

Exploring the Impact of Artificial Intelligence Integration on Indonesia Banking Sector

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ABSTRACT

Artificial Intelligence (AI) has emerged as a strategic enabler of digital transformation in the banking industry, improving operational efficiency, customer experience, and risk management. **This study examines** the extent of AI adoption in Indonesian commercial banks and analyzes how organizational characteristics influence implementation patterns. Using a descriptive and verificative research design, survey data were collected from 181 senior banking executives representing 30 commercial banks classified as KBMI II to KBMI IV. **The data were analyzed** using descriptive statistics and SmartPLS 4 to evaluate relationships between bank characteristics and AI integration. **The findings** indicate that 64.6% of banks have implemented AI, with adoption concentrated in digital operations (65.4%), customer analytics (51.6%), and risk management (23.9%). Larger banks, particularly KBMI IV institutions, exhibit significantly higher adoption intensity and implementation maturity than smaller banks. **The structural model** shows that organizational readiness, capital strength, and ownership structure positively influence AI integration, explaining a substantial proportion of variance in adoption levels. **The study extends** global research on AI in banking by providing empirical evidence from an emerging economy and demonstrates that AI adoption contributes to SDG 8 and SDG 9 by strengthening productivity, innovation, and financial resilience. **The results** suggest that banks should adopt differentiated implementation strategies based on their capital capacity, digital maturity, and strategic priorities.

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1. INTRODUCTION

The banking sector is a vital component of a nation's economic engine. As financial intermediaries, banks play an essential role in driving the economy and the real sector. They serve as a channel that facilitates the efficient movement of capital, which is crucial for economic development initiatives [1].

According to [2], banks significantly impact a country economy in various ways. They contribute to the stability of the financial system by managing payment networks, overseeing liquidity, assessing risks, and supporting central banks. Additionally, banks are instrumental in implementing monetary policy by establishing reserve requirements, providing credit, and managing interest rates. They also invest in national projects and support government initiatives, aiding in infrastructure development [3]. Furthermore, banks help distribute financial risks and enhance their organizational resilience [4]. Banks stimulate economic growth by supplying

capital to businesses, promoting consumer spending and diverse economic activities, expanding money markets through wider outreach, offering a variety of financial products, and bolstering the overall strength of the financial sector [5]. Indonesia banking industry faces challenges similar to those encountered by banks globally, where profitability is increasingly difficult. Rising economic pressures have diminished consumer purchasing power, while intensified competition among banks exacerbates the situation. These factors lead to an increase in non-performing loans and tighter liquidity, as growth in third-party funds from the public has slowed [6].

In addition to these challenges, the banking sector is also experiencing pressure from changing consumer preferences [7]. Banks must consistently invest in technology to remain competitive, retain existing customers, and attract new ones, all while navigating fierce competition and stricter regulations [8]. The rapid pace of technological change driven by AI and digital disruption has transformed competition within the banking sector. The emergence of digital transformation, open banking, instant payments, and other advanced tools provides significant advantages to agile and innovative companies. Conversely, those that struggle to adapt may find their market position eroding [9].

As transactions and economic activities have increasingly shifted to digital platforms, particularly during and after the COVID-19 pandemic, banks must accelerate their digital transformation to keep pace with these changes. Indonesia Financial Services Authority (OJK) has outlined in the Indonesian banking development roadmap 2020 until 2025 that this transformation should focus on enhancing governance and IT risk management, adopting key technologies such as APIs, cloud computing, blockchain, AI, and fostering collaboration among banks, other financial institutions, digital innovation providers, and technology companies. Additionally, banks are encouraged to evolve into more advanced digital banking entities. By hastening digital transformation, banks are expected to operate more efficiently and provide improved services to all segments of Indonesia population.

Overall, AI has become a crucial element in driving digital transformation within Indonesia banking sector. It assists banks in improving customer service, streamlining operations, and enhancing risk management. As technology continues to evolve and market demands shift, the application of AI is anticipated to grow and adapt. Research by [10], the financial sector is undergoing a significant transformation, with the widespread adoption of AI at the forefront of this change. As technology progresses, it is evident that AI is not merely a fleeting trend, it is a powerful force fundamentally reshaping traditional financial institutions, particularly banks. In an era where data is as valuable as currency and agility is essential, banks are leveraging AI to capitalize on new opportunities, address complex challenges, and rethink their service delivery [11].

