and audio. Big Data (F. Wang et al., 2024) can provide significant insights that can support decision-making and technological innovation through advanced analytics and machine learning applications. In the business context, the use of big data has opened the door for companies to not only understand their customers and markets more profoundly but also optimize operations and adjust business strategies in real-time. Big Data has become essential to digital transformation, helping organizations across industries improve efficiency, reduce costs, and provide more personalized and responsive services.

The integration of Enterprise Architecture and Big Data offers significant potential to transform business decisions into more data-driven and timely insights. EA provides a strategic framework that organizes the entire IT infrastructure and business operations, ensuring that technology and information systems are executed in accordance with broader corporate objectives. By including Big Data in EA, organizations can ensure that extensive data analysis is not isolated as a technology project but is deeply integrated with the overall business strategy. This integration enables large volumes of diverse data to be managed and utilized efficiently, supporting innovation and operational efficiency.

This integration process also addresses essential challenges such as data storage, processing, and real-time analysis that have become critical in dynamic business environments. Big Data, with its variability and velocity, when combined with a robust EA structure, facilitates the creation of operational dashboards and analytics that can aid executive-level decision-making. Furthermore, harmonization between architecture and data enables organizations to not only respond to market changes at a higher speed but also leverage machine learning algorithms to identify trends and patterns that are invisible to regular human analysis.

The integration of Big Data with Enterprise Architecture is a transformative step that amplifies the data processing capacity and augments the organization's intelligence in navigating operational and market complexities. This shift enables a more proactive approach to risk management and opportunity capitalization, transitioning from intuition-based decisions to data-driven and predictive analysis. The result is a sustainable competitive advantage, optimized resources, and improved operational outcomes. In today's dynamic business landscape, the ability to swiftly adapt and strategically leverage data is the key to sustaining and accelerating growth.

The methodology adopted in this research is designed to ensure that the findings combine deep theoretical richness with high practical applicability, which is essential in the practice and literature of Enterprise Architecture and Big Data (Zuo et al., 2024). By focusing on the systematic integration between EA and Big Data technologies, this research provides new insights and concrete solutions that can be implemented in the lending industry. The approach involves prototype development, empirical evaluation, and continuous iteration, ensuring that the resulting model is not based solely on speculation but is supported by real-world data and analysis. This allows the research results to bring significant contributions to EA theory and Big Data (Zuo et al., 2024) applications, offering insights and methodologies that can be directly applied to improve efficiency, security, and data-driven decisions in the lending sector. As such, this research not only strengthens academic literature but also encourages practical innovations that have a real impact on business operations and strategies in the lending industry.

