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Financial Inclusion and Institutional Resilience in AI-Driven Islamic Finance: A Contract-Based Risk Governance Framework

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ABSTRACT

The growing use of artificial intelligence (AI) in Islamic finance has complicated the allocation of responsibility when financing decisions depend on automated assessments. This study develops a conceptual governance framework by reconstructing the complementary functions of *Kafalah*, *Wakalah*, and *rahn*. Using a qualitative doctrinal-comparative approach, it examines the contracts individually and through three pairwise relationships, then maps their functions to AI-related risks and institutional controls. The analysis identifies *Kafalah–rahn* as a mechanism for coordinating guarantees and collateral, *Kafalah–Wakalah* for linking guarantee obligations with accountable delegation, and *Wakalah–rahn* for governing delegated collateral activities. These relationships inform a five-layer architecture covering contractual authority, contingent risk allocation, collateral risk mitigation, technological governance, and *maqāṣid al-sharīʿah*-based evaluation. An illustrative financing scenario shows how model validation, human oversight, decision traceability, and proportionate safeguards may operate together. The framework distinguishes responsible financial access from institutional resilience without assuming that either outcome follows automatically. Its contribution is conceptual, and practical effectiveness requires subsequent expert and institutional assessment.

1. INTRODUCTION

Artificial intelligence (AI) is reshaping financial intermediation by supporting credit assessment, fraud detection, customer profiling, and risk management. For Islamic financial institutions, these applications offer opportunities to improve operational efficiency and extend financial services to underserved customers. Their adoption, however, raises concerns that cannot be resolved through technological performance alone. Arsyad et al. [1] identify transparency, data security, and supervisory oversight as important challenges in AI-driven Islamic finance. Darmawan [2] similarly examines technological and institutional risks associated with Islamic digital financial services, while the literature mapping conducted by Azwar et al. [3] reflects growing academic attention to AI applications in this sector. These developments highlight a governance problem: as financial institutions rely more extensively on automated systems, responsibility for the decisions they support must remain identifiable and accountable. The relationship between automated assessment and equitable financial access presents a particular challenge. AI models can process information that conventional credit evaluation may overlook, potentially improving the assessment of applicants with limited financial histories. Yet predictive accuracy does not necessarily ensure fair treatment. Das et al. [4] examine the competing considerations involved in algorithmic fairness, while evidence from financial technology lending indicates that digital decision-making may still produce discriminatory outcomes [5]. Fuster et al. [6] further demonstrate how machine learning can influence credit markets and the distribution of lending opportunities. Although these studies primarily concern conventional financial services, their findings raise relevant questions for Islamic finance. An applicant may receive an unfavorable assessment without sufficient understanding of the factors influencing the decision or a meaningful opportunity to challenge it. Such circumstances create difficulties when financial institutions must reconcile technological efficiency with justice, transparency, and responsible financing.

These challenges become more complicated when viewed through the contractual structure of Islamic finance. Financial risk is not determined solely by an institution's ability to predict default. It also depends on how obligations, authority, and financial exposure are distributed among participating parties. Barau et al. [7] examine risk-sharing arrangements in Islamic banking and their implications for stability and resilience, while Saleem et al. [8] investigate the relationship between contractual structures, credit risk, and sustainable financial intermediation. Their findings provide a basis for considering risk governance beyond

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conventional measures of financing performance. When AI contributes to financial decisions, the institution producing or approving a decision may differ from the technology provider responsible for developing the underlying model. This separation introduces uncertainty over who exercises authority, who bears contractual obligations, and who should respond when an automated assessment proves unreliable. Islamic commercial jurisprudence offers contractual mechanisms that can help clarify these responsibilities. Among them, *Kafalah*, *Wakalah*, and *rahn* address different dimensions of financial risk. *Kafalah* concerns guarantees and the assumption of specified obligations, *Wakalah* regulates delegated authority, and *rahn* provides security through pledged assets. Although their juridical functions remain distinct, they may operate in complementary ways within financial intermediation. Their relevance becomes apparent when AI supports financing approval, guarantee assessment, or collateral valuation. An automated recommendation may influence these activities, but it cannot independently establish contractual authority or assume legal responsibility. Financial institutions must therefore distinguish the operational role of technology from the obligations of guarantors, authorized agents, and parties involved in collateral arrangements.

Addressing these concerns requires a connection between Islamic contractual principles and contemporary approaches to AI governance. Zafar and Ali [9] emphasize the importance of incorporating *Sharīʿah* supervision throughout the AI lifecycle, including development, deployment, and monitoring. The NIST AI Risk Management Framework [10] provides a broader foundation for identifying, measuring, and managing AI-related risks, while ISO/IEC 42001:2023 [11] establishes requirements for organizational AI management systems. These approaches support practices such as model validation, documented decision authority, human oversight, and continuous monitoring. Their application to Islamic finance, however, requires further consideration of the contractual relationships affected by automated decisions. Technological safeguards may improve the reliability of financial assessments, but they do not independently determine whether the resulting obligations are consistent with Islamic contractual principles. A related concern is how financial institutions balance inclusion with resilience. Expanding financing opportunities for applicants with limited credit histories may improve access, although unreliable assessments can create additional financial exposure. Conversely, excessive collateral requirements may strengthen immediate creditor protection while excluding potentially viable applicants. These outcomes should not be treated as equivalent. Financial inclusion concerns fair and responsible access to financial services, whereas resilience reflects an institution's capacity to manage losses, respond to disruptions, and maintain essential operations. The principles of *maqāṣid al-sharīʿah* provide a normative perspective for examining this balance. Laldin and Furqani [12] distinguish the objectives of Islamic finance from the instruments used to achieve them, emphasizing that financial arrangements should be evaluated according to their underlying purposes. Accordingly, the protection of wealth, prevention of avoidable harm, and preservation of responsible financial access should inform both contractual safeguards and technological governance.

Despite growing research on Islamic financial risk and AI governance, the functional relationships between established Islamic contracts and AI-assisted decision-making remain insufficiently explained. Existing studies provide insights into contractual compliance, institutional stability, algorithmic fairness, and technological oversight, but these discussions are often developed separately. What remains underexplored is how different contractual mechanisms may be coordinated to address financial and technological risks without altering their legal characteristics. This study approaches that gap through three pairwise relationships. The combination of *Kafalah* and *rahn* concerns guarantee and collateral risk protection, *Kafalah* and *Wakalah* connects contingent obligations with accountable delegation, and *Wakalah* and *rahn* addresses delegated collateral governance. These relationships do not constitute new Islamic contracts. Rather, they represent complementary governance functions that may be supported by AI-assisted assessment, monitoring, and documentation. This study develops these relationships through a qualitative doctrinal-comparative approach, drawing on Islamic contractual standards, financial risk literature, and contemporary AI governance principles. The analysis examines the legal functions of the three contracts, compares their complementary relationships, and identifies technological risks affecting their application. The resulting synthesis proposes a five-layer Islamic risk governance framework comprising contractual authority, contingent risk allocation, collateral risk mitigation, technological governance, and normative evaluation based on *maqāṣid al-sharīʿah*. An illustrative AI-assisted financing scenario is used to explain how the proposed mechanisms could operate when institutions assess applicants with limited financial records, determine appropriate safeguards, and review automated recommendations. It is expected to contributes in Islamic financial governance by connecting established contractual principles with identifiable responsibilities and technological controls. Its principal contribution lies in reconstructing three pairwise governance mechanisms and positioning them within an integrated five-layer architecture. This approach clarifies the relationships between contractual liability, delegated authority, collateral protection, model reliability, and institutional oversight. It also distinguishes the potential contribution of the framework to responsible financial inclusion from its implications for institutional resilience. The proposed architecture remains conceptual and does not establish that combining these mechanisms improves financial outcomes. Instead, it provides a structured foundation for future institutional assessment and evaluation of AI-assisted Islamic financing practices.