The application of AI extends far beyond basic personalization. It enables predictive analytics that can foresee customer needs even before they are expressed. AI-driven algorithms can analyze vast amounts of data to identify patterns, detect anomalies, and recognize potential risks more effectively than traditional methods [12]. By examining factors such as transaction histories, spending behaviors, and significant life events, AI can proactively recommend relevant products or services [13]. For example, a customer planning to purchase a home might automatically receive tailored offers for a mortgage or home insurance. This proactive approach not only benefits the customer but also helps the bank establish trust and reinforce its position as a dependable financial partner.

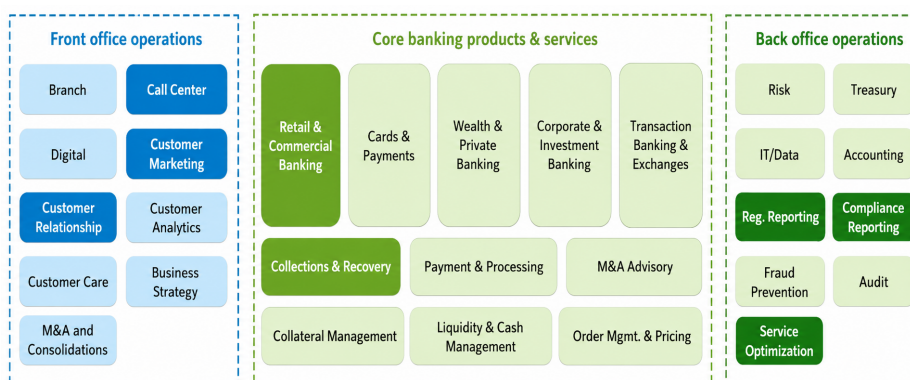


Figure 1. AI Implementation In Various Functions within the Bank

Source: [14].

Figure 1 illustrates the application of AI in banking, including customer service, fraud detection, and personalized financial services. However, adoption remains limited due to challenges related to regulation, data privacy, investment costs, legacy systems, and customer trust [15]. In Indonesia, AI adoption is more common among large banks with strong capital, classified into KBMI I to KBMI IV. Integrating AI has become a strategic priority to enhance operational efficiency, competitiveness, and data governance [16].

2. LITERATURE REVIEW

2.1. Artificial Intelligence in Banking

AI has emerged as a transformative technology that enables banks to automate decision-making, improve customer interactions, and strengthen operational efficiency [17]. As a general-purpose technology, AI significantly reduces prediction costs and enhances the ability of organizations to process large volumes of data and generate actionable insights [18, 19]. In the banking sector, AI has become integral to various functions, including customer service, customer relationship management, fraud detection, credit scoring, marketing, payment services, and back-office operations [20, 21]. These applications allow banks to improve service quality, reduce costs, and respond more effectively to evolving market demands. One of the earliest and most visible AI applications in banking is the use of chatbots and robo-advisors [22]. These technologies provide real-time responses to customer inquiries and offer personalized financial recommendations based on user profiles and transaction histories [23, 24]. AI is also widely employed in credit decision-making, where machine learning algorithms evaluate customer creditworthiness with greater speed and accuracy than traditional methods [25, 26]. In addition, AI supports fraud detection, anti-money laundering, and compliance monitoring by identifying anomalies and generating continuous risk assessments [21, 27]. The European Banking Federation classifies AI applications in banking into three major domains: enhancing customer interaction and experience, improving process efficiency, and strengthening security and risk control [28]. These domains highlight the strategic role of AI in helping banks achieve digital transformation and sustainable performance. However, despite its benefits, AI adoption remains uneven across institutions and countries, suggesting that organizational and environmental factors play an important role in determining successful implementation [29].

2.2. Organizational Determinants of AI Integration

The successful integration of AI depends not only on technological availability but also on organizational readiness and structural characteristics. AI adoption often requires firms to redesign business processes, adjust governance structures, and develop new capabilities [30, 31]. Organizations with modular structures are generally better able to implement AI because changes can be introduced without disrupting other functions [32, 33]. In the banking sector, AI adoption is influenced by several organizational factors. Capital strength is essential because AI implementation requires significant investment in infrastructure, software, and skilled personnel [34]. Larger banks are therefore more likely to adopt advanced AI solutions. Ownership structure also plays a role, as foreign owned and private banks often have greater flexibility and access to global expertise [35]. In addition, organizational readiness including employee skills, management support, and digital maturity—strongly affects the success of AI deployment [36]. However, barriers such as fragmented data, legacy systems, regulatory uncertainty, and ethical concerns related to privacy and algorithmic bias can hinder adoption [37, 38]. Customer trust is also critical, as users must feel confident in AI systems and data security [39]. Overall, AI integration is a multidimensional process shaped by technological, strategic, and institutional factors.

