



Strategic Governance, Risk, Compliance, And Sustainability (GRCS) in the Adoption of Artificial Intelligence for Digital Banking Transformation

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ABSTRACT

This study examines the role of Strategic Governance, Risk, Compliance, and Sustainability (GRCS) in supporting the adoption of Artificial Intelligence (AI) in digital banking transformation. The rapid advancement of AI technology has significantly reshaped the banking sector by improving operational efficiency, enhancing customer services, and optimizing data-driven decision-making processes. However, the implementation of AI also introduces new challenges related to governance structures, technological risks, regulatory compliance, and the long-term sustainability of digital banking systems. This research employs a qualitative approach through a literature review to explore how GRCS integration serves as a strategic framework for managing both risks and opportunities arising from AI adoption in the banking industry. The findings indicate that strong governance ensures transparency and accountability in AI utilization, risk management mitigates threats such as algorithmic bias and data security issues, compliance ensures alignment with digital banking regulations, and sustainability supports the responsible and continuous use of AI technologies. The study concludes that successful digital banking transformation depends not only on advanced AI technologies but also on the readiness of institutions to implement an integrated GRCS framework. Therefore, GRCS becomes a critical foundation for building a secure, adaptive, and sustainable digital banking ecosystem in the era of technological disruption.

INTRODUCTION

The development of digital technology in the last decade has brought significant changes to the financial sector, particularly the banking industry. Digital transformation not only changes the model of conventional banking services to be technology-based but also drives the emergence of innovations based on artificial intelligence (AI) that are increasingly integrated into banking business processes. AI is used in various strategic functions such as credit scoring, fraud detection, chatbot-based customer service, and faster and more accurate data-driven decision-making. In this context, AI becomes the main driver of a more efficient, responsive, and competitive digital banking transformation amid global technological disruption (Prihandini & Safaria, 2025).

In Indonesia, the adoption of AI in the banking sector has also seen significant increases along with the acceleration of financial services digitalization. Both large banks and digital banks are starting to integrate AI to improve operational efficiency and the quality of customer service. However, behind that great potential, the implementation of AI in banking also presents complex challenges, especially related to governance, technological risks, regulatory compliance, and the long-term sustainability of digital systems. This indicates that digital transformation does not only depend on technological sophistication but also on the institution's readiness to manage risks and ensure compliance and system sustainability (Tjahyono et al., 2025).

One of the main challenges in the implementation of AI in the banking sector is the increasing systemic and operational risks. These risks include algorithmic risks such as bias in decision-making, data security risks, and system failure risks that can impact financial stability. In addition, the use of AI also poses ethical and transparency challenges, where decisions made by automated systems are often difficult to explain to users or regulators. Therefore, a governance approach that can integrate oversight, risk control, and regulatory compliance comprehensively is needed (Wiriani et al., 2025).

In this context, the concept of Governance, Risk, and Compliance (GRC) becomes increasingly relevant to be expanded with the dimension of Sustainability, evolving into GRCS. GRC functions as a framework that ensures the use of technology, including AI, remains within regulatory boundaries, safe, and accountable. The integration of sustainability aspects adds a dimension of sustainability that emphasizes the importance of using technology that is not only economically efficient but also socially and environmentally responsible. Studies show that the integration of AI with risk management and sustainability can enhance bank performance in the long term (Tjahyono et al., 2025).

In the latest developments in literature, AI governance in banking is increasingly directed toward the concept of algorithmic governance, which emphasizes the importance of accountability, transparency, and risk-based oversight. AI systems in modern banking are no longer just operational tools, but have become part of the decision-making structure that directly impacts the stability of the financial system. Therefore, regulators in various countries are beginning to develop a risk-based approach to regulate the use of AI in the

financial sector, including aspects of model risk management and algorithm audits (García-Llorente & Olmeda, 2026).

In addition to governance aspects, compliance is also an important issue in the implementation of AI in the banking sector. Regulations related to data protection, cybersecurity, and algorithm transparency are becoming stricter as the use of digital technology increases. In Indonesia, strengthening digital banking regulations and internal bank governance has become a key factor in mitigating compliance risks. The digitalization of banking without strengthening compliance can increase the potential for regulatory violations and the reputational risk of financial institutions (Iswan Nur, 2026).

Meanwhile, the aspect of sustainability in digital banking is receiving increasing global attention, especially regarding the environmental impact of using digital technology and AI that require large computing infrastructure. AI is known to have a significant carbon footprint due to the energy requirements in large-scale data processing. Therefore, the integration of green banking principles and ESG (Environmental, Social, and Governance) has become increasingly important in the development of sustainable digital banking systems (Latisha & Dirkharehza, 2024). Thus, sustainability not only encompasses environmental aspects but also includes operational and social sustainability in the long term.

In the context of Indonesia, the digital transformation of banking is also influenced by the dynamics of geopolitical risks, economic stability, and varying levels of technology adoption among financial institutions. Research shows that the adoption of AI can enhance the financial stability and profitability of banks, but it can also increase risks if not balanced with a strong governance framework (Prajasari, 2025). This reinforces the argument that AI must be managed strategically through an integrative approach that combines governance, risk management, compliance, and sustainability within a unified framework.

Although various studies have discussed AI in banking from the perspectives of technology, risk, and sustainability separately, there is still a gap in research that comprehensively integrates all these dimensions into a single strategic GRCS model. Most studies tend to focus on the technical aspects of AI implementation or on regulatory aspects partially, so not many have examined how the integration of GRCS can serve as a strategic foundation in supporting a safe, compliant, and sustainable digital banking transformation.