2. LITERATURE REVIEW

2.1 Kafalah: Guarantee and Credit Risk Governance

Kafalah is a contractual arrangement in Islamic commercial jurisprudence whereby a guarantor (*kāfil*) assumes responsibility for an obligation owed by another party. By introducing an additional party capable of fulfilling a specified obligation, this arrangement strengthens contractual assurance and may help Islamic financial institutions manage financing defaults without requiring borrowers to provide additional assets. Maulana [13] examines the role of guarantees in Islamic banking, particularly in *musyārakah* and *muḍārabah* financing, and highlights their relevance to financing risk management. Yet the protective function of

Kafalah depends on more than the existence of a guarantor. The underlying obligation must be clearly established, the contractual commitments must be enforceable, and the responsibilities of each party must remain identifiable. These conditions become particularly relevant when financial institutions rely on automated assessments to determine financing exposure. The application of *Kafalah* in contemporary financial products requires attention to its normative foundations. AAOIFI *Sharīʿah* Standard No. 5 provides guidance on guarantees, including their contractual conditions, scope, and permissible arrangements [14]. These provisions help distinguish legitimate guarantee obligations from arrangements involving excessive uncertainty or inappropriate compensation. Busari et al. [15] compare the treatment of guarantees under Bank Negara Malaysia resolutions and AAOIFI standards, highlighting differences in their regulatory and institutional applications. Such differences suggest that technological standardization cannot replace the interpretation of applicable contractual requirements. Even where AI is used to assess creditworthiness or administer guarantees, financial institutions must identify the relevant regulatory framework and communicate contractual obligations transparently to guarantors and financing recipients.

Remuneration presents another area where contemporary practice requires careful interpretation. Although classical discussions generally associate *Kafalah* with non-compensatory undertakings, some modern arrangements recognize fees associated with guarantee-related services. AAOIFI *Sharīʿah* Standard No. 5 distinguishes reimbursement of actual expenses from compensation for providing a personal guarantee [14]. Putra [16] examines *Kafalah bil ujrah* under DSN-MUI fatwas, explaining how the reconsideration of earlier juristic positions has influenced the treatment of fee-based guarantees in Indonesia. These developments should not be interpreted as unrestricted permission to charge for guarantees. Rather, they reveal the importance of distinguishing remuneration for legitimate services from the contractual assumption of liability. Where AI supports the calculation of guarantee-related charges or financial exposure, its recommendations must remain consistent with the applicable *Sharīʿah* requirements. AI-assisted financing introduces risks that conventional guarantee arrangements were not designed to address independently. Automated models can estimate default probabilities, identify repayment patterns, and classify financing applicants, but their assessments remain vulnerable to incomplete data, algorithmic bias, and prediction errors. Research on AI governance in Islamic finance [1] and algorithmic fairness in financial services [4] suggests that predictive performance alone cannot establish whether a financing decision is appropriate. Consider an institution that approves financing through an automated scoring model and subsequently requires a third-party guarantee. If the model relies on inaccurate customer information, the resulting assessment may misrepresent the underlying exposure. The guarantor's contractual obligation should not automatically extend to losses arising from an institution's failure to validate its own assessment procedures. This distinction separates liability for the guaranteed obligation from institutional responsibility for technological failures. It also reinforces the need for financial institutions to maintain oversight over the systems used to inform their decisions.

Reconstructing *Kafalah* for AI-driven finance consequently requires a connection between contractual risk allocation and technological accountability. Before establishing a guarantee, the financing institution should document the underlying obligation, the extent of liability, the conditions triggering payment, and the parties authorized to approve the arrangement. Where AI contributes to the assessment process, relevant data sources, model versions, generated recommendations, and human approval decisions should also be traceable. Model validation and periodic monitoring can help identify unreliable assessments, while escalation procedures allow material errors to be reviewed before they affect contractual decisions. These safeguards are consistent with broader approaches to AI lifecycle governance and organizational risk management [9], [10]. Their proposed role is not to transfer responsibility from institutions to technological systems, but to prevent automation from obscuring existing contractual obligations. Properly governed, *Kafalah* may also provide an alternative form of financial protection for applicants with limited collateral, although its contribution to inclusion depends on the availability, affordability, and suitability of guarantee arrangements. Questions concerning the authorization and supervision of AI-assisted financial activities lead to the complementary function of *Wakalah*, examined in the following section.

2.2 Wakalah: Delegated Authority and Agency Risk

Wakalah establishes a contractual relationship in which a principal (*muwakkil*) authorizes an agent (*wakīl*) to perform specified activities on the principal's behalf. Unlike *Kafalah*, which addresses contingent obligations through a guarantee, *Wakalah* concerns the exercise of delegated authority and the responsibilities associated with that delegation. AAOIFI Shari'ah Standard No. 23 provides a normative foundation for agency arrangements, including the legal capacity of contracting parties, the scope of authorized activities, and the conditions governing an agent's conduct [17]. These provisions are relevant to financial intermediation because delegation does not grant unlimited discretion. An agent must operate within an identifiable mandate, while questions of liability depend on the contractual terms and circumstances of the agent's conduct. When financial institutions incorporate AI into delegated activities, this distinction becomes particularly significant. An algorithm may perform analytical or operational tasks, but it does not automatically acquire the juridical status of a *wakīl*. The legal relationship remains attributable to the parties authorized to establish and execute the underlying financial arrangements.

The effectiveness of delegated authority also depends on institutional governance rather than contractual designation alone. Mollah and Zaman [18], in their comparative analysis of Islamic and conventional banks, find that *Shariah* supervisory boards contribute positively to Islamic bank performance when they exercise an effective supervisory role, whereas their influence is considerably weaker when their involvement remains primarily advisory. Although their research does not examine AI-assisted financing, it highlights a distinction relevant to technological delegation: assigning formal oversight responsibilities does not necessarily ensure that those responsibilities are exercised effectively. An institution may establish internal approval procedures or appoint personnel to supervise automated decisions while leaving them without adequate information or authority to intervene. Under such circumstances, governance can become procedural rather than substantive. The reconstruction of *Wakalah* should

consequently consider whether authorized personnel possess the operational capacity to examine, challenge, and correct decisions produced through delegated technological processes.

AI-assisted financial intermediation complicates conventional agency relationships because decision-making activities may be distributed across several organizational and technological actors. A financial institution may appoint an external technology provider, obtain data from third-party services, and use a machine-learning model to assess an applicant's repayment capacity. The model then generates a risk score or financing recommendation that may be reviewed by an employee or processed through an automated approval system. These activities form an interconnected decision process, although each participant exercises a different degree of control over its outcomes. The resulting governance challenge concerns the identification of who authorizes the assessment, who controls the model and its inputs, and who remains responsible for the financial decision. The lifecycle-oriented governance approach discussed by Zafar and Ali [9] provides a relevant foundation for addressing this distribution of responsibilities. From the perspective of *Wakalah*, institutions should distinguish the delegation of technical tasks from the delegation of contractual authority. Outsourcing model development or data processing does not, by itself, transfer the institution's responsibility for decisions made under its financial mandate.

Automated recommendations introduce additional governance concerns when credit assessments rely on incomplete records, historically biased data, or models whose performance changes after deployment. As discussed by Das et al. [4], predictive accuracy does not necessarily ensure equitable treatment. From the perspective of *Wakalah*, institutions must therefore establish clear boundaries for automated decisions and identify circumstances requiring human intervention. The NIST AI Risk Management Framework [10] offers a basis for monitoring model performance, investigating potentially discriminatory outcomes, and initiating corrective action. Meaningful oversight also requires authorized personnel to understand the principal factors influencing consequential recommendations and to challenge unreliable assessments. Records of model versions, relevant inputs, approval authority, and subsequent modifications should remain available for institutional review and *Sharīʿah* supervision. These arrangements reflect the emphasis on accountability in AI-driven Islamic finance [1], while allowing the intensity of human review to reflect the significance of each financial decision.

Reconstructing *Wakalah* as a governance mechanism therefore involves translating the principles of authorized representation into identifiable institutional controls. The proposed interpretation does not extend legal agency to AI systems or replace established rules concerning the responsibilities of principals and agents. Instead, it provides a conceptual basis for organizing decision rights, oversight duties, documentation, and accountability when computational systems assist the performance of delegated financial activities. Its potential contribution to financial inclusion lies in reducing the likelihood that applicants are excluded through unreviewable or unreliable automated assessments. For institutional resilience, clearer responsibility boundaries may support earlier detection of governance failures and more coordinated responses to operational disruptions. These are proposed governance mechanisms rather than empirically verified outcomes. While *Wakalah* addresses the authority under which financial decisions are made, it does not independently determine how potential financing losses should be secured. This remaining concern introduces the complementary function of *rahn*, which is examined in the following section.