2.3. Artificial Intelligence Integration in the Indonesian Banking Sector

Indonesia banking industry is undergoing rapid digital transformation under the OJK Banking Development Roadmap 2020–2025, which promotes the adoption of advanced technologies such as AI to improve efficiency and financial inclusion. However, AI adoption varies across banks due to differences in capital capacity, ownership structure, and technological readiness [40]. Indonesian banks are classified into core capital groups known as KBMI. Larger banks, particularly KBMI IV, tend to adopt AI more extensively because of stronger financial resources and more advanced digital infrastructure, while smaller banks face greater resource and capability constraints [41]. Although AI in banking has been widely studied, empirical evidence from Indonesia remains limited. This study addresses this gap by examining the impact of AI integration in the Indonesian banking sector and how organizational factors influence its adoption.

3. RESEARCH METHOD

3.1. Research Approach

This study employs both descriptive and verificative methodologies. The descriptive research component aims to present a detailed overview of each research variable, particularly focusing on AI integration. A descriptive survey is utilized to collect information directly from the research participants. The unit of analysis for this study is the commercial banking sector in Indonesia. Data collection is conducted using a cross-sectional, one-time approach, meaning that all information was gathered empirically in the field during a specific timeframe from December 2024 to April 2025.

3.2. Resource and Method of Sample Determination

According to this definition, the study's population comprises commercial banks in Indonesia. The sample includes a minimum of 30 banks categorized under the Core Capital Bank Group (KBMI) III and IV, as well as selected banks from KBMI II that have already implemented AI [42]. These 30 banks were identified using data from their 2024 annual reports, as presented in Table 1. The unit of analysis is the banks themselves. Respondents consisted of senior management representatives from each bank, including C-level executives, senior vice presidents, vice presidents, and assistant vice presidents, leading to a total of 300 respondents [43].

Table 1. Sample Details by Commercial Bank

No.	Bank Sample	KBMI	# Respondents
1.	Bank Rakyat Indonesia	IV	10
2.	Bank Mandiri	IV	10
3.	Bank Central Asia	IV	10
4.	Bank Negara Indonesia	IV	10
5.	Bank CIMB Niaga	III	10
6.	Bank Danamon	III	10
7.	Bank Panin	III	10
8.	Bank UOB Indonesia	III	10
9.	Bank Permata	III	10
10.	Bank OCBC NISP	III	10
11.	Bank Tabungan Negara	III	10
12.	Bank Mega	III	10
13.	Bank Maybank Indonesia	III	10
14.	Bank BJB	III	10
15.	Bank Syariah Indonesia	III	10
16.	Bank BTPN	III	10
17.	Bank KB Bukopin	III	10
18.	Bank Citibank Indonesia	II	10
19.	Bank DBS Indonesia	II	10
20.	Bank BNP Paribas	II	10
21.	Bank Sinarmas	II	10
22.	Bank Jago	II	10
23.	Bank MUFG	II	10
24.	Bank HSBC Indonesia	II	10
25.	Allo Bank	II	10
26.	Bank Mandiri Taspen	II	10
27.	Bank DKI	II	10
28.	Bank Woori Saudara	II	10
29.	KEB Hana Bank	II	10
30.	Bank Maspion	II	10
Total			300

Stated that the number of respondents between 100 and 200 people is sufficient to obtain a representative descriptive picture, especially when the study does not aim to conduct statistical inferential generalization.

Based on these considerations, the number of respondents in this study was set around 200 banking practitioners, with the criteria of being in the Assistant Vice President level and above and actively working in banking industry in Indonesia [44]. The sampling technique used is non-probability sampling, especially purposive sampling, which is selecting respondents who meet the criteria relevant to the research objectives.