RESULT

Business Architecture

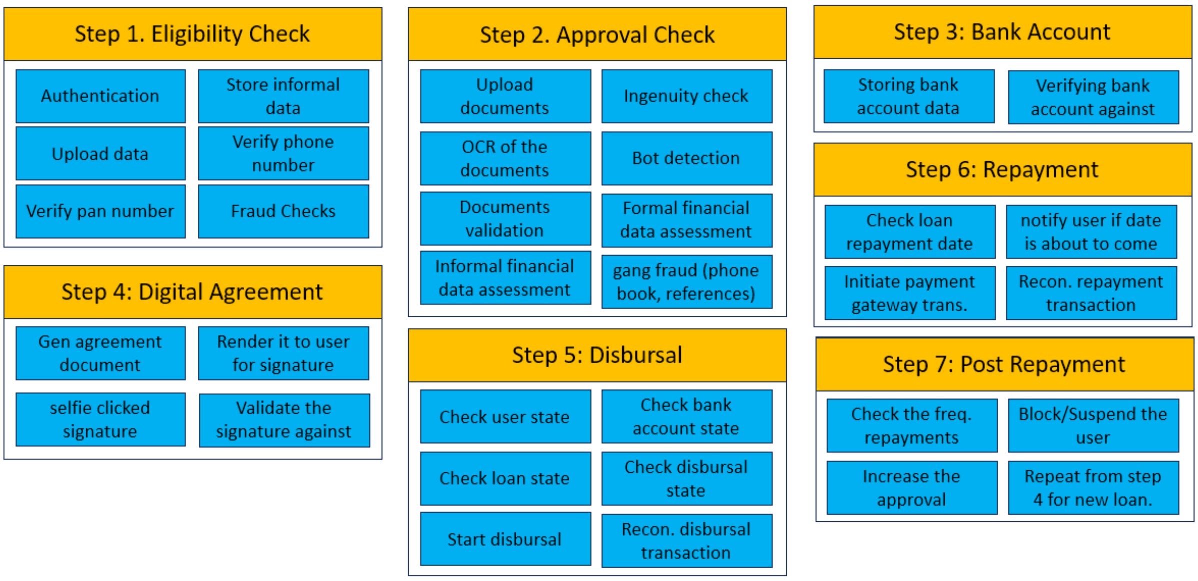

Figure 2. Business Architecture
Source: Property Researcher

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 8, Number 2, April 2024
DOI : https://doi.org/10.33395/sinkron.v8i2.13648
e-ISSN : 2541-2019
p-ISSN : 2541-044X

The digital loan application process, meticulously structured by lending institutions, is designed to optimize transaction security and efficiency, all while providing a convenient experience for prospective borrowers. The process commences with Stage 1, Eligibility Check, where prospective borrowers can authenticate their identity by simply uploading relevant data. This includes verification of PAN number and phone number, a crucial step in preventing identity abuse and other frauds. At this stage, informal data is also stored to provide a comprehensive view of the prospective borrower, bolstering the data foundation used in credit decisions. Advancing to Stage 2, the Approval Check, this step involves meticulous scrutiny of the uploaded documents. The utilization of OCR (Optical Character Recognition) ensures a swift and accurate identification of data from documents. This process not only validates the documents but also involves a comprehensive assessment of the authenticity and integrity of the informal financial data that the prospective borrower has submitted. This authenticity assessment is crucial to prevent fraud and ensure that all information provided is accurate and reliable, instilling a sense of trust and reliability in the process.

Stage 3 of the digital lending process focuses on the all-important stage of bank account verification. At this stage, the bank account details provided by the borrower are rigorously tested for accuracy against the personal data provided. This thorough investigation ensures that the bank account used for loan-related transactions actually belongs to the borrower in question, which significantly reduces the potential for identity abuse or fraud. This verification not only protects lending institutions but also consumers from unauthorized transactions that could lead to financial loss or reputational damage, fostering a sense of security and protection. Stage 4, where the borrower enters the digital agreement stage. In today's digital age, formal legal processes such as contract signing have been transformed to be more efficient using technology. Borrowers are asked to upload a selfie along with their signature, a move that supports modern banking practices without compromising the legal rigor required. This signature verification is a crucial step to confirm that the borrower interacting with the system is the same individual as stated in the loan application document. This authenticity guarantees the validity of the agreement and confirms the borrower's commitment to the terms and conditions of the loan.

By entering Stage 5, Disbursement, lending institutions begin the process of disbursing funds once all checks have been successfully passed. This involves checking the status of the loan and ensuring that all conditions have been met before funds are disbursed to the borrower. This stage is crucial in ensuring that the lending process is carried out according to established protocols and conditions. The process moves on to Stage 6, Payment, where the lending institution organizes and monitors loan repayments. Borrowers are reminded of payment dates, and payment transactions are made through a secure gateway to ensure that payments are made on time and recorded correctly. Finally, Stage 7, Post-Payment, aims to audit the payment cycle and improve the borrower's eligibility for future loans. This stage also includes the necessary steps in the event of delays or issues in repayment, including account blocking or suspension if required, while continually giving the borrower the opportunity to restart the process from Stage 4 for a new loan.