2.3 Rahn: Collateral-Based Risk Mitigation and Financial Inclusion

Rahn is a security arrangement in Islamic commercial jurisprudence through which an identifiable asset is pledged to secure the fulfillment of a financial obligation. Unlike *Kafalah*, which introduces a guarantor's contingent responsibility, *rahn* provides a creditor with a security interest in an asset that may be used to recover an outstanding obligation in accordance with applicable contractual and legal requirements. The pledging party (*rāhin*) retains ownership of the asset, while the creditor (*murtahin*) obtains rights associated with the security arrangement. AAOIFI Shari'ah Standard No. 39 addresses the legal structure of *rahn*, including the characteristics of pledged assets, possession, contractual responsibilities, and the realization of security when obligations remain unfulfilled [19]. These principles establish an important distinction between securing a financial obligation and transferring ownership of the pledged property. Within Islamic financial intermediation, this distinction provides a foundation for protecting creditor interests while preserving the contractual rights of financing recipients.

Collateral serves an important function in limiting potential financial losses, particularly when an institution faces uncertainty regarding repayment. Its effectiveness, however, depends on more than the availability of an asset with an estimated market value. The asset must be identifiable, appropriately valued, legally available as security, and subject to clearly established realization procedures. Excessive reliance on collateral may also restrict financing opportunities for individuals and microenterprises that possess productive capacity but lack formally recognized assets. This creates a tension between institutional risk protection and financial inclusion. Increasing collateral requirements may reduce certain forms of loss exposure, yet the same requirements can prevent financially constrained applicants from obtaining otherwise viable financing. A governance approach based on *rahn* should consequently consider the relationship between the value of the pledged asset, the nature of the financing obligation, and the applicant's circumstances rather than treating collateral maximization as an independent objective.

Advances in machine learning have created opportunities to reconsider how financial institutions evaluate credit risk before determining the security required for financing arrangements. Khandani et al. [20] demonstrate that machine-learning techniques can improve consumer credit-risk forecasting by combining customer transaction information with conventional credit data. Their findings concern predictive credit assessment rather than collateral valuation, but they illustrate how additional analytical capacity may inform financing decisions. For Islamic financial institutions, this distinction is relevant because repayment capacity and collateral adequacy represent different dimensions of risk. A customer with limited assets may nevertheless demonstrate sufficient repayment potential, while substantial collateral does not necessarily indicate reliable future cash flows. Treating automated credit scores as the sole basis for determining collateral requirements could obscure these differences. A more appropriate approach would

evaluate the contribution of predictive models alongside contractual obligations, asset characteristics, and institutionally established risk limits.

Alternative data may further influence the relationship between collateral requirements and financial access. Berg et al. [21] investigate the predictive value of digital footprints in consumer credit assessment and show that such information can complement conventional credit bureau data, including for individuals with limited traditional credit records. This evidence suggests that digital information may improve assessments of applicants who would otherwise be difficult to evaluate through established scoring methods. Nevertheless, the availability of additional data should not be equated with fair or reliable decision-making. Digital footprints may differ considerably across socioeconomic groups, and their use can raise concerns about representativeness, privacy, and the relevance of behavioral information to financial obligations. Research on algorithmic fairness [4] and discrimination in financial technology lending [5] reinforces the need to evaluate whether automated assessment practices produce unjustified differences in financing outcomes. In a *rahn*-based arrangement, these concerns become particularly consequential when model outputs influence the amount or type of collateral demanded from individual applicants.

The use of AI for collateral valuation introduces additional governance considerations. Automated valuation models may estimate asset values using historical transactions, market indicators, asset characteristics, or other available information. Although such methods could improve the consistency and efficiency of valuation procedures, their reliability would depend on data quality, market conditions, and the suitability of the model for the asset being assessed. A model developed using observations from established urban property markets, for example, may produce less reliable estimates for assets located in areas with limited transaction records. Similar difficulties may arise when assets possess unique characteristics or when market conditions change substantially after model development. These examples illustrate potential risks rather than empirically established weaknesses of a particular Islamic financing system. Where automated valuation is adopted, institutions should document data sources, examine model limitations, establish procedures for identifying material valuation errors, and provide human review when an assessment is contested. Such controls would help prevent technical estimates from being accepted without adequate consideration of their contractual consequences.

The relationship between *rahn* and financial inclusion should therefore be considered alongside the applicant's repayment capacity and the proportionality of the required security. AI-assisted assessments may provide additional information for applicants with limited assets, but they should not automatically determine collateral obligations. Where appropriate, a permissible guarantee arrangement may offer complementary protection, subject to the institution's risk assessment and applicable contractual requirements. A reconstructed approach to *rahn* should preserve the legitimacy of collateral-based security while establishing safeguards against disproportionate requirements and unreliable technological assessments. Transparent asset valuation, secure custody or legally recognized possession, documented obligations, and clearly communicated default procedures remain necessary components of the arrangement. Financing recipients should also understand relevant charges, including any permissible *ujrah* associated with custody or services, and the procedures governing the realization of pledged assets. Where AI supports these processes, model validation, auditability, human oversight, and continuing monitoring should form part of institutional risk governance. The broader lifecycle principles discussed in AI governance literature [9], [10] provide a basis for organizing these controls without replacing the contractual requirements established under *rahn*. For financial inclusion, the intended contribution is to reduce avoidable exclusion arising from excessive or inaccurately determined collateral requirements. For resilience, the contribution is different: sound valuation and enforceable security arrangements may improve an institution's ability to manage potential losses while maintaining confidence in its financing procedures. These remain conceptual propositions requiring institutional evaluation. The complementary roles of *Wakalah*, *Kafalah*, and *rahn* can now be considered together to explain how delegated authority, contingent responsibility, and collateral-based protection may operate within an integrated Islamic risk-governance framework.

2.4 Integrating Kafalah, Wakalah, and Rahn into Islamic Risk Governance

The integration of *Kafalah*, *Wakalah*, and *rahn* requires a broader understanding of financial risk than the individual contractual functions discussed in the preceding sections. Islamic financial institutions face interconnected exposures involving credit performance, agency relationships, asset recovery, and operational continuity. These risks cannot always be addressed through a single contractual mechanism, particularly when financial decisions depend on automated assessments and external technology providers. Abedifar et al. [22], in their examination of risk and stability across Islamic and conventional banks, identify differences in credit and insolvency risks that vary according to institutional characteristics. Their findings suggest that the relationship between contractual arrangements and financial stability should not be assessed independently of the conditions under which financial institutions operate. Beck et al. [23] similarly report differences in capitalization, asset quality, intermediation, and stability between Islamic and conventional banks, while highlighting considerable variation across institutions and jurisdictions. Although these studies do not investigate AI-mediated financing, they establish a relevant analytical foundation: financial resilience depends on institutional characteristics and risk-management arrangements rather than contractual classification alone. The introduction of AI adds another dimension to this relationship because errors in automated assessments may influence several financial and contractual decisions simultaneously.

A functional integration of the three contracts can address these interdependencies without altering their respective legal identities. *Wakalah* establishes the boundaries of delegated authority and provides a basis for identifying the parties responsible for decisions supported by AI. *Kafalah* addresses contingent financial responsibility when an obligation covered by a valid guarantee remains unfulfilled, whereas *rahn* provides security and potential recovery through pledged assets. These functions operate at different points in the financing process and should not be interpreted as substitutes for one another. An institution may, for example, authorize an AI-assisted credit assessment under a defined operational mandate, use a permissible guarantee to support a financing

obligation, and require proportionate collateral where justified by the underlying exposure. However, the presence of a guarantee or collateral does not resolve weaknesses in model validation, data quality, or institutional decision-making. Similarly, delegating technical activities to a service provider does not automatically transfer the institution's contractual responsibilities. The governance challenge is therefore to establish appropriate relationships between decision authority, financial liability, recovery mechanisms, and technological controls. These relationships should remain sufficiently transparent to permit institutional review and *Shariah* supervision throughout the financing process.

Coordination across these functions also requires governance arrangements capable of identifying failures before they affect contractual outcomes. Minaryanti et al. [24], through a systematic literature review, examine the contribution of *Shariah* governance, supervisory boards, and internal *Shariah* review to financing risk management in Islamic banking. Their analysis emphasizes the need to strengthen supervisory arrangements while acknowledging limitations in the existing research concerning their effectiveness in reducing financing risk. This observation is relevant to AI-driven finance because formal supervisory responsibilities may provide limited protection when institutions lack the technical information needed to evaluate automated decisions. The framework proposed in this study therefore treats contractual governance and technological oversight as complementary responsibilities. Each contractual mechanism retains its established legal function, while the institution deploying AI should establish controls over model outputs, data integrity, decision authorization, and exception handling. The resulting functional relationships are presented in Table 1, which distinguishes the principal contractual risks from those introduced or intensified by AI-assisted financial processes.