4. RESULT AND DISCUSSION

The findings of this study were obtained through questionnaires distributed online between December 2024 and May 2025 via two channels. The first distribution was conducted through the Banking Risk Management Association (BaRA), while the second was carried out through LinkedIn's banking community network. A total of 295 responses were collected using the Google Forms survey platform. This figure surpasses the initial target, providing extra data to serve as a backup in case any responses were incomplete or unusable. Below is an explanation of the quantitative data quality assessment that was performed Table 2.

Table 2. Data Quality Control (Survey Research Data)

Item checked	No. of data item	Note	Status
Collected data	295	All recorded data collected on the Google Form survey platform used.	Collected
Incomplete survey data	15	Respondents filled out the data incompletely.	Deleted
Survey discontinued	99	Condition where respondents could not continue filling out the survey after indicating that their bank has not implemented AI.	Deleted
Respondent Data Used	181	Total number of respondent data used before being grouped by bank institution.	Accepted
Total Respondent Data After Grouping by Bank Institution	48	Total number of data used in statistical processing using SmartPLS 4.	Accepted

Characteristics respondents based on how long banks has been implementing AI The respondents were categorized based on the duration of their banks' use of Artificial Intelligence. The results revealed that 35.4% indicated that their banks had not yet adopted AI. Meanwhile, 32.1% reported that their bank had been operating AI programs for 1 to 3 years. Additionally, 10.7% stated that AI had been in use at their banks for over 3 years, while 21.8% mentioned that their banks had only begun adopting AI within the past year. Figure 2 provides a detailed profile of respondents according to the length of AI implementation at their banks.

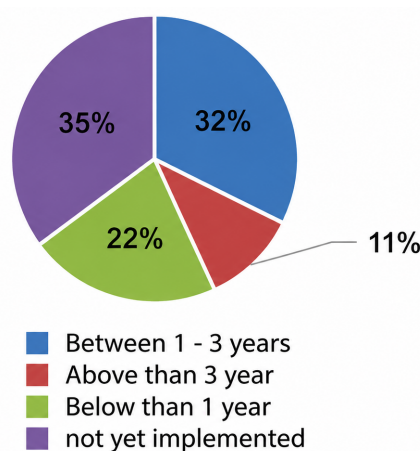


Figure 2. AI implementation Duration Among Banks

The duration of AI implementation across each KBMI bank category is presented in Figure 3 below. In KBMI 4 banks, 75.8% of respondents indicated that their bank has been using AI for the past 1 to 3 years, while 24.2% reported that AI adoption began within the last year. Among KBMI 3 banks, 51.5% stated that their bank started implementing AI less than a year ago, 26.5% mentioned it had been in place for 1 to 3 years, and 22.1% reported using AI for more than 3 years. For KBMI 2 banks, 51.5% of respondents noted that their bank has been utilizing AI for 1 to 3 years, 25.8% indicated that adoption occurred within the last year, and 22.7% reported that AI had been implemented for over 3 years. Lastly, in KBMI 1 banks, 92.9% of respondents shared that AI had been in use for 3 to 5 years, while 7.1% stated it had been adopted within the past year.