Therefore, this research is important to provide a conceptual contribution in developing the Strategic GRCS approach as an integrative framework in the adoption of AI in the digital banking sector. This approach is expected to address the complex challenges arising from digital transformation, while also providing strategic direction for banking institutions in optimizing the benefits of AI without neglecting aspects of risk, compliance, and sustainability. Thus, this research is not only academically relevant but also has practical implications for regulators, banking industry players, and policymakers in building a more resilient, adaptive, and sustainable digital banking ecosystem in the era of technological disruption.

LITERATURE REVIEW

Adoption of Artificial Intelligence in Digital Banking

Transformation Digital banking transformation is a strategic change through the utilization of technology to enhance operational efficiency, service quality, information management, and decision-making. One of the key technologies is Artificial Intelligence (AI), which is applied in credit assessment, detection of suspicious transactions, chatbot services, product personalization, and risk analysis.

However, the adoption of AI also poses risks, such as algorithmic bias, model errors, privacy violations, and limited decision transparency. Therefore, its implementation requires governance, risk control, compliance, and long-term impact evaluation. OECD (2023, 2024) emphasizes the importance of accountability, transparency, security, privacy protection, and risk management throughout the AI lifecycle. Thus, the success of AI adoption is not only measured by efficiency but also by the level of trust and institutional accountability.

Strategic Governance in AI Adoption

Strategic governance is a mechanism for directing, decision-making, oversight, and accountability to ensure that the utilization of organizational resources aligns with strategic objectives. In AI adoption, this includes goal setting, delegation of authority, management oversight, clarity of responsibilities, and system decision evaluation.

NIST (2023) through the Artificial Intelligence Risk Management Framework (AI RMF) places the Govern function as the foundation for AI risk management throughout its lifecycle. In banking, its implementation can be realized through AI usage policies, human oversight of high-risk decisions, documentation of data and processes, risk owner designation, and periodic evaluations. Thus, governance becomes the foundation for the integration of other GRCS dimensions.

Risk Management in AI Banking Adoption

Risk management is a systematic process for identifying, analyzing, evaluating, handling, and monitoring organizational risks. In AI-based banking, risks include data quality, model inaccuracy, algorithm bias, cyber-attacks, information leaks, dependence on technology providers, and operational failures.

NIST (2023) through the AI RMF establishes four main functions, namely Govern, Map, Measure, and Manage, which encompass governance, context and impact identification, measurement, and risk handling. In banking, its application includes model validation, data testing, algorithm performance monitoring, access control, and incident handling. The risk dimension in GRCS aims to maintain the benefits of AI while minimizing potential losses for customers and institutions.

Compliance and Regulatory Accountability

Compliance ensures that the activities and decisions of the organization

are in accordance with laws, regulations, standards, and internal policies. In the adoption of banking AI, compliance includes personal data protection, information security, consumer protection, technology risk management, and decision documentation.

OECD (2024) emphasizes transparency, system explainability, process traceability, and accountability of both developers and users of AI. Therefore, compliance needs to be integrated from system design to operational monitoring, not just formal adherence to regulations. In the context of Indonesia, its implementation needs to be adjusted to the regulations of the Financial Services Authority, Bank Indonesia, and related legislation. Thus, compliance connects technological innovation with legal legitimacy, consumer protection, and institutional trust.

Sustainability in Digital Banking Transformation

Sustainability is the ability of an organization to create long-term value by considering economic, social, environmental, and governance aspects. In the adoption of AI in banking, sustainability encompasses resource efficiency, system resilience, service fairness, social impact, and adaptability to change.

OECD (2024) places inclusive growth, sustainable development, and well-being as AI principles. In banking, these principles are relevant to the efficiency of computing infrastructure, inclusive service access, prevention of algorithmic discrimination, and maintenance of customer trust. Thus, sustainability complements the dimensions of governance, risk, and compliance by considering the benefits and impacts of AI adoption in the long term.

Integration of Strategic Governance, Risk, Compliance, and Sustainability (GRCS)

Governance, risk, compliance, and sustainability have different but complementary functions. Governance sets direction and accountability, risk management identifies and controls potential losses, compliance ensures adherence to regulations, while sustainability considers economic, social, environmental, and operational sustainability.

This approach aligns with OECD (2023) and NIST (2023), which emphasize the integration of governance and risk management throughout the AI lifecycle. However, neither framework directly establishes GRCS as a standard model specifically for Indonesian banking. Therefore, this research positions GRCS as an integrative conceptual framework that connects AI governance, risk control, regulatory compliance, and organizational sustainability.

The integration of GRCS can be achieved through the establishment of goals and responsibilities for AI usage, identification and evaluation of risks, compliance checks, and long-term impact assessments. The results of monitoring serve as the basis for policy evaluation and system improvement. In banking, this framework has the potential to balance innovation with security, compliance, customer trust, and sustainability. However, as a literature-based conceptual study, this research explains theoretical relationships and formulates conceptual propositions, rather than proving causal relationships without empirical testing.

Literature Synthesis and Research Gap

The literature shows that AI adoption requires systems that are transparent, accountable, secure, and sustainable. OECD (2023, 2024) provides principles for trustworthy AI governance, while NIST (2023) offers an operational framework to identify, measure, and address AI risks throughout its lifecycle.

However, the relationship between governance, risk, compliance, and sustainability still needs to be examined in the strategic context of AI adoption in the banking industry, particularly considering regulations, operational risks, consumer protection, and sustainability needs in Indonesia. The gap in this research lies in the need to develop a conceptual synthesis that integrates these four dimensions into a single analytical framework.