Integration Application Architecture and Big Data

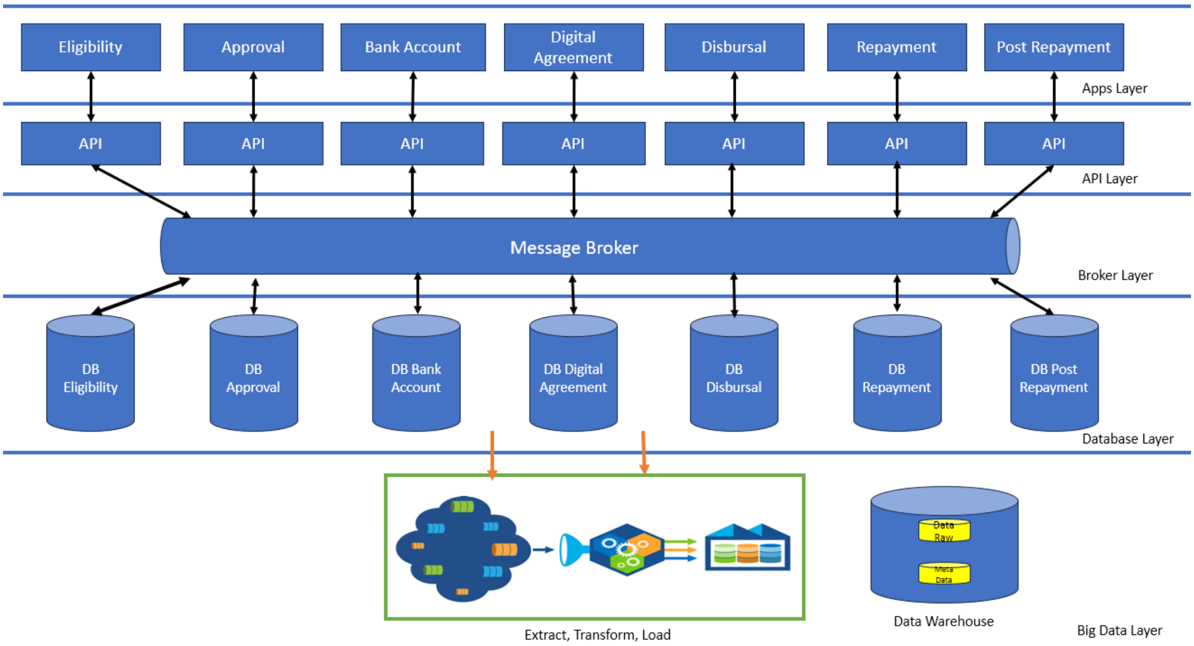

Figure 3. Application and Information Architecture
Source: Property Researcher

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 8, Number 2, April 2024
DOI : https://doi.org/10.33395/sinkron.v8i2.13648
e-ISSN : 2541-2019
p-ISSN : 2541-044X

In figure 3, an application and information architecture are designed using a microservices approach. This architecture is divided into three main layers: the application layer, the API layer, and the broker layer, all of which are supported by the database layer. The application layer in this system architecture, often referred to as the "Apps Layer," is the core of the automated lending process. In this layer, we see a clear and separate division of functions into specialized modules, each designed to handle certain aspects of the lending cycle. The "Eligibility" module is tasked with determining the eligibility of potential borrowers, calculating various factors such as credit score and financial history. The "Approval" module takes the next step by processing the information to approve the loan application. Then, "Bank Account" takes care of verifying and managing the borrower's bank account information (Prawira et al., 2023), an essential step for financial transaction security. "Digital Agreement" creates and stores a digital agreement authorized by the borrower's electronic signature, reinforcing the legal validity of the loan process. Once all conditions are met, "Disbursal" handles the disbursement of loan funds to the verified account. This process is followed by "Repayment," where payments are returned, and the system monitors and records installments paid on time. Finally, "Post Repayment" handles the steps after the loan is paid off, such as closing the loan account or preparing for the following loan.

The API layer plays a vital role in this microservices architecture, serving as a mediator that facilitates interaction between the application layer and other layers. Each application module is described in the application layer, from eligibility verification to approvals to bank account handling and beyond, with an associated Application Programming Interface (API) (Elayan & Mustafa, 2021). These APIs are designed to provide a set of protocols and tools for software creation, allowing application modules to communicate with each other and access data or functionality provided by other modules, either within the application layer itself or across different layers. When an application module needs to exchange data or needs to trigger an action, the API passes the request through the Message Broker, a bridging system that manages and synchronizes the flow of communication. This Message Broker manages data traffic, ensuring that each request and response is processed efficiently and securely, eliminating bottlenecks, and minimizing communication latency. Through this API layer, microservices can dynamically interact with their corresponding databases, each of which is isolated in its container within the database layer, guaranteeing optimal data separation and security.