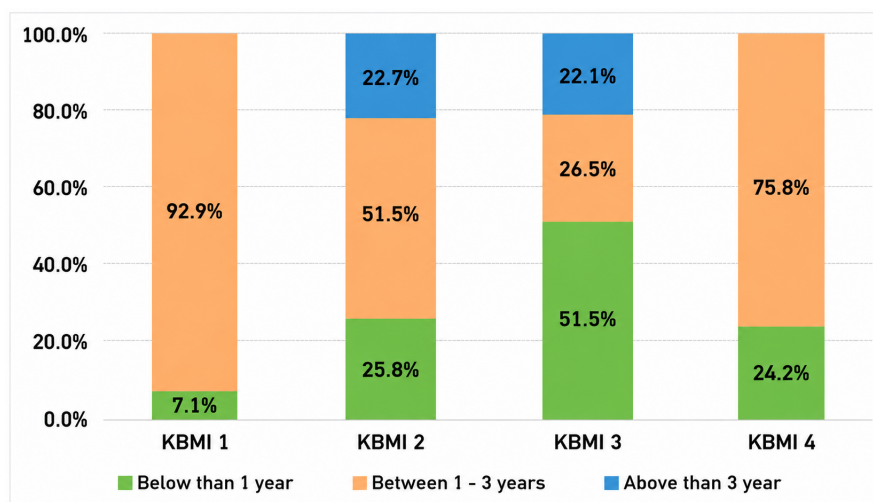


Figure 3. Respondent Distribution by AI implementation Duration per KBMI

Additionally, when examining the profile of how long these banks have been implementing AI from the perspective of the majority shareholder, Figure 4 below presents this information. In state-owned banks, 61.9% of respondents indicated that their bank began using AI within the past year, 14.3% reported that adoption occurred within the last 1 to 3 years, and 23.8% stated that their bank has been utilizing AI for more than 3 years. Among national private banks, 75.0% of respondents mentioned that AI has been implemented in the past 1 to 3 years, while the remaining 25.0% said adoption took place within the last year. For foreign banks, 52.8% of respondents noted that their bank has been using AI for 1 to 3 years, 28.1% reported implementation within the past year, and 19.1% indicated that their bank has been utilizing AI for over 3 years. In regional development banks, 70.0% of respondents shared that AI adoption occurred in the last 1 to 3 years, while 30.0% stated that their bank has had AI in place for more than 3 years.

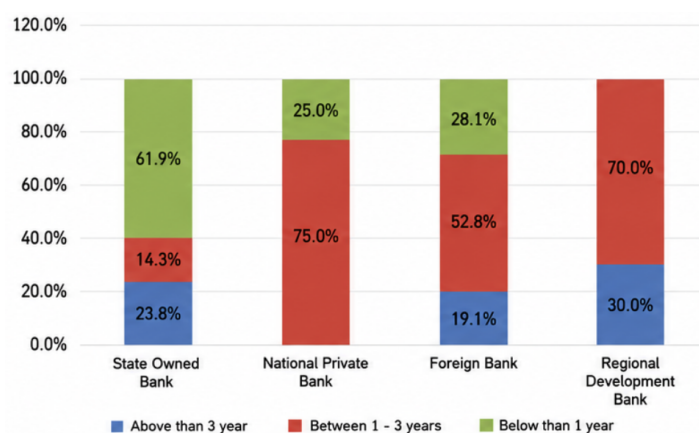


Figure 4. Distribution of Respondents by AI Implementation Duration per Majority Shareholder

Characteristics of respondents based on in which bank area has been implementing AI When respondents were asked about the areas within their banks that have adopted AI and were allowed to select multiple options, Figure 5 shows that 65.4% indicated that AI has been applied in Digital Operations. Additionally, 51.6% reported its use in Customer Analytics. Furthermore, 32.4% believed that AI has been implemented in IT/Data functions, while the same percentage reported its application in Retail Banking. Moreover, 29.8% stated that AI is utilized in Call Center services, and 23.9% noted its use in Risk Management.

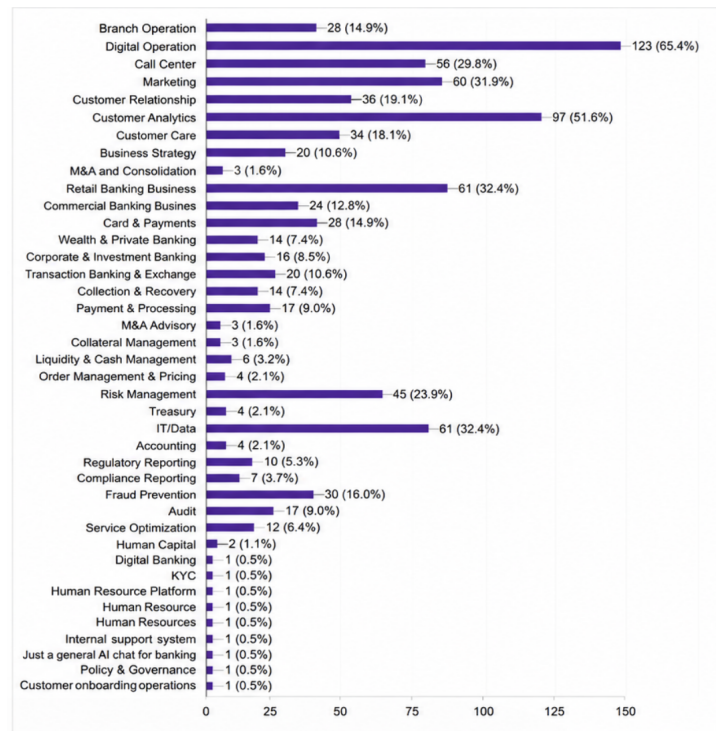


Figure 5. Distribution of Respondents Based on Banks Implementing AI

Overall, these findings demonstrate that AI implementation in Indonesian banks is most prominent in operational areas that involve large volumes of customer and transactional data. This pattern suggests that banks prioritize AI adoption in functions where automation, predictive analytics, and improved decision-making can generate the greatest operational and strategic benefits.