Table 1. Functional Integration of Islamic Contracts and AI Risk Governance Mechanisms

Contract or governance component	Core function	Financial and AI-related risks	Responsible parties	Proposed governance controls
Wakalah	Delegated authority and accountable decision-making	Agency risk, unauthorized automated decisions, model errors, and fragmented accountability	Principal, authorized agent, and institution deploying AI	Defined mandates, decision authorization, audit trails, human oversight, and escalation procedures
Kafalah	Allocation of specified contingent financial obligations	Default risk, inaccurate credit assessment, and uncertainty concerning guarantee exposure	Guarantor for the defined guaranteed obligation; financing institution for its own assessment and governance duties	Clear liability boundaries, documented guarantee conditions, model validation, and transparent risk assessment
Rahn	Collateral-based security and financial recovery	Recovery risk, valuation errors, disproportionate collateral requirements, and potential exclusion	Financing institution and parties responsible for custody, valuation, and realization of security	Validated asset valuation, proportionate security, transparent realization procedures, and human review
Integrated governance	Coordination of contractual and technological responsibilities	Model risk, data risk, operational disruption, and accountability gaps across financing processes	Financial institution, designated governance functions, and relevant external providers under their contractual responsibilities	Lifecycle monitoring, data governance, internal review, *Shariah* supervision, incident management, and corrective action

Table 1 demonstrates that integrating Islamic contractual mechanisms requires coordination among decision authority, contingent liability, and financial security rather than the creation of a new contractual structure. AI adds complexity because unreliable assessments may influence several contractual activities simultaneously. Institutions should therefore maintain clear responsibility boundaries, documented decisions, and procedures for reviewing technological failures. The proposed integration also requires attention to the balance between financial protection and responsible access, particularly when guarantee arrangements or collateral requirements affect underserved applicants. These considerations establish the basis for the technological governance controls examined in the following section.

2.5 Best-Practice Framework for AI-Driven Islamic Finance

The integration of Islamic contractual principles with AI governance requires an institutional framework capable of translating legal responsibilities into operational practices. As financial institutions increasingly rely on automated credit assessment, risk classification, and collateral valuation, contractual compliance alone may not provide sufficient protection against errors arising from technological systems. A financing arrangement may satisfy its formal contractual requirements while relying on inaccurate predictions or decision processes that affected customers cannot reasonably understand. Explainable artificial intelligence (XAI) offers one approach to addressing this difficulty. Barredo Arrieta et al. [25] examine the concepts, methods, and limitations of XAI, emphasizing the importance of understanding how computational models produce their outputs and how explanations can support

responsible AI applications. For Islamic financial institutions, explainability is particularly relevant when automated recommendations influence the allocation of financial obligations or determine access to financing. However, providing an explanation should not be confused with demonstrating that a decision is accurate, fair, or contractually appropriate. These matters require separate evaluation within the institution's governance structure.

The choice of AI models presents a related consideration. Financial institutions may favor complex machine-learning approaches because of their ability to identify patterns in large datasets, yet such models can become difficult to scrutinize when their outputs affect consequential financial decisions. Rudin [26] challenges the assumption that explaining an opaque model after a decision has been produced is necessarily sufficient for high-stakes applications. Her argument favors inherently interpretable models when they can provide appropriate predictive performance. This perspective raises an important question for AI-assisted Islamic finance: whether additional computational complexity produces benefits that justify the resulting limitations in accountability. The proposed governance framework does not require every financial application to use a particular modeling technique. Instead, institutions should assess model suitability in relation to decision materiality, available validation evidence, and the ability of responsible personnel to understand and challenge its outputs. Where an interpretable model is technically suitable, its use may reduce dependence on explanations generated after the underlying assessment. More complex models would require stronger documentation, independent validation, and carefully defined human review procedures.

Algorithmic fairness represents another concern because financial data may reflect existing differences in economic opportunity, access to banking services, and patterns of financial participation. Mehrabi et al. [27] identify multiple sources of bias in machine-learning systems, including biases arising from data collection, model development, and the interpretation of algorithmic outcomes. These distinctions are useful for Islamic financial institutions because unfair decisions may originate before an AI model is deployed. An applicant with limited formal banking records, for example, may receive an unfavorable assessment because the available training data inadequately represent comparable financing circumstances. Conversely, removing sensitive attributes from a dataset does not necessarily eliminate discrimination when other variables remain correlated with protected characteristics. Institutions should therefore evaluate data representativeness, examine differences in model performance across relevant applicant groups where lawful and feasible, and establish procedures for investigating potentially unjustified outcomes. Fairness assessments should be adapted to the financial product and decision involved rather than reduced to a single numerical threshold. From the perspective of *maqāṣid al-sharīʿah*, these safeguards are relevant to the prevention of avoidable harm and the protection of equitable access to legitimate financial opportunities.

Technical controls also need to operate within an ethical framework that clarifies why particular governance requirements are necessary. Floridi et al. [28] propose an ethical approach to AI grounded in principles including beneficence, non-maleficence, autonomy, justice, and explicability. These principles offer a basis for evaluating whether the use of automated financial systems serves legitimate human interests rather than prioritizing efficiency without adequate consideration of its consequences. Nevertheless, ethical agreement does not automatically produce consistent institutional practice. Jobin et al. [29], in their comparative examination of AI ethics guidelines, identify convergence around transparency, justice and fairness, non-maleficence, responsibility, and privacy, alongside substantial differences in how these principles are interpreted and implemented. Such variation indicates that ethical commitments require operational definitions, assigned responsibilities, and reviewable evidence. Within Islamic finance, *Sharīʿah* supervision can contribute to this process by examining whether technological decisions remain consistent with the underlying contractual obligations and the broader objectives of justice and protection of wealth. Its role should complement technical evaluation rather than replace the specialist assessment needed to identify model failures or data-related vulnerabilities.

Data governance is especially important because automated financial assessments often depend on personal and transactional information that customers may not fully understand or control. Rosmaini et al. [30], in their examination of organizational privacy policies in Indonesia, discuss the need for clearer arrangements governing personal information, including collection, processing, access, and disclosure. Although their study predates Indonesia's current personal data protection legislation, it provides a relevant organizational perspective on the relationship between privacy responsibilities and information-system requirements. Law No. 27 of 2022 concerning Personal Data Protection establishes a more recent legal framework for personal data processing and the protection of data subjects in Indonesia [31]. These sources support the inclusion of privacy governance within AI-assisted financial processes, particularly where alternative data, external service providers, or automated customer profiling are involved. For institutions operating under Indonesian jurisdiction, the proposed framework should therefore incorporate appropriate legal grounds for processing, clear information about data use, controls over access and disclosure, and procedures for addressing data-subject requests. Data provenance, retention arrangements, and restrictions on secondary use should also be documented. Such controls are relevant not only to regulatory compliance but also to the preservation of customer trust and the prevention of unnecessary exposure of sensitive financial information.

Human oversight provides the connection between these technological safeguards and the contractual responsibility of financial institutions. Under *Wakalah*, an authorized agent operates within a defined mandate, and the use of AI does not automatically remove the responsibilities attached to that authorization. When an automated model recommends rejecting a financing application or imposing additional collateral requirements, designated personnel should be able to examine the relevant assessment and determine whether intervention is justified. The scope of review should reflect the significance of the decision. Routine low-risk analytical activities may operate under established monitoring procedures, whereas decisions with substantial consequences for customers may warrant individual review or a clearly available reconsideration mechanism. Audit records should identify the model version, relevant decision inputs, generated outputs, approval authority, and subsequent changes. These records would assist institutions in distinguishing errors arising from the model, inappropriate reliance on its recommendations, and failures to follow established contractual procedures. Guarantee and collateral arrangements require comparable safeguards. A *Kafalah* obligation

should remain defined by its contractual terms rather than by an automated risk score, while AI-supported valuation under *rahn* should be subject to appropriate verification and correction.