Based on this gap, this research aims to develop a conceptual understanding of the role of Strategic Governance, Risk, Compliance, and Sustainability (GRCS) in supporting AI adoption in digital banking transformation. The expected contribution is a conceptual framework that explains the functions and interrelationships of the GRCS dimensions and their implications for the safe, compliant, accountable, adaptive, and sustainable management of AI. This framework can also serve as a basis for empirical research in banking institutions.

METHODOLOGY

This research uses a qualitative approach with a literature review method to deeply examine the application of Strategic Governance, Risk, Compliance, and Sustainability (GRCS) in the adoption of Artificial Intelligence (AI) in digital banking transformation. This approach was chosen because it can provide a comprehensive conceptual understanding of the integration between governance, risk, compliance, and sustainability in the digital technology-based banking ecosystem without conducting direct empirical testing (Ramdani et al., 2025).

The data sources in this study come from various relevant scientific literature, such as accredited national journals, international journals, proceedings, reports from the Financial Services Authority (OJK), Bank Indonesia, as well as other academic publications published within the last eight years (2018–2026). The main focus of the literature includes topics such as Artificial Intelligence in banking, digital banking transformation, governance model, risk management framework, regulatory compliance, as well as sustainability and ESG in the financial sector (Prajasari, 2025).

Data collection was carried out through documentation techniques by exploring scientific databases such as Google Scholar, Garuda, SINTA, SpringerLink, ScienceDirect, and educational institution repositories. The keywords used in the search include "Artificial Intelligence banking Indonesia," "GRCS framework," "digital banking governance," "risk management AI," and "sustainable banking Indonesia" (Aulia, 2026). The collected literature is then selected based on relevance, novelty, source credibility, and direct connection to the research focus.

Data analysis is conducted using content analysis techniques and a descriptive-interpretative approach. The stages of analysis include data reduction, concept grouping (coding), interpretation of findings, and theory synthesis to build the GRCS conceptual framework in the adoption of AI in the banking sector. Additionally, a comparison of previous research findings was conducted to identify patterns, research gaps, and opportunities for developing an integrative GRCS model (Tjahyono et al., 2025).

To enhance the validity of the research results, source triangulation techniques were used by comparing various academic literature and official policy documents from regulators such as OJK and Bank Indonesia. This approach aims to ensure that the analysis results are objective, consistent, and scientifically accountable (Iswan Nur, 2026).

This literature review method is considered relevant because the topic of GRCS and AI in banking is a continuously evolving multidisciplinary issue that requires synthesis from various scientific perspectives. Thus, this research is expected to produce a strong conceptual framework regarding the role of GRCS in supporting the transformation of digital banking based on Artificial Intelligence that is safe, compliant, and sustainable (Wiriani et al., 2025).

RESULTS

The Role of Strategic Governance in Ensuring Transparency, Accountability, and Effectiveness of Artificial Intelligence Adoption in Digital Banking

Transformation The rapid transformation of digital banking in recent years cannot be separated from the role of Artificial Intelligence (AI) technology, which has become a key component in enhancing efficiency and service quality. In this context, the role of strategic governance becomes a key factor determining the success of AI adoption in the banking sector. Governance is not only understood as a decision-making structure but also includes oversight mechanisms, control, and policy formation that ensure the implementation of technology adheres to the principles of transparency, accountability, and effectiveness. Without strong governance, the use of AI in banking has the potential to create various risks such as algorithmic bias, data misuse, and non-compliance with applicable regulations (Tjahyono et al., 2025).

In the perspective of digital transformation of banking in Indonesia, strategic governance plays an important role in ensuring that every implementation of AI-based technology remains within a clear governance framework. The Financial Services Authority (OJK) and Bank Indonesia have emphasized the importance of implementing good digital governance to ensure that technological innovations do not disrupt the stability of the financial system. This is in line with findings that banks with strong governance structures tend to be more prepared to adopt digital technology sustainably because they have more effective internal control mechanisms (Prajasari, 2025).

Transparency is one of the main elements in strategic governance related to the use of AI in banking. Transparency in this context not only includes the openness of information to customers but also clarity in the decision-making processes carried out by AI systems. Many AI models, especially those based on machine learning and deep learning, are often considered "black boxes" because

they are difficult to explain technically. Therefore, governance is necessary to ensure that banks are able to provide adequate explanations regarding the decisions made by the AI system, especially in cases of credit denial or customer risk detection (Aulia, 2026).

In addition to transparency, accountability is also an important aspect of strategic governance. Accountability in the use of AI means having clear responsibility for every decision made by the automated system. In practice, this includes determining who is responsible when a system error occurs, whether due to data errors, algorithm errors, or system failures. Without clear accountability mechanisms, the use of AI can pose significant legal and reputational risks for banking institutions. Research shows that the implementation of AI without a strong accountability system can increase the potential for digital governance failures (Wiriani et al., 2025).

The effectiveness of AI adoption in banking is also greatly influenced by the quality of governance implemented. Effective strategic governance is capable of creating a balance between technological innovation and risk control. In this context, governance plays a role in ensuring that AI technology investments provide real added value to the organization, whether in the form of increased operational efficiency, cost reduction, or improved service quality to customers. Banks with good governance tend to integrate AI into core business processes more quickly because they have a clear strategic direction (Ramdani et al., 2025).

Furthermore, strategic governance also serves as a link between risk management and regulatory compliance in AI implementation. In the banking sector, every technological innovation must comply with strict regulations related to data security, consumer protection, and financial system stability. Good governance ensures that the entire process of AI development and implementation has undergone comprehensive risk evaluation and complies with applicable regulatory standards. This becomes increasingly important in the digital era because the high complexity of AI systems can increase systemic risk if not properly supervised (Iswan Nur, 2026).