5. MANAGERIAL IMPLICATION

This study contributes to both theoretical and managerial perspectives regarding digital transformation and AI adoption in the banking sector, particularly within emerging economies. From a theoretical standpoint, the research enriches the current understanding of how financial institutions integrate advanced digital technologies into their operational and strategic frameworks. The findings demonstrate that AI adoption in Indonesian banks is not driven solely by technological availability, but is also significantly influenced by organizational characteristics such as capital size, ownership structure, and operational capacity.

These factors determine the readiness and capability of banks to implement AI-based solutions effectively. By providing empirical evidence from the Indonesian banking context, the study expands existing discussions on technology adoption, innovation diffusion, and digital capability development in financial institutions operating in developing markets. At the same time, the research offers valuable managerial insights for banking leaders and decision-makers in designing effective AI implementation strategies. Bank management should prioritize strategic investments in AI technologies that enhance customer experience, improve service personalization, and increase operational efficiency, particularly in areas such as digital operations, fraud detection, credit assessment, and customer analytics. For banks with lower levels of digital maturity, adopting phased or gradual implementation strategies may help reduce operational risks while enabling progressive tech-

nological integration. Moreover, successful AI adoption requires strong alignment between AI initiatives and the bank's overall business strategy. Managers should also establish robust data governance frameworks to ensure secure data management, regulatory compliance, and ethical data usage. In addition, continuous employee training and skill development programs are essential to prepare the workforce for AI-supported operations, while effective change management initiatives can foster organizational acceptance and encourage a culture of digital innovation. Through these combined strategic, technological, and organizational efforts, banks can maximize the benefits of AI adoption and strengthen their competitiveness in the rapidly evolving digital financial ecosystem.

6. CONCLUSION

The research findings indicate that AI adoption has become increasingly widespread in the Indonesian banking sector, although the level of implementation varies considerably across institutions. Based on the survey results, 35.4% of banks had not yet implemented AI, while 32.3% had adopted AI for one to three years, 22.3% for less than one year, and 11.0% for more than three years. These findings suggest that most AI initiatives are relatively recent and that many banks are still in the early stages of developing AI capabilities. Overall, the results demonstrate that AI adoption is progressing steadily, with banks gradually integrating intelligent technologies into their operational and strategic activities.

When analyzed by KBMI classification, larger banks generally exhibited more advanced and consistent AI adoption. KBMI IV banks were predominantly classified as having implemented AI for one to three years, indicating that these institutions have moved beyond pilot projects and are scaling AI across multiple functions. KBMI III and KBMI II banks displayed more varied adoption timelines, with some banks reporting recent implementation and others indicating more mature use. Differences were also observed across ownership types. National private banks and foreign banks tended to adopt AI earlier than state-owned banks and regional development banks, reflecting greater organizational flexibility, stronger technological capabilities, and broader access to international expertise and innovation networks.

In terms of application areas, AI implementation is concentrated primarily in customer-facing and data-intensive functions. The most frequently reported area was Digital Operations (65.4%), followed by Customer Analytics (51.6%), IT/Data Management (32.4%), Retail Banking (32.4%), Call Center Services (29.8%), and Risk Management (23.9%). Other functions such as Marketing, Fraud Prevention, Regulatory Reporting, and Compliance Reporting also showed moderate levels of adoption. These findings indicate that banks prioritize AI in areas where automation, predictive analytics, and intelligent decision support can improve operational efficiency, strengthen risk control, and enhance customer experience. Overall, the results confirm that bank size, ownership structure, and organizational readiness are important determinants of AI adoption in Indonesia's banking industry.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: BT, MA, WG, and DD; Methodology: MA, WG, and DD; Software: WG, and DD; Formal Analysis: MA, WG, and DD; Investigation: MA, WG, and DD; Resources: BT, MA, and WG; Data Curation: MA, WG and DD; Writing Original Draft Preparation: BT and MA; Writing Review and Editing: BT, MA, and WG; Visualization: WG and DD; All authors, BT, MA, WG, and DD have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The datasets used to support the findings of this study are available from the direct link in the dataset citation.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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