The proposed best-practice framework brings these responsibilities together through five interconnected governance layers. Its structure draws on the complementary contractual functions established in the preceding analysis and the lifecycle-oriented approach to AI management discussed by Zafar and Ali [9]. The NIST AI Risk Management Framework [10] provides a further reference through its functions of governing, mapping, measuring, and managing AI risks, while ISO/IEC 42001:2023 [11] offers a management-system perspective on organizational AI responsibilities. These frameworks inform the operational design but do not independently determine *Sharīʿah* compliance or the legal obligations arising from Islamic contracts. Within the proposed architecture, contractual authority, risk allocation, and risk mitigation establish the responsibilities associated with financial transactions. Technological governance provides controls over the AI systems supporting those transactions, while normative outcomes provide criteria for evaluating their implications for fairness, inclusion, and resilience. Table 2 presents the functions, safeguards, and reviewable evidence associated with each layer.

Table 2. Five-Layer Islamic Risk Governance Framework and Proposed Operational Controls

Governance layer	Principal mechanism	AI-related governance requirements	Proposed operational controls and evidence	Intended contribution
Layer 1: Contractual Authority	*Wakalah*: delegated authority and institutional accountability	Unauthorized automated decisions, unclear mandates, and fragmented responsibility	Documented decision rights, responsibility mapping, approval thresholds, human intervention procedures, and decision audit logs	Accountable delegation and traceable financial decisions
Layer 2: Risk Allocation	*Kafalah*: allocation of defined contingent obligations	Inaccurate credit assessments, uncertain guarantee exposure, and inappropriate attribution of technological failures	Defined guarantee conditions, documented liability boundaries, validated credit assessments, and records of institutional authorization	Transparent contingent liability and responsible credit-risk allocation
Layer 3: Risk Mitigation	*Rahn*: collateral security and potential financial recovery	Automated valuation errors, disproportionate collateral requirements, and exclusion of asset-constrained applicants	Valuation review procedures, documented security requirements, proportionate collateral assessment, and transparent recovery arrangements	Loss mitigation with safeguards for responsible financial access
Layer 4: Technological Governance	AI lifecycle management and organizational oversight	Algorithmic bias, model errors, data drift, privacy breaches, and operational failures	Data provenance records, model validation, fairness assessment, performance monitoring, access controls, incident reporting, and corrective action	Reliable, auditable, and accountable AI-supported financial processes
Layer 5: Normative Outcomes	*Maqāṣid al-sharīʿah* and integrated *Sharīʿah* governance	Unjustified exclusion, avoidable financial harm, weak institutional resilience, and misalignment with contractual objectives	*Sharīʿah* review, customer complaint monitoring, assessment of financing accessibility, review of adverse outcomes, and resilience-related governance indicators	Protection of wealth, responsible financial inclusion, and institutional resilience

The five layers presented in Table 2 represent interdependent governance functions rather than a fixed sequence of contractual activities. Contractual authority establishes responsibility for financial decisions, while risk allocation and mitigation determine the obligations and safeguards associated with those decisions. Technological governance operates across these functions by supporting model evaluation, oversight, and corrective action. The normative layer provides a basis for assessing whether the resulting arrangements remain consistent with responsible financial access and institutional protection. Their integration offers a conceptual structure for examining governance trade-offs, although the effectiveness of the proposed controls and their implications for financial inclusion and resilience require further evaluation

3. RESEARH METHODS

3.1 Research Design

This study adopts a qualitative doctrinal-comparative approach to examine how Islamic contractual principles can be reconstructed into an integrated risk-governance framework for AI-driven financial services. The research combines doctrinal interpretation, functional comparison, and conceptual framework development to investigate the relationships among *Kafalah*,

Wakalah, and *rahn*. The doctrinal component examines the legal characteristics and responsibilities associated with each contract, while the comparative component considers how their distinct functions may complement one another in contemporary financial intermediation. Rather than evaluating these contracts solely as individual financial instruments, the study examines their potential relationships in managing delegated authority, contingent obligations, and collateral-based financial protection. This approach provides a basis for considering how established Islamic contractual principles may remain relevant when financial assessments and operational decisions are increasingly supported by artificial intelligence.

The analysis focuses on three contractual combinations: *Kafalah* and *rahn*, *Kafalah* and *Wakalah*, and *Wakalah* and *rahn*. Each combination is examined according to its complementary risk-governance functions, the responsibilities of the parties involved, and the technological controls required when AI supports related financial activities. The findings of these comparisons provide the conceptual foundation for developing a five-layer governance framework that connects contractual authority, risk allocation, risk mitigation, technological governance, and normative outcomes. The study does not seek to establish a new Islamic contract or assign independent legal responsibility to AI systems. Its primary concern is the coordination of existing contractual mechanisms within an institutional structure capable of addressing contemporary technological risks. As a conceptual investigation, the research does not involve statistical hypothesis testing, institutional experiments, or the empirical measurement of governance effectiveness.

3.2 Documentary Sources and Analytical Scope

The research relies on documentary materials that provide normative, theoretical, and technological foundations for examining Islamic risk governance. These materials are organized according to their analytical functions rather than treated as a systematically retrieved literature sample. The first group consists of Islamic contractual standards and related scholarly discussions concerning guarantees, delegated authority, and collateral. AAOIFI Shari'ah Standard No. 5 provides a normative reference for *Kafalah* [14], Standard No. 23 addresses the contractual characteristics of *Wakalah* [17], and Standard No. 39 establishes principles relevant to *rahn* [19]. These standards are considered alongside academic literature discussing guarantees, contractual arrangements, and financial risk in Islamic banking [13][15][16]. Their purpose is to establish the distinct legal functions of the three contracts before examining their potential integration. The standards are used as contemporary normative references rather than presumed to have identical legal authority across all jurisdictions.

A second group covers AI governance, algorithmic accountability, and the organizational management of technological risks. Research on the governance of AI in Islamic finance [1][9] provides the institutional context for examining automated financial decisions. The NIST AI Risk Management Framework [10] and ISO/IEC 42001:2023 [11] are used as references for identifying organizational controls associated with AI development, deployment, monitoring, and corrective action. Literature concerning algorithmic fairness, explainability, and model reliability further informs the assessment of technological risks affecting financial decisions [4][25][27]. These sources contribute different forms of analytical support. Technical literature helps identify potential weaknesses in automated assessments, whereas governance standards provide a basis for considering how institutions might organize responsibility and oversight.

The remaining materials address financial intermediation, risk allocation, institutional governance, financial inclusion, and resilience. Studies of Islamic financial risk-sharing arrangements [7], [8] and *Shariah* governance [24] provide perspectives on how contractual and institutional arrangements relate to financial stability and responsible financing. Regulatory materials, including Indonesia's Personal Data Protection Law [31], contribute to the discussion of data-processing responsibilities where relevant. The documentary scope is purposefully bounded by the study's conceptual objectives: a source is considered analytically relevant when it clarifies a contractual function, identifies a financial or technological risk, informs a governance control, or contributes to the interpretation of inclusion and resilience. The research does not apply a systematic literature review protocol, database-based screening procedure, or bibliometric analysis. Instead, it uses focused documentary interpretation to develop and substantiate the proposed relationships between Islamic contractual mechanisms and AI governance.

3.3 Doctrinal and Pairwise Contractual Analysis

The analytical procedure begins by distinguishing the legal and economic functions of *Kafalah*, *Wakalah*, and *rahn*. Each contract is examined through four dimensions: the parties involved, the authority or obligation established, the financial risk addressed, and the limitations governing its application. Under this classification, *Kafalah* concerns the assumption of a defined guarantee obligation, *Wakalah* establishes authorized representation, and *rahn* provides security for an underlying financial obligation. These functions are interpreted with reference to their respective contractual standards [14][17][19]. Establishing these distinctions is necessary because the three mechanisms do not allocate responsibility in the same manner. A guarantor's contractual obligations cannot automatically be equated with those of an authorized agent, while the existence of pledged collateral does not independently determine responsibility for a financing decision. The doctrinal analysis therefore establishes the boundaries within which functional integration may be considered without altering the juridical identity of each contract.

The study subsequently compares the three contracts in pairs to identify complementary governance functions. The *Kafalah–rahn* pairing is examined through the coordination of guarantees and collateral, *Kafalah–Wakalah* through the relationship between contingent obligations and delegated authority, and *Wakalah–rahn* through accountability in collateral-related activities. Each comparison considers the responsibilities of the parties, potential governance gaps, and limitations on contractual integration. The procedure does not presume that combining these mechanisms necessarily improves financial performance.