The broker layer, represented by "Message Broker" in this system architecture, plays a crucial role in ensuring that the interaction between the various microservices runs smoothly and efficiently. As a coordination center, the message broker controls service-to-service communication, being the guarantor that any messages or requests forwarded from the API to the microservices in question arrive safely and in an orderly fashion. This function is critical in highly modular systems, where processes and data are often treated separately and isolated. In the context of data transfer, the message broker controls the density of information traffic and ensures that there are no data collisions or information loss during communication. Data integrity is crucial in the lending industry, where financial data accuracy and security are paramount. In addition, message brokers support system scalability by facilitating the addition or subtraction of services without disrupting the existing infrastructure. The security aspect of transactions is managed with respect to strict security protocols, often involving sophisticated encryption and authorization, to protect against unauthorized access or data interception. Message brokers actively monitor transactions and requests, identify unusual traffic patterns that may indicate suspicious activity, and provide the ability to take preventative measures to avoid potential vulnerabilities. Through the effective handling of these tasks, the message broker facilitates an adaptive and resilient application ecosystem, enabling the information architecture to be more responsive and reliable to changing business needs.

The 'Database Layer' is a cornerstone within the intricate structure of information technology architecture. This layer is a collection of distributed databases (DBs), each uniquely configured to operate in conjunction with a specific microservice. This deliberate separation ensures that each microservice has rapid and reliable access to the datasets they require for their operations, ranging from user authentication to financial transaction processing. The fragmented database design is the bedrock that supports the system's overall scalability. It enables the easy addition or removal of resources, in response to dynamic demand, without necessitating a complete overhaul of the architecture. The isolation between services maintained in this layer also eliminates the risk of disruptions between services. If a microservice encounters a problem or requires an update, it can be addressed without affecting other microservices.

In Big Data architecture, the data layer is a crucial component that handles the large volumes of information generated and collected from various sources. This layer consists of storage infrastructure such as data lakes and warehouses designed to hold data in diverse formats, ranging from structured to unstructured data. It also includes components such as distributed database management systems, batch and real-time data processing platforms, and analytics frameworks for data processing. In a Big Data framework (Zhang et al., 2020), the data layer serves as the foundation that enables large-scale data integration, storage, and analysis, providing the necessary foundation for data- and insight-driven business decision-making. The ability to manage and analyze information quickly and accurately at the data layer is what actualizes the power of Big Data, empowering organizations to make data-and insight-driven business decisions that can shape their future success.

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 8, Number 2, April 2024
DOI : https://doi.org/10.33395/sinkron.v8i2.13648
e-ISSN : 2541-2019
p-ISSN : 2541-044X

Moreover, the capability to test and manage each database independently injects agility and efficiency into data management. Any modifications, whether schema adjustments or performance optimizations, can be implemented in a controlled and responsible manner. This ensures that the data architecture upholds the principles of continuity and reliability, qualities that are paramount for digital banking operations that are consistently confronted with new challenges and escalating performance expectations. With this adaptable and segmented approach, the database layer not only caters to current needs but is also primed to embrace future trends and technologies.

An enterprise architecture design that integrates Big Data technologies forms a comprehensive framework to facilitate digital transformation across the organization. In this design, Enterprise Architecture (EA) acts as the backbone that provides structure and discipline in organizing IT assets and organizational resources. Big Data, on the other hand, can analyze lots of internal and external data. This integration enables organizations to gain real-time operational and strategic insights, which optimize business decisions and improve operational efficiency. The data layer, including data lakes and advanced analytics, seamlessly integrates with other EA components, such as business applications and IT infrastructure, ensuring that the data and insights gained can be fully utilized to support business objectives. This design not only eliminates data silos but also opens new opportunities for innovation and competition in a dynamic market.