In Indonesia, the main challenge in implementing strategic governance on AI in the banking sector is the existing gap between the speed of technological innovation and the readiness of regulations and human resources. Many banking institutions have already started adopting AI, but they do not yet fully have a mature governance framework to optimally manage the technology. This condition can lead to an imbalance between innovation and control, which ultimately has the potential to create operational and strategic risks (Latisha & Dirkharehza, 2024).

Moreover, the role of the board of directors and top management in strategic governance is also very crucial. The commitment from the highest level of the organization is crucial for the success of AI implementation in banking. Without strategic support from leadership, the implementation of AI often tends to be partial and not integrated with long-term business strategies. Therefore, governance is not only technical but also strategic, encompassing high-level decision-making in the direction of the organization's digital transformation (Prihandini & Safaria, 2025).

In practice, strategic governance also includes the application of ethical AI governance principles that emphasize aspects of fairness, non-discrimination, and personal data protection. This is important because the use of AI in banking is closely related to sensitive customer data. Without proper oversight, AI can produce biased or unfair decisions, which can harm certain groups. Therefore, governance must ensure that every AI model used has undergone an ethical audit and model validation process on a regular basis (Tjahyono et al., 2025).

Overall, the role of strategic governance in the adoption of AI in the digital banking sector not only functions as a control mechanism but also as a key enabler in creating added value from technology. Strong governance can ensure that AI is used transparently, accountably, and effectively, while maintaining a balance between innovation and risk. Thus, strategic governance becomes the main foundation in building a sustainable, secure, and adaptive digital banking ecosystem in response to rapid technological changes (Prajasari, 2025).

Integration of Risk Management in Algorithmic Risk Mitigation, Data Security, and AI System Uncertainty in the Modern Banking Sector

The development of Artificial Intelligence (AI) in the modern banking sector has brought significant changes to the way financial institutions manage operations, decision-making, and customer service. However, behind the benefits offered, the implementation of AI also brings increasingly diverse and unpredictable risk complexities. In this context, the integration of risk management becomes a fundamental element that cannot be separated from the process of AI adoption in digital banking. Risk management not only serves as a mitigation tool but also as a strategic framework that ensures AI technology is used safely, controlled, and in line with organizational goals (Tjahyono et al., 2025).

One of the main forms of risk in the use of AI in the banking sector is algorithmic risk. This risk arises when AI systems produce biased, non-transparent, or unrealistic decisions regarding customers' actual conditions. Algorithmic bias can occur due to imbalances in training data, model errors, or system designs that do not consider fairness aspects. In the context of banking, this risk is very crucial because it can affect important decisions such as credit granting, customer risk assessment, and fraud detection. Therefore, risk management is necessary to ensure that AI models have undergone validation, testing, and regular audits to remain accurate and fair (Wiriani et al., 2025).

In addition to algorithmic risks, data security becomes a very important issue in the integration of AI in the banking sector. AI systems require large amounts of data to function optimally, including sensitive personal and financial data of customers. This condition increases the potential risk of data breaches, cyber-attacks, and information misuse. In this case, risk management plays a role in implementing strict data security policies, including data encryption, access control, and integrated cyber threat detection systems. Research shows that the higher the level of banking digitalization, the greater the need for adaptive risk-based security systems (Iswan Nur, 2026).

Furthermore, the integration of risk management also includes efforts to mitigate the uncertainties of AI systems. These uncertainties arise due to the

adaptive nature of AI, which continuously learns from new data, causing the results to change over time. This poses challenges in terms of predictability and consistency of system decisions. In the banking sector, this uncertainty can impact operational stability and customer trust. Therefore, a risk-based governance approach is needed that can continuously oversee the performance of AI models through regular monitoring, evaluation, and system recalibration (Aulia, 2026).

In the context of Indonesia, the implementation of AI-based risk management in the banking sector still faces various challenges, particularly related to the readiness of technological infrastructure and human resources. Many banking institutions have adopted AI technology, but have not yet fully integrated comprehensive risk management systems. This creates a gap between technological innovation and risk control capabilities, which can increase the potential vulnerability of the financial system (Prajasari, 2025).

The integration of risk management also heavily depends on the quality of the bank's internal governance. In practice, risk management cannot operate effectively without strong coordination between the information technology unit, the compliance unit, and the risk management itself. The silo approach in risk management often leads to delays in problem detection and response to threats. Therefore, an integrated approach is needed that combines all organizational functions within a risk governance framework that is adaptive to technological changes (Ramdani et al., 2025).

In addition, the development of regulations in the banking sector also encourages the importance of implementing stricter risk management in the use of AI. The Financial Services Authority (OJK) and Bank Indonesia have emphasized the importance of implementing information technology risk management as part of digital banking governance. These regulations require banks to not only focus on innovation but also ensure that every technology used has undergone a comprehensive risk assessment process. This includes operational risk, reputational risk, and compliance risk (Iswan Nur, 2026).

In a global perspective, the approach to risk management in AI is also evolving toward a dynamic risk assessment model, where risks are no longer assessed statically, but are continuously updated based on real-time data. This approach allows banks to respond to threats more quickly and accurately. In the context of digital banking, this is very important because cyber threats and changes in customer behavior can occur quickly and unexpectedly (Tjahyono et al., 2025).

In addition to technical aspects, organizational culture factors also influence the effectiveness of risk management integration in AI adoption. Organizations with a strong risk culture tend to be more prepared to face technological uncertainties and more proactive in identifying potential threats. Conversely, organizations that do not yet have a high level of risk awareness tend to be reactive in addressing issues, which can increase the impact of the resulting losses (Wiriani et al., 2025).