The contractual relationships are further examined through their implications for institutional accountability and the distribution of financial risk. For each pairing, the analysis distinguishes obligations created by the underlying contracts from operational responsibilities associated with financial decision-making. This distinction becomes relevant when financial institutions use automated assessments or external technology providers. A technology provider may perform an analytical function, for example,

without becoming a guarantor, a contractual agent, or a party holding a security interest. Similarly, the use of multiple risk-mitigation instruments does not justify overlapping recovery claims beyond the enforceable obligation. The pairwise analysis therefore considers the clarity of contractual responsibilities, the compatibility of the combined functions, and the institutional arrangements needed to prevent ambiguity or disproportionate risk transfer. The resulting categories provide an analytical foundation for mapping AI-related risks onto the three contractual combinations.

3.4 AI Risk Mapping and Framework Synthesis

The next analytical stage examines how technological risks interact with the contractual relationships identified through the pairwise comparison. Rather than treating AI as an independent contractual mechanism, the study considers its role in supporting credit assessment, collateral valuation, risk monitoring, and administrative decision-making. Each contractual pairing is examined through a common set of analytical dimensions: the financial activity supported by AI, the information used in the activity, the potential sources of technological failure, the parties responsible for the resulting decisions, and the controls required to maintain accountability. Particular attention is given to algorithmic bias, model errors, unreliable data, limited explainability, and inappropriate automated decision-making. These risks are relevant to financing because an inaccurate or discriminatory assessment may affect a customer's eligibility, the structure of a guarantee, or the amount of collateral required. The literature on algorithmic fairness [4][27] provides a basis for identifying these concerns without assuming that every AI application produces the same level or type of risk.

AI-related risks are mapped to the contractual activities they may affect. For each pairing, the analysis considers the reliability of automated assessments, the authority to act on their outputs, and the consequences of inaccurate information for financing obligations. The mapping distinguishes technical risks, such as model errors and unreliable valuations, from institutional responsibilities concerning approval, monitoring, and corrective action. These relationships provide the analytical basis for identifying contract-sensitive technological controls without treating the proposed applications as empirically tested implementations.

To translate the identified risks into governance requirements, the study draws on the governance, mapping, measurement, and management functions of the NIST AI Risk Management Framework [10], together with the organizational management principles outlined in ISO/IEC 42001:2023 [11]. These references inform the identification of controls such as model validation, documented decision rights, data provenance, human oversight, performance monitoring, and incident response. The lifecycle approach to Islamic AI governance discussed by Zafar and Ali [9] further supports consideration of *Shariah* supervision across technological development and operation. The mapping distinguishes between controls designed to evaluate AI performance and those required to preserve contractual accountability. An accurate model does not independently establish the permissibility of a contractual arrangement, while a valid contract does not eliminate the need to examine technological errors that may affect its implementation.

The contractual and technological findings are subsequently synthesized into a five-layer governance architecture. The first three layers represent contractual authority through *Wakalah*, contingent risk allocation through *Kafalah*, and collateral-based risk mitigation through *rahn*. The fourth layer addresses technological governance, including the controls needed to manage AI-assisted financial processes. The fifth layer introduces *maqāṣid al-sharīʿah* as the normative basis for examining justice, protection of wealth, responsible financial inclusion, and institutional resilience. The three contractual pairings are positioned as functional relationships operating across the contractual layers rather than additional layers or newly established contracts. Technological governance supports these relationships by providing mechanisms for monitoring and reviewing AI-assisted activities, while the normative layer establishes criteria for examining their broader consequences. Table 3 summarizes the analytical procedure used to connect documentary interpretation, pairwise comparison, technological risk mapping, and conceptual framework development.

Table 3. Analytical Procedure for Pairwise Contractual Integration and Governance Framework Development

Analytical stage	Analytical focus	Procedure	Expected analytical output
Stage 1: Doctrinal analysis	Legal functions and responsibilities of *Kafalah*, *Wakalah*, and *rahn*	Examine contractual authority, obligations, security rights, and applicable limitations	Individual contractual risk-governance functions
Stage 2: Pairwise contractual analysis	Complementary relationships between the three contracts	Compare *Kafalah* + *rahn*, *Kafalah* + *Wakalah*, and *Wakalah* + *rahn*	Three proposed pairwise governance mechanisms
Stage 3: AI risk mapping	Technological risks associated with each contractual pairing	Identify AI-supported activities, potential failures, accountable parties, and relevant safeguards	Contract-specific AI risk and governance-control mapping
Stage 4: Framework synthesis	Integration of contractual and technological governance functions	Connect the three contractual functions and their pairwise relationships with AI oversight and normative assessment	Integrated five-layer Islamic risk-governance framework
Stage 5: Conceptual assessment	Contractual coherence, accountability, financial inclusion, and resilience	Examine the proposed architecture against legal, technological, and normative considerations	Conceptual implications, governance trade-offs, and research limitations

3.5 Conceptual Assessment and Research Limitations

The proposed framework is assessed conceptually through criteria reflecting its legal coherence, institutional accountability, technological governance, and potential implications for financial inclusion and resilience. Contractual coherence concerns whether the integration preserves the distinct functions and obligations of *Kafalah*, *Wakalah*, and *rahn*. Institutional accountability is considered through the identification of decision authority, responsibility for technological oversight, and mechanisms for reviewing consequential financial decisions. Technological governance concerns the suitability of controls for detecting model errors, examining potentially discriminatory outcomes, protecting financial information, and responding to operational failures. The normative assessment draws on the relationship between the objectives and instruments of Islamic finance discussed by Laldin and Furqani [12], particularly the need to evaluate financial arrangements in relation to their underlying purposes. Financial inclusion is considered in terms of fair access, proportionate safeguards, and the treatment of applicants with limited financial records or collateral. Resilience is examined separately through the capacity of institutions to allocate financial exposure, manage potential losses, and maintain accountability when technological or financial disruptions occur.

The assessment remains interpretive and does not establish the operational effectiveness of the proposed architecture. The study does not employ interviews, expert consensus procedures, prototype implementation, simulated performance testing, or empirical comparisons between alternative governance arrangements. Its documentary basis also limits the extent to which the proposed relationships can account for jurisdiction-specific legal interpretations, institutional differences, and practical implementation constraints. Moreover, the analytical scope does not represent an exhaustive review of Islamic jurisprudence or AI governance scholarship. These limitations mean that the relationships identified in the framework should be understood as propositions requiring further examination rather than verified improvements in financial inclusion or resilience. Subsequent research could evaluate the framework through expert review, scenario-based assessment, or prototype-supported institutional testing. Such evaluation would help determine whether the proposed contractual combinations and technological controls are sufficiently clear, legally appropriate, and operationally feasible for application in AI-assisted Islamic financing.

4. RESULT AND DISCUSSIONS

4.1 Pairwise Reconstruction of Islamic Contractual Risk Governance

The doctrinal-comparative analysis identifies three complementary contractual relationships that may provide a foundation for governing financial risks in AI-assisted Islamic finance. Rather than treating *Kafalah*, *Wakalah*, and *rahn* as interchangeable mechanisms, the reconstruction examines how their distinct functions can be coordinated when financing decisions involve automated assessments, delegated operational activities, and multiple forms of financial protection. The analysis produces three pairwise governance mechanisms: guarantee and collateral risk protection through *Kafalah* and *rahn*, guarantee and agency accountability through *Kafalah* and *Wakalah*, and delegated collateral governance through *Wakalah* and *rahn*. These mechanisms represent functional relationships between established contracts, not newly constituted contractual instruments. Their significance lies in clarifying how financial obligations, decision-making authority, and risk-mitigation arrangements may interact within a common governance structure. This interpretation extends the institutional perspective on Islamic financial risk discussed by Abedifar et al. [22] and Beck et al. [23] by considering the additional responsibilities that arise when financial processes are supported by AI. The first combination, *Kafalah* and *rahn*, produces a complementary mechanism of guarantee and collateral risk protection. Both arrangements may strengthen the protection available to a financing institution, but they operate through different legal relationships. *Kafalah* establishes a defined guarantee obligation involving a guarantor, whereas *rahn* provides security through an identifiable pledged asset. Their coordination may allow an institution to structure financial protection according to the characteristics of the financing exposure rather than relying exclusively on collateral or third-party guarantees. For example, a financing applicant with limited assets may be supported by a permissible guarantee arrangement, while collateral may be required only where its value and availability justify additional security. The resulting arrangement must preserve the applicable conditions of each contract, including the boundaries of guarantee liability, ownership of pledged assets, and procedures for recovering outstanding obligations [14][19]. Using both mechanisms does not create an entitlement to recover more than the enforceable obligation. Their proposed integration instead offers a means of coordinating financial safeguards while considering the potential exclusionary effects of excessive collateral requirements. When AI assists credit assessment or collateral valuation, its contribution is analytical: it may help institutions evaluate exposure and security adequacy, but it cannot independently determine contractual liability or establish the permissibility of a guarantee.