Big Data Architecture

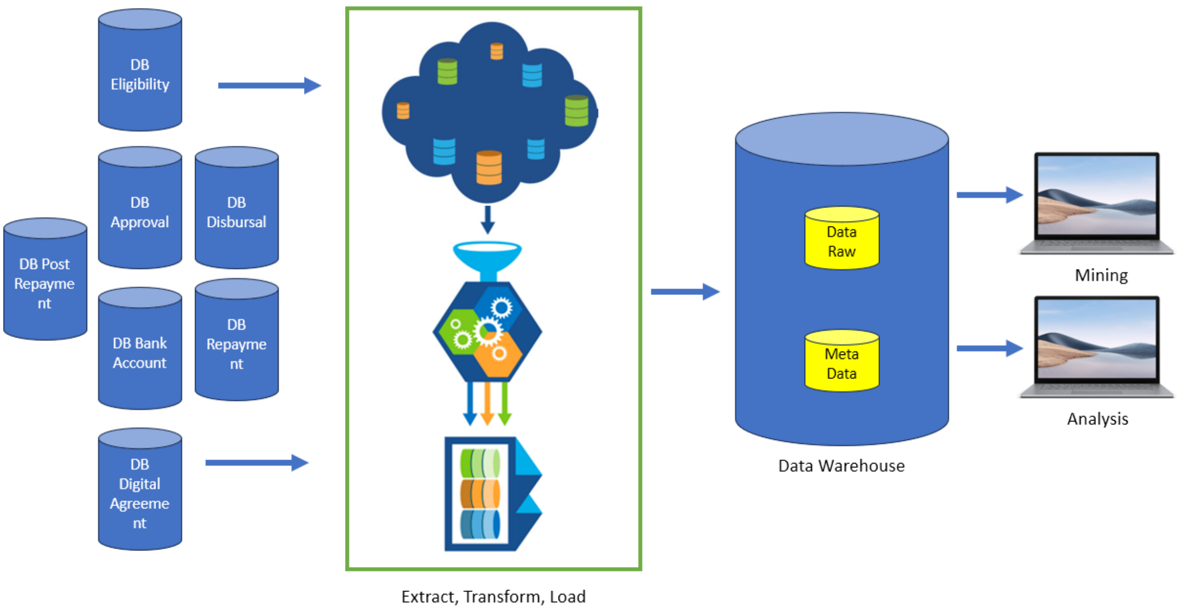

Figure 4. Big Data Architecture
Source: Researcher Property

Figure 4 is a Big Data management process consisting of several key steps, starting from data collection from various databases (DBs) to in-depth data analysis. The first step involves a collection of separate databases, each storing information related to a different lending process-eligibility, approval, disbursement, payment, and post-payment activities, as well as bank account information and digital agreements.

Large and complex data integration processes usually begin with ETL, which stands for Extract, Transform, and Load. At the 'Extract' stage, data in its raw state is extracted from its various sources, which may include databases of eligibility, credit approval, disbursement, and so on. This raw data includes all the information that has been collected during the transactions and daily operations of the lending institution. This stage is crucial for pulling data from multiple sources in different formats. This work ensures that no critical information is missed before the data is processed further. After the extraction process, the raw data goes to the 'Transform' stage, where it is transformed and standardized. This step involves a series of cleaning processes to remove inaccuracies or incomplete data, record merging to combine information from different sources, and changing the format of the data to suit the needs of the analysis. This transformation process is critical as it ensures the data is clean, consistent, and ready to be appropriately analyzed. Once the data has been transformed, the next stage is 'Load,' where this data is loaded into the Data Warehouse (Andry, 2020). This system is specifically designed to store vast amounts of data of various types, providing a robust and efficient platform for long-term storage. The quality and structure of data storage in the data warehouse are critical as they support the subsequent stages of data analysis and data

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 8, Number 2, April 2024
DOI : https://doi.org/10.33395/sinkron.v8i2.13648
e-ISSN : 2541-2019
p-ISSN : 2541-044X

mining, where new patterns, trends, and insights can be identified and extracted for strategic importance and business decisions.

The Data Warehouse assumes a central role in the data management architecture, serving as a pivotal repository where raw data sets and metadata are stored in a structured form. This data is organized in a manner that facilitates rapid access, supports complex analytical tasks, and necessitates swift response times. The functionality of a Data Warehouse empowers companies to execute intensive and diverse queries, spanning from basic reports to intricate predictive analysis. Data processing within the Data Warehouse is of paramount importance, ensuring the integrity and reliability of information, thereby fostering trust in the insights generated and their role in supporting decision-making.