Overall, the integration of risk management in the adoption of AI in the modern banking sector is a crucial element to ensure the sustainability of digital

transformation. Risk management not only serves as a protective mechanism but also as an enabler that allows banks to optimize the benefits of AI safely and in a controlled manner. With an integrated approach, algorithmic risks, data security, and system uncertainties can be managed more effectively, thereby supporting the creation of a stable, adaptive, and sustainable digital banking ecosystem (Prajasari, 2025).

Implementation of the Compliance Framework as an Effort to Adjust Regulations and Data Protection in the Use of Artificial Intelligence in the Digital Banking Industry

The development of Artificial Intelligence (AI) in the digital banking industry has driven significant changes in how financial institutions operate, particularly in aspects of data-driven decision-making, service automation, and system efficiency improvement. However, behind these various benefits, serious challenges arise related to compliance with regulations and the protection of customer data. In this context, the implementation of a compliance framework becomes an important element that ensures the use of AI in banking remains within the legal, ethical, and security standards in force (Iswan Nur, 2026).

The compliance framework in the use of AI not only serves as an instrument for adhering to external regulations but also as part of the internal control system that governs how technology is implemented responsibly. In the banking sector, compliance includes adherence to regulations on personal data protection, cybersecurity, anti-money laundering (AML), and the principle of know your customer (KYC). With the increasing complexity of AI usage, the need for adaptive and technology-based compliance systems is also rising (Tjahyono et al., 2025).

One of the main challenges in implementing AI in the banking sector is the protection of customer data, which is the primary material in the algorithm learning process. AI requires large amounts of data to generate accurate predictions and decisions, but this also increases the risk of privacy violations and data breaches. Therefore, the compliance framework must ensure that all processes of data collection, storage, and processing are carried out in accordance with applicable regulations and the principles of data minimization and purpose limitation (Prajasari, 2025).

In Indonesia, the strengthening of regulations related to personal data protection through the Personal Data Protection Law (UU PDP) has become an important foundation in the implementation of compliance in the digital banking sector. This regulation requires financial institutions to have a data management system that is transparent, secure, and accountable. In the context of AI, this means that every algorithm used must be auditable and explainable (explainable AI), especially when it involves decisions that directly impact customers, such as credit denial or financial risk assessment (Aulia, 2026).

In addition to data protection, the aspect of algorithm transparency is also an important part of the compliance framework. Many AI systems used in banking are black boxes, making it difficult to understand how decisions are made. This poses challenges in terms of accountability and regulatory compliance. Therefore, the explainable AI (XAI) approach is being implemented

to ensure that every decision made by the AI system can be logically explained and audited by regulators as well as the bank's internal parties (Wiriani et al., 2025).

The implementation of the compliance framework also includes strengthening internal and external audit systems for the use of AI in banking. This audit aims to ensure that the AI system not only operates efficiently but also complies with the applicable regulatory standards. The audit process includes the evaluation of algorithm models, data quality, system security, and compliance with the bank's internal policies. With continuous audits, the risk of regulatory violations can be minimized from the outset (Ramdani et al., 2025).

In practice, compliance in the use of AI must also be able to adapt to the rapid technological developments. Static regulations often cannot keep up with the dynamic innovations of AI that are constantly evolving. Therefore, an adaptive compliance framework is needed that allows banking institutions to flexibly adjust internal policies without neglecting the fundamental principles of compliance and data protection (Iswan Nur, 2026).

On the other hand, the role of regulators such as the Financial Services Authority (OJK) and Bank Indonesia is very important in building a healthy compliance ecosystem in the digital banking sector. Regulators do not only function as supervisors but also as facilitators that encourage technological innovation to continue alongside consumer protection. In recent years, the OJK has begun developing guidelines related to digital banking governance that encompass aspects of technology risk, data security, and responsible AI usage (Prajasari, 2025).

Furthermore, the implementation of compliance is also closely related to the organizational culture within banking institutions. Banks that have a strong compliance culture tend to be more disciplined in applying regulatory standards and more prepared to face legal risks. Conversely, a weak compliance culture can lead to both unintentional and intentional violations, which can ultimately harm the institution's reputation and stability (Tjahyono et al., 2025).

Overall, the implementation of a compliance framework in the use of AI in the digital banking industry is a fundamental element that cannot be overlooked. Compliance not only functions as a control tool but also as a guaranty that technological innovation goes hand in hand with data protection, regulatory compliance, and system security. With a strong and adaptive compliance framework, the banking sector can maximize the benefits of AI without sacrificing public trust and the stability of the financial system (Aulia, 2026).

Strengthening the Sustainability Dimension in the Development of Artificial Intelligence to Achieve Green Banking and Sustainable Digital Transformation

The development of Artificial Intelligence (AI) in the digital banking sector not only impacts the improvement of operational efficiency and service quality but also brings significant implications for sustainability aspects. In the context of modern banking transformation, sustainability becomes a strategic dimension that cannot be separated from the adoption of digital technology, particularly AI. This is because the use of AI requires large computing

infrastructure, high energy consumption, and massive data processing, which can impact the digital carbon footprint. Therefore, strengthening the sustainability dimension becomes very important to ensure that the digital transformation of banking remains aligned with the principles of green banking and sustainable development (Latisha & Dirkhareshza, 2024).