Figure 1 presents an AI-Enabled Risk Governance Framework for Financial Inclusion and Resilience, which integrates artificial intelligence into a continuous, five-stage risk governance process: AI-enabled appraisal and insights to learn from experience; risk assessment and evaluation to identify, predict, and analyze potential hazards; risk characterization and management to determine risk severity and implement appropriate mitigation and control measures; readiness for resilience and inclusion to strengthen institutional capacity, financial accessibility, and adaptive capabilities; and AI-supported decision-making and continuous improvement to optimize interventions based on evolving evidence. These stages are supported by enabling conditions, including appropriate policies and regulations, secure data and digital infrastructure, stakeholder collaboration, financial literacy, and organizational capacity building. AI technologies, such as predictive analytics, scenario simulation, real-time monitoring, and automated risk reporting, enhance the ability of financial institutions and regulators to identify emerging risks, assess their socioeconomic implications, and respond proactively. The framework ultimately connects responsible AI governance with two principal outcomes: financial inclusion, reflected in wider access to affordable financial services, reduced inequality, and greater digital participation; and resilience, reflected in stronger financial stability, improved crisis preparedness, and the capacity to absorb and recover from economic, technological, cyber, and environmental shocks. Its measurement framework operationalizes these

objectives through indicators covering model accuracy and fairness, data quality, risk mitigation effectiveness, compliance, financial service accessibility, and recovery capacity, enabling systematic evaluation of whether AI governance contributes to inclusive, accountable, and resilient financial systems. In this regard, financial inclusion represents a multidimensional outcome involving access to appropriate financial products, actual service usage, affordability, digital participation, and equitable treatment across socioeconomic groups, whereas resilience refers to the capacity of financial institutions, households, enterprises, and the broader financial ecosystem to anticipate, absorb, adapt to, and recover from financial crises, cyberattacks, technological disruptions, and environmental shocks. The measurement component therefore requires a combination of technical, organizational, and socioeconomic indicators, including model accuracy and bias, data governance quality, risk detection performance, incident response time, regulatory compliance, audit findings, account ownership, active financial service usage, service affordability relative to income, financial literacy, income stability, and recovery time following adverse events. These indicators should be evaluated against clearly defined baselines and periodically monitored to distinguish improvements attributable to AI governance from changes caused by macroeconomic conditions, regulatory reforms, or broader digitalization. A further methodological consideration is that increased AI adoption does not automatically produce greater financial inclusion or resilience; its effects depend on institutional capacity, data representativeness, governance quality, regulatory safeguards, and the availability of accessible alternatives for users who cannot effectively engage with digital systems. Consequently, the framework emphasizes a continuous feedback loop in which observed outcomes, stakeholder feedback, audit findings, and emerging risks inform subsequent model updates, policy revisions, and organizational learning.



Figure 1. AI-Enabled Risk Governance Framework for Financial Inclusion and Resilience

A different governance relationship emerges from combining *Kafalah* and *Wakalah*. Whereas the first pairing addresses financial protection, this combination concerns the connection between guarantee obligations and the authority exercised in administering financing arrangements. Under *Wakalah*, an authorized agent performs specified activities within an established mandate, while *Kafalah* assigns contingent responsibility according to the terms of the guarantee. Their functional integration becomes relevant when a financial institution delegates activities such as applicant assessment, guarantee documentation, approval processing, or exposure monitoring. The analysis indicates that operational authority and contractual liability must remain distinguishable even when these activities are technologically interconnected. An institution may authorize personnel or service providers to support a guarantee-related process without transferring the guarantor's obligations to those actors. Conversely, the guarantor's contractual undertaking does not relieve the financing institution of responsibility for assessing applications and supervising decisions made under its authority. The contractual requirements addressed by AAOIFI Shari'ah Standards No. 5 and No. 23 provide the normative boundaries for maintaining these distinctions [14][17]. AI-supported decision tracking and monitoring may strengthen this relationship by documenting who authorized an assessment, what information informed the decision, and whether the action remained within the approved mandate.

The third combination, *Wakalah* and *rahn*, establishes a mechanism of delegated collateral governance. Collateral arrangements frequently involve activities beyond the initial establishment of security, including asset valuation, documentation, custody, periodic monitoring, and realization when obligations remain unfulfilled. These activities may be performed by different institutional actors under defined authority. The proposed integration uses *Wakalah* to clarify the scope of delegated responsibilities while preserving the security function of *rahn*. A financial institution may, for instance, authorize a valuation service provider to assess a pledged asset without granting that provider unrestricted authority to determine financing terms or initiate collateral realization. The distinction is especially relevant when automated valuation systems contribute to operational decisions. Although AI may support valuation consistency and identify unusual changes in asset information, an inaccurate estimate can affect the adequacy of security or impose disproportionate requirements on a financing applicant. Institutions should consequently distinguish technical assessment from the authority to approve, modify, or enforce collateral arrangements. The contractual principles associated with *Wakalah* and *rahn* [17][19] provide a basis for identifying these responsibilities, while model validation and human review help address the technological uncertainty introduced by automated valuation.

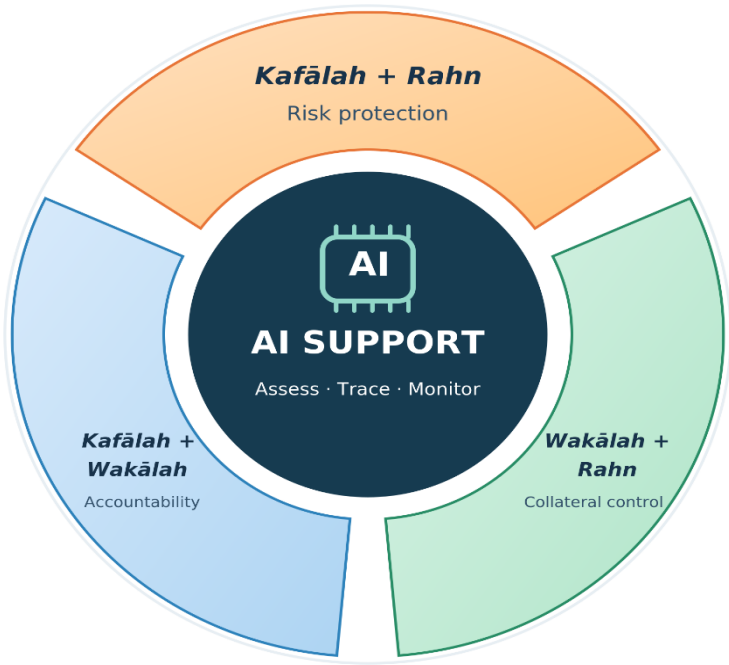


Figure 2. Pairwise integration of Islamic contractual mechanisms and AI-supported risk governance

Figure 2 illustrates the three pairwise contractual mechanisms and their relationship with AI-supported financial activities. The central position of AI reflects its analytical role in assessment, decision traceability, and monitoring, while the surrounding segments distinguish the governance functions of each contractual pairing. The diagram does not imply that AI possesses contractual authority or that all three combinations are required in every financing arrangement. Their application remains conditional on the underlying financial activity and institutional responsibilities, consistent with established approaches to AI lifecycle governance [9][10]. The principal finding of the pairwise reconstruction is that contractual integration can address distinct governance problems without altering the legal identity of the participating contracts. Guarantee and collateral coordination concerns financial protection, guarantee and agency accountability clarifies decision authority, and delegated collateral governance establishes responsibility for security-related activities. These relationships require institutional oversight rather than contractual coordination alone. As discussed by Minaryanti et al. [24], *Sharīʿah* governance remains relevant to financing risk management, although its effectiveness depends on institutional implementation. The proposed reconstruction consequently provides a conceptual foundation for examining how AI-related risks interact with established contractual responsibilities.