The 'Mining' process in a Data Warehouse leverages advanced algorithms and data analysis methods to unearth hidden patterns and generate insights that can enhance the company's value. At the 'Analysis' stage, sophisticated analytics such as machine learning and statistical tools are employed to delve deeper, unearthing trends and relationships in the data that may elude manual examination. This empowers organizations to make data-driven decisions, bolster operational efficiency, and steer business strategy. Hence, the utilization of a Data Warehouse for data analysis enriches the decision-making process by amalgamating comprehensive information and precise analytics, furnishing a robust foundation for data-driven business strategies and operations.

DISCUSSIONS

What are the challenges of TOGAF and Big Data integration in lending institutions, and how can they be solved? The integration between TOGAF (The Open Group Architecture Framework) and Big Data technologies in lending institutions faces significant challenges that require strategic and technical solutions to be achieved. Key challenges include the difficulty of aligning existing enterprise architecture with big data solutions that require high scalability and real-time processing capabilities. The TOGAF framework, which has proven effective in mapping and refining business processes, only sometimes provides enough tools to support the complex analytical needs demanded by Big Data technologies. One issue that often arises is inefficient data integration and architecture between legacy systems and new Big Data platforms. Research should consider a modular approach in architecture development to ensure that new components can be integrated smoothly without disrupting existing system operations. This could include the use of container technologies and the utilization of cloud computing that provides the required flexibility and scalability.

Data security and privacy issues are also becoming increasingly important, given the increased risks associated with managing large volumes of data. Lending institutions must implement strict security protocols, leverage advanced encryption technologies, and adopt data minimization principles to ensure that customer data is effectively protected. Research must also ensure that all security solutions meet applicable regulatory standards, such as GDPR, to avoid legal sanctions and reputational damage. Furthermore, the need for more skilled workers in both domains- TOGAF and Big Data- is often a bottleneck. To overcome this, lending institutions can invest time and resources in thorough in-house training or work with vendors and consultants who specialize in EA and Big Data integration. Both technologies should be taught theoretically and practically, ensuring that teams can effectively apply their knowledge in a dynamic environment. Interoperability issues often arise when lending institutions try to integrate disparate systems. Adopting standardized APIs and middleware solutions that can serve as a bridge between old and new systems can minimize this difficulty. Research should look for technologies that support secure and efficient data exchange between systems, ensuring that integration takes place without compromising system performance or security.

By understanding and addressing these challenges strategically, the proposed research will not only enrich the existing literature by identifying practical solutions for TOGAF and Big Data integration but also make valuable contributions to industry practice, especially in improving operational efficiency and security in the lending industry. Successful implementation of this model is expected to open new avenues in the way lending institutions utilize enterprise architecture and big data analytics to support more informed strategic and operational decisions.

CONCLUSION

This research presents an integration model that harnesses the unique strengths of TOGAF and Big Data to enhance data operational efficiency in the lending industry. The key findings demonstrate that when these two technologies are properly integrated, they can synergize to bolster the analytical and operational capacity of financial institutions. The resulting model not only facilitates digital transformation through improved data management and more informed decision-making but also opens new opportunities in service personalization and more accurate risk management. The findings of this study provide significant implications for theory in the fields of Enterprise Architecture, Big Data, and lending applications. Theoretically, this research fills a gap in the existing literature by showing how the strategic integration between EA and Big Data can be implemented and measured for effectiveness in the actual context of the lending industry. Specifically, it addresses the lack of comprehensive models that consider both the technical and strategic aspects of this integration. In terms of practice, the developed

*name of corresponding author

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 8, Number 2, April 2024
DOI : https://doi.org/10.33395/sinkron.v8i2.13648
e-ISSN : 2541-2019
p-ISSN : 2541-044X

model offers a framework that financial institutions can adopt to streamline their business processes while improving data security and integrity. This directly supports the industry's need for faster and more effective technology adaptation, especially in the face of intensifying market competition and changing regulations. However, this research has some limitations that should be recognized. First, this research is a plan for modelling limited to a particular scale and scope of data, which may only partially reflect the diversity of real-world scenarios. Second, certain aspects of TOGAF and Big Data, such as change management and real-time system updates, have yet to be fully explored. For future research, it is recommended to apply this model in various operational contexts with a broader range of data variables to test its universality and scalability. This opens exciting new perspectives and could change how we view and use Enterprise Architecture and Big Data in lending.