The concept of green banking itself refers to banking practices oriented toward environmental sustainability by reducing the negative impact of the bank's operations on the environment. In the context of AI, green banking can be realized through the optimization of energy use in data centers, algorithm efficiency, and the utilization of more environmentally friendly cloud technology. The integration of AI that does not consider sustainability aspects has the potential to significantly increase energy consumption, thereby contradicting the sustainability principles that are currently the main focus in the global financial sector (Prajasari, 2025).

In Indonesia, awareness of the importance of sustainability in the banking sector is beginning to increase along with the implementation of Environmental, Social, and Governance (ESG) principles. Major banks are starting to integrate ESG indicators into their business strategies, including in the development of AI-based digital technologies. This shows that digital transformation is no longer solely focused on profitability and efficiency aspects, but also on the social and environmental impacts generated by the use of such technologies (Tjahyono et al., 2025).

The strengthening of the sustainability dimension in AI development is also closely related to the concept of sustainable digital transformation, which is a digital transformation that considers the balance between technological innovation, economic efficiency, and environmental and social responsibility. In the context of banking, sustainable digital transformation means that every AI implementation must be designed to support long-term efficiency without sacrificing the sustainability of environmental and social ecosystems. This includes the use of more energy-efficient algorithms, optimal data management, and the reduction of digital waste (Aulia, 2026).

Besides the environmental aspect, sustainability in AI also encompasses social and governance dimensions. In the social aspect, the use of AI in banking must be able to provide inclusive benefits for all layers of society without causing digital discrimination. For example, in AI-based credit scoring systems, it is important to ensure that the models used are not biased against certain groups. This becomes part of the bank's social responsibility in creating a fair and inclusive financial system (Wiriani et al., 2025).

From a governance perspective, sustainability also demands a mechanism for continuous oversight of AI usage. Sustainability-oriented governance ensures that decisions made by AI systems are not only economically beneficial but also consider the long-term impacts on the environment and society. Therefore, the integration of governance, risk management, compliance, and sustainability (GRCS) becomes highly relevant in supporting the development of responsible AI (Ramdani et al., 2025).

The main challenge in achieving sustainability in AI in the banking sector is the high demand for computational energy and digital infrastructure. The process of training AI models, especially those based on deep learning, requires a very large amount of computational resources. This results in increased electricity consumption and carbon emissions, especially if the data centers do not use renewable energy. Therefore, many global banking institutions are starting to switch to the use of green data centers and more efficient cloud computing technology (Iswan Nur, 2026).

In Indonesia, the implementation of sustainability in banking AI is still in its early stages, but it shows positive development. Some banks have started adopting digital sustainability policies by reducing paper usage, enhancing digital services, and optimizing AI-based systems to reduce physical operational burdens. Nevertheless, the integration between AI and sustainability principles still requires the strengthening of regulations and more comprehensive policies (Prajasari, 2025).

In addition, the role of regulations and government policies is also very important in promoting the implementation of AI-based green banking. The Financial Services Authority (OJK) and Bank Indonesia have begun to encourage the implementation of sustainable finance through various ESG policies and a digital banking roadmap. However, a stronger integration between digital technology policies and environmental sustainability policies is needed so that the transformation of digital banking can proceed holistically (Tjahyono et al., 2025).

Overall, strengthening the sustainability dimension in AI development is an important step in creating a digital banking system that is not only technologically advanced but also environmentally and socially responsible. By integrating green banking principles, energy efficiency, and sustainable governance, the banking sector can ensure that the digital transformation undertaken not only provides short-term benefits but also long-term sustainability for society and the environment (Latisha & Dirkharehza, 2024).

Strategic Synergy of Governance, Risk, Compliance, and Sustainability (GRCS) as an Integrative Model in Optimizing Digital Banking Transformation Based on Artificial Intelligence

The development of Artificial Intelligence (AI) in the digital banking sector has driven fundamental changes in the way financial institutions operate, make decisions, and provide services to customers. However, the complexity arising from the implementation of AI demands an approach that not only focuses on technological aspects but also on governance, risk, compliance, and sustainability. In this context, the strategic synergy of Governance, Risk, Compliance, and Sustainability (GRCS) becomes a highly important integrative model to ensure that AI-based digital banking transformation can proceed optimally, safely, and sustainably (Tjahyono et al., 2025).

Governance within the GRCS framework serves as the main foundation that directs the entire decision-making process in AI implementation. Governance ensures that the use of AI in banking is not only oriented toward efficiency but also toward transparency, accountability, and alignment with the

organization's long-term strategy. Without strong governance, AI integration has the potential to cause irregularities in data management, non-transparent decision-making, and weak internal controls (Prajasari, 2025).

Meanwhile, risk management in GRCS functions to identify, analyze, and mitigate various risks arising from the use of AI, such as algorithmic risk, data security risk, and operational risk. In a digital banking system that heavily relies on data, the risk of system failure or algorithmic errors can significantly impact financial stability and customer trust. Therefore, the integration of risk management becomes an important element to ensure that AI is used safely and in a controlled manner (Wiriani et al., 2025).

Compliance within the GRCS framework ensures that all AI implementations in banking adhere to applicable regulations, both at the national and international levels. This includes compliance with personal data protection, anti-money laundering (AML) regulations, and cybersecurity standards. With the tightening regulations on digital banking, compliance has become an important instrument to maintain the reputation and legality of banking institutions in adopting AI technology (Iswan Nur, 2026).

On the other hand, sustainability is becoming an increasingly important dimension in the development of modern GRCS. Sustainability is not only related to environmental aspects but also encompasses social and economic sustainability in the long term. In the context of AI, sustainability emphasizes the importance of using energy-efficient, environmentally friendly technology that also has a positive impact on society at large. The integration of sustainability in GRCS ensures that digital transformation is not only financially beneficial but also socially and environmentally responsible (Latisha & Dirkhreshza, 2024).

The synergy between these four elements of GRCS creates an integrative model that supports each other in the process of AI-based digital banking transformation. Governance provides strategic direction, risk management controls potential threats, compliance ensures adherence to regulations, and sustainability maintains a long-term balance between innovation and responsibility. When these four elements operate synergistically, the implementation of AI in banking can generate optimal value without sacrificing system stability (Aulia, 2026).

In practice, the implementation of the integrative GRCS model still faces various challenges, particularly related to the complexity of AI technology and the readiness of banking institutions. Many organizations still manage governance, risk, compliance, and sustainability separately (silo-based approach), leading to a lack of coordination between functions. This condition can hinder the effectiveness of AI management and increase the potential for operational risks (Ramdani et al., 2025).

Additionally, another challenge that arises is the lack of human resources with multidisciplinary competencies in understanding the relationship between AI technology and the GRCS framework. The digital transformation of banking requires professionals who not only understand technological aspects but also regulations, risk management, and sustainability principles. Without adequate

human resources, the implementation of an integrative GRCS is difficult to optimize (Tjahyono et al., 2025).

In Indonesia, the development of GRCS implementation in the digital banking sector shows a positive trend, especially with the increasing attention of regulators toward digital governance and sustainability. The Financial Services Authority (OJK) and Bank Indonesia continue to promote the strengthening of digital governance and the application of ESG principles in the financial industry. This becomes an important foundation for the development of a more integrated GRCS model in supporting AI adoption in the banking sector (Prajasari, 2025).

In the future, the synergy of GRCS is predicted to become the new standard in AI-based digital banking governance. This model not only serves as a control framework but also as an enabler of innovation, allowing banks to responsibly optimize AI technology. With an integrated approach, the banking sector can simultaneously enhance efficiency, reduce risk, ensure compliance, and support long-term sustainability (Iswan Nur, 2026).

Overall, GRCS is a strategic model capable of addressing the complex challenges in AI-based digital banking transformation. The synergy between governance, risk, compliance, and sustainability creates an ecosystem that balances innovation and control, enabling the creation of a more adaptive, secure, and sustainable digital banking system in the era of technological disruption (Latisha & Dirkharehza, 2024).

DISCUSSION

Digital transformation in the banking sector is experiencing significant acceleration with the development of Artificial Intelligence (AI) technology. The implementation of AI is not only used for automating banking services but also becomes a strategic instrument in enhancing operational efficiency, customer data management, fraud detection, and data-driven decision-making. In this context, the implementation of Strategic Governance, Risk, Compliance, and Sustainability (GRCS) becomes an important factor to ensure that digital transformation proceeds in a directed, safe, and sustainable manner. The integration of GRCS helps banking institutions maintain a balance between technological innovation and organizational stability in the face of digital disruption (Pratama & Nugroho, 2022).

In the perspective of strategic management theory, the application of AI in digital banking can be explained through the Dynamic Capability theory developed by David Teece. This theory explains that organizations must have the ability to integrate, build, and reconfigure both internal and external competencies to respond to rapid changes in the business environment. In the banking sector, this adaptive capability is evident through the use of AI to enhance the quality of digital services, product personalization, and business process efficiency. However, without good strategic governance, the use of AI can actually increase operational risks and regulatory uncertainty (Saputra & Hidayat, 2023).

Besides Dynamic Capability, the Resource-Based View (RBV) theory is also relevant in explaining the importance of AI as a strategic resource for organizations. According to RBV, a company's competitive advantage is

obtained through the utilization of valuable, rare, inimitable, and non-substitutable resources. In the context of digital banking, AI becomes a strategic asset because it can enhance data analysis capabilities and technology-based services. However, these advantages can only be maintained if supported by an effective governance and risk management system. This shows that AI technology is not merely an operational tool, but rather a part of the long-term business strategy of digital banking (Rahman & Putri, 2024).

The third theory supporting this research is Stakeholder Theory developed by R. Edward Freeman. This theory asserts that the success of an organization is determined by its ability to meet the interests of various parties, including regulators, customers, investors, and the community. In the implementation of AI, banks are not only required to generate business efficiency but also to maintain transparency, data security, and ethical use of technology. Therefore, the aspects of compliance and sustainability in GRCS become important to maintain public trust in the digital banking system (Kurniawan & Lestari, 2021).

The implementation of governance in AI adoption aims to create a supervisory system that ensures the use of technology operates transparently and accountably. Good governance enables organizations to establish operational standards, technology audit mechanisms, and control over customer data usage. In the digital banking sector, governance becomes a key element because AI operates through the processing of large amounts of data that are vulnerable to misuse and algorithmic bias. Research shows that weak AI governance can lead to credit decision disparities, digital service discrimination, and customer privacy violations (Fauzi & Ramadhan, 2022).

The risk management aspect in GRCS plays a role in identifying, analyzing, and controlling various risks that arise from the implementation of AI. These risks include cyber risks, algorithmic errors, technological dependence, and data breach threats. In practice, digital banking requires an adaptive risk mitigation system because technological threats evolve dynamically. The use of AI does indeed increase operational efficiency, but at the same time, it also increases the complexity of managing digital security. Therefore, the integration of risk management with digital strategy has become a primary necessity in the transformation of modern banking (Sari & Wijaya, 2025).