REFERENCES

Afarah, S. F., Hindarto, D., & Wahyuddin, M. I. (2024). *Optimizing Automotive Manufacturing Systems through TOGAF Modelling*. *9*(1), 414–425.

Afarini, N., & Hindarto, D. (2023). *The Proposed Implementation of Enterprise Architecture in E-Government Development and Services*. *3*(December), 219–229.

Amalia, N., & Hindarto, D. (2024). Enterprise Architecture for Efficient Integration of IoT Lighting System in Smart City Framework. *Sinkron*, *8*(2), 1091–1099. https://doi.org/10.33395/sinkron.v8i2.13591 e-ISSN

Andry, J. F. (2020). Perancangan Arsitektur Bisnis Pada Industri Aluminium Foil Menggunakan Togaf. *IT Journal Research and Development*, *5*(1), 98–108. https://doi.org/10.25299/itjrd.2020.vol5(1).4755

Elayan, O. N., & Mustafa, A. M. (2021). Android malware detection using deep learning. *Procedia Computer Science*, *184*(2019), 847–852. https://doi.org/10.1016/j.procs.2021.03.106

Hindarto, D. (2023a). Enterprise Architecture Development to Strengthen Sustainability in the Supply Chain. *JTIK*, *7*(4).

Hindarto, D. (2023b). The Management of Projects is Improved Through Enterprise Architecture on Project Management Application Systems. *International Journal Software Engineering and Computer Science (IJSECS)*, *3*(2 SE-Articles), 151–161. https://doi.org/10.35870/ijsecs.v3i2.1512

Hindarto, D. (2024). Building the Future of the Apparel Industry : The Digital Revolution in Enterprise Architecture. *Sinkron*, *9*(1), 542–555.

Liu, Y., Zhang, Y., Xie, X., & Mei, S. (2024). Affording digital transformation : The role of industrial Internet platform in traditional manufacturing enterprises digital transformation. *Heliyon*, *10*(March).

Onorato, G., Pampurini, F., & Grazia, A. (2024). Research in International Business and Finance Lending activity efficiency . A comparison between fintech firms and the banking sector. *Research in International Business and Finance*, *68*(June 2023). https://doi.org/10.1016/j.ribaf.2023.102185

Prawira, K. T., Makmur, A., & Santoso, H. (2023). Enterprise Architecture for Payment System Industry in Industrial Era 4.0. *Sinkron*, *8*(1), 517–525. https://doi.org/10.33395/sinkron.v8i1.11933

Stefanelli, V., Ferilli, G. B., & Boscia, V. (2022). Exploring the lending business crowdfunding to support SMEs' financing decisions. *Journal of Innovation & Knowledge*, *7*. https://doi.org/10.1016/j.jik.2022.100278

Wang, D., & Shao, X. (2024). Research on the impact of digital transformation on the production efficiency of manufacturing enterprises : Institution-based analysis of the threshold effect. *International Review of Economics and Finance*, *91*(December 2023), 883–897.

Wang, F., Gai, Y., & Zhang, H. (2024). Blockchain user digital identity big data and information security process protection based on network trust. *Journal of King Saud University - Computer and Information Sciences*, *36*(April).

Wang, J., Liu, G., Xu, X., & Xing, X. (2024). Credit risk prediction for small and medium enterprises utilizing adjacent enterprise data and a relational graph attention network. *Journal of Management Science and Engineering*, *9*, 177–192. https://doi.org/10.1016/j.jmse.2023.11.005

Werner, T., Lehan, A., Werner, T., & Lehan, A. (2023). Enterprise Architecture Management (EAM) as a fundamental approach for the digital transformation of the German road infrastructure management. *ScienceDirect*, *00*(2022). https://doi.org/10.1016/j.trpro.2023.11.564

Zhang, N., Zhao, X., & He, X. (2020). Understanding the relationships between information architectures and business models: An empirical study on the success configurations of smart communities. *Government Information Quarterly*, *37*(2), 101439. https://doi.org/10.1016/j.giq.2019.101439

Zuo, W., Yu, D., Hu, Q., & Liu, L. (2024). A big data quality evaluation method based on group heterogeneity rationality perception information fusion. *Computers & Industrial Engineering*, *190*(January). https://doi.org/10.1016/j.cie.2024.110009

*name of corresponding author