Compliance becomes the next important dimension in the implementation of AI in the digital banking sector. Regulations regarding data protection, electronic transaction security, and digital technology governance continue to evolve in line with changes in the business environment. Banks must ensure that the use of AI complies with national regulations as well as international standards related to information security and digital consumer protection. Compliance with regulations not only reduces legal risks but also strengthens the legitimacy of banking institutions in the eyes of the public. Thus, compliance serves as a strategic instrument to maintain the stability of digital transformation in the long term (Hidayat & Maulana, 2024).

Meanwhile, sustainability in GRCS emphasizes the importance of responsible and sustainable AI usage. Digital banking should not only focus on

economic efficiency but also consider the social impact and ethics of technology. The sustainable implementation of AI includes the use of inclusive technology, protection of customer rights, energy efficiency of digital systems, and the development of innovations that support the sustainability of the organization. The sustainability approach is also related to the organization's ability to maintain the continuity of digital transformation in the face of regulatory changes and global market dynamics (Yuliana & Setiawan, 2023).

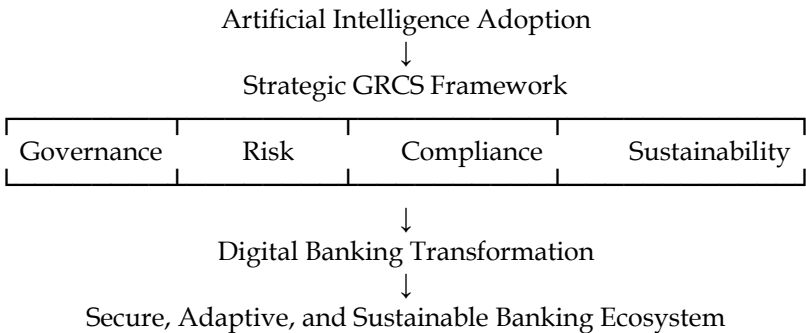
International research also reinforces the importance of integrating GRCS in the adoption of AI in the banking sector. A study from the Harvard Business Review explains that the success of AI implementation heavily depends on the organization's ability to build adaptive and risk-based digital governance. Additionally, research published in the Journal of Business Research shows that companies that implement governance and compliance in an integrated manner have a higher success rate in digital transformation compared to organizations that only focus on technological aspects. The findings indicate that AI and GRCS are two complementary elements in creating the competitiveness of modern digital banking.

Here is the table analyzing the integration of GRCS in the AI-based digital banking transformation.

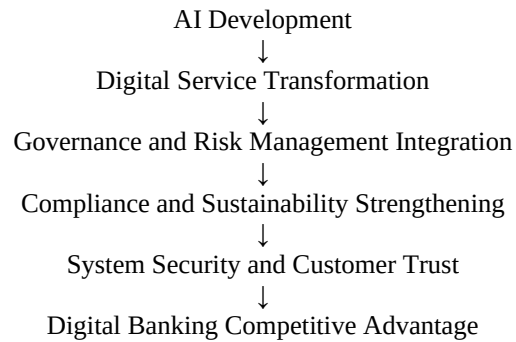
Table 1. Analyzing The Integration Of GRCS In The AI-Based Digital Banking Transformation

GRCS Component	Role in AI Adoption	Impact on Digital Banking
Governance	Regulates AI governance and system transparency	Enhances accountability and customer trust
Risk Management	Identifies and mitigates digital risks	Reduces cyber threats and algorithmic bias
Compliance	Ensures compliance with regulations	Strengthens legitimacy and legal protection
Sustainability	Ensures sustainable AI utilization	Supports long-term digital innovation

To clarify the relationships between components, here is a conceptual model of the research on the integration of GRCS in AI-based digital banking transformation.



In addition, the implementation strategy of GRCS in the digital transformation of banking can be described as follows:



Based on the discussion, it can be understood that the implementation of AI in the digital banking sector requires a strategic approach that is not only oriented toward technological innovation but also toward governance, risk control, regulatory compliance, and organizational sustainability. The integration of GRCS becomes the main foundation in ensuring that digital transformation proceeds effectively, safely, and sustainably. Thus, the success of AI adoption in the banking sector is greatly influenced by the institution's ability to build an integrated and adaptive GRCS system in response to global technological dynamics.

CONCLUSIONS AND RECOMMENDATIONS

The transformation of digital banking based on Artificial Intelligence (AI) shows very significant changes in the modern financial services system, especially in terms of operational efficiency, improved service quality, and accelerated decision-making processes. However, the study results show that the success of AI implementation is not only determined by the sophistication of technology but also by the organization's readiness to implement an integrated strategic framework through Governance, Risk, Compliance, and Sustainability (GRCS).

First, governance plays a crucial role in ensuring that the use of AI in banking operates transparently, accountably, and in alignment with the organization's strategic direction. Strong governance can strengthen internal controls and enhance public trust in digital banking services. Second, risk management becomes a key element in identifying and controlling various potential risks arising from the use of AI, such as algorithmic risks, data security, and system uncertainty, thereby maintaining the operational stability of banking.

Third, compliance functions to ensure that all AI implementations comply with applicable regulations, particularly regarding data protection, cybersecurity, and digital banking operational standards. Good compliance is an important factor in maintaining the legality, credibility, and reputation of financial institutions in the digital era. Fourth, sustainability emphasizes the importance of digital transformation that is not only oriented toward economic profit but also considers environmental and social impacts through the application of green banking principles and long-term sustainability.

Overall, it can be concluded that the synergy between governance, risk, compliance, and sustainability is an integrative model that is very important in

supporting the optimization of digital banking transformation based on Artificial Intelligence. The integration of these four aspects can create a more innovative, secure, compliant, and sustainable banking system, thereby addressing the challenges and dynamics of technological development in the future.

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