4.2 AI Risk Mapping and Governance Controls

The pairwise reconstruction developed in the preceding section reveals that AI-related financial risks cannot be adequately governed through contractual arrangements alone. Although *Kafalah*, *Wakalah*, and *rahn* establish distinct forms of responsibility and financial protection, the reliability of the information supporting their application remains a separate governance concern. Automated assessments may influence financing eligibility, guarantee exposure, collateral requirements, and the authorization of financial decisions. Errors within these processes can therefore affect more than predictive performance. They may also alter the financial obligations imposed on customers or the decisions undertaken by authorized institutions. Research on algorithmic fairness demonstrates that accurate predictions do not necessarily ensure equitable treatment [4], while explainable AI literature highlights the difficulties of interpreting complex computational decisions [25]. The proposed framework consequently distinguishes three categories of technological risk: unreliable or biased assessments, failures in automated decision authority, and weaknesses in the information systems supporting financial operations. Each category requires controls that reflect the contractual activities potentially affected by the technological failure.

For the *Kafalah–rahn* combination, the principal technological concern arises when AI-supported credit assessment and collateral valuation are used to determine the adequacy of financial protection. An institution may estimate repayment risk through a predictive model and subsequently use that estimate to determine whether a guarantee, pledged asset, or combination of safeguards is appropriate. Yet the resulting assessment may be unreliable when historical financing records are incomplete, economic conditions change, or the model performs unevenly across applicant groups. Research on machine-learning credit assessment illustrates the potential value of additional financial information [20], but this predictive capacity does not eliminate concerns about data quality and representativeness. The proposed governance response involves validating credit-risk estimates, reviewing unusual valuation outcomes, monitoring changes in model performance, and examining whether collateral requirements remain proportionate to the underlying exposure. Where a material discrepancy is detected, authorized personnel should be able to request an independent valuation or reconsider the financing arrangement. The institution must also preserve the distinction between the guarantor's defined contractual liability and its own responsibility for the reliability of the assessment process. A defective prediction should not automatically be treated as a new obligation assumed by the guarantor.

The relationship between *Kafalah* and *Wakalah* presents a different technological challenge. Here, the primary concern is whether automated recommendations remain within an identifiable chain of delegated authority. Consider a financial institution that uses an AI model to recommend financing approval, determine guarantee requirements, and monitor changes in credit exposure. If the system generates a recommendation based on erroneous information, responsibility for accepting or rejecting that recommendation must remain traceable to an authorized institutional actor. An automated output should not be treated as independent contractual authorization merely because it was produced by an approved system. This distinction is consistent with the governance principles of *Wakalah* [17] and the lifecycle accountability approach discussed by Zafar and Ali [9]. The proposed controls include documented approval thresholds, clearly assigned decision rights, records of model-generated recommendations, and procedures for escalating disputed outcomes. For consequential financing decisions, responsible personnel should have access to explanations sufficient to identify relevant decision factors and determine whether further investigation is necessary. Where the model cannot provide an explanation appropriate to the decision's significance, institutions should consider stronger review procedures or the use of more interpretable alternatives [26]. Such arrangements protect the integrity of delegated authority without assuming that technological transparency alone guarantees appropriate financial decisions.

In the *Wakalah–rahn* combination, AI-related risks are concentrated in the management of collateral-related information and the exercise of authority over pledged assets. Automated valuation systems may assist institutions in estimating asset values, identifying unusual changes, or prioritizing assets requiring further inspection. Their assessments, however, may become inaccurate when market conditions change or when available transaction records inadequately represent the assets being evaluated. A valuation error may lead to insufficient financial security, excessive collateral requirements, or an unjustified restriction on financing access. The proposed framework therefore separates the technical production of an estimate from the institutional authority to accept, modify, or act upon that estimate. Model performance should be monitored against relevant valuation evidence, while material discrepancies should trigger documented review by authorized personnel. Decisions involving changes to collateral requirements or the realization of pledged assets must remain subject to applicable contractual procedures under *rahn* [19]. The ability to override an automated recommendation is particularly important where an inaccurate valuation could create substantial consequences for the financing recipient.

These risks are compounded by vulnerabilities in the digital infrastructure through which financial information is collected, processed, and exchanged. AI-assisted financing may depend on application interfaces, external data services, software libraries, and cloud-based components that introduce security exposures beyond the predictive model itself. Maulana et al. [32], through their examination of the Log4j vulnerability from ethical hacking and cyberlaw perspectives, illustrate how weaknesses in widely used software components can expose information systems to exploitation. Although their study does not investigate AI-driven Islamic finance directly, it provides a relevant cybersecurity perspective for institutions relying on interconnected technological services. Within the proposed framework, cybersecurity controls should include software dependency management, timely vulnerability remediation, access restrictions, secure information exchange, and incident-response procedures. Protection of financial information also requires attention to organizational privacy responsibilities, as discussed by Rosmaini et al. [30], and applicable personal data protection requirements [31]. These controls are particularly relevant when financing assessments incorporate customer transactions, alternative data, or information obtained from external providers. A system that produces reliable predictions may still expose customers and institutions to significant harm if its supporting infrastructure fails to protect sensitive information.

Governance responsibilities should consequently extend throughout the AI lifecycle rather than being confined to model approval before deployment. The NIST AI Risk Management Framework [10] provides a basis for organizing these activities through governance, contextual risk identification, measurement, and risk treatment. ISO/IEC 42001:2023 [11] offers a complementary organizational perspective by emphasizing the management of AI-related responsibilities and processes. Applied to the proposed contractual combinations, these principles suggest that institutions should maintain an inventory of AI applications, document their intended uses, identify responsible personnel, and establish criteria for reviewing model performance. Monitoring should consider predictive errors, changes in data distributions, potentially discriminatory outcomes, and decisions requiring human intervention. Where material weaknesses arise, corrective measures may include reviewing the underlying data, recalibrating the model, restricting automated decision authority, or temporarily suspending its use. These measures should be proportionate to the financial significance of the application and documented sufficiently to support internal audit and *Shariah* supervision. Importantly, monitoring procedures should examine the consequences of model outputs for contractual decisions rather than relying exclusively on aggregate measures of predictive accuracy.

The resulting governance interpretation positions AI as an analytical and operational support mechanism within a structure of identifiable human and institutional responsibility. Technological controls address whether automated systems operate reliably,

while contractual governance determines whether the resulting financial decisions remain authorized, transparent, and consistent with the obligations of the participating parties. Neither dimension can substitute for the other. A technically accurate credit assessment may still support an inappropriate collateral requirement, just as a formally valid guarantee may be administered through an inadequately controlled decision process. The proposed framework addresses this tension by linking model validation, decision traceability, cybersecurity, and human oversight to the specific activities governed by *Kafalah*, *Wakalah*, and *rahn*. Its contribution is the identification of contract-sensitive technological safeguards rather than evidence that these safeguards have already improved institutional performance. How such mechanisms may operate together in a representative financing process is examined in the following section through an illustrative AI-assisted financing scenario.

4.3 Illustrative AI-Assisted Financing Scenario

The practical relevance of the proposed framework can be illustrated through a hypothetical financing application submitted by a microenterprise with limited conventional credit history and insufficient assets to satisfy standard collateral requirements. The applicant operates a small trading business and maintains transaction records through digital payments and business activities, although these records may not provide a complete account of financial performance. In a conventional assessment, the absence of an established credit history could restrict financing opportunities despite indications of ongoing commercial activity. AI-assisted credit assessment offers an alternative by examining available transaction patterns and other permissible financial information. Khandani et al. [20] demonstrate the potential of machine-learning techniques for consumer credit-risk prediction, while Berg et al. [21] show that digital footprints can provide additional information for evaluating applicants with limited conventional credit records. Nevertheless, the availability of alternative data does not establish that an applicant is creditworthy or that an automated assessment will be fair. The scenario therefore examines how the proposed contractual combinations could support financing decisions while maintaining appropriate safeguards against unreliable predictions and disproportionate financial obligations.

The assessment begins with the institution determining which activities may be supported by AI and who remains authorized to make the resulting financing decision. Under the governance function of *Wakalah*, delegated activities should operate within a defined mandate rather than allowing an automated scoring system to exercise unrestricted decision-making authority. Suppose the AI model identifies the applicant as relatively high risk because the available records contain gaps or differ from the patterns represented in its training data. Such an outcome may reflect genuine financial uncertainty, but it could also arise from incomplete information or limitations in model generalization. Research on algorithmic fairness [4], [27] provides grounds for examining whether these limitations produce unjustified differences in assessment outcomes. Instead of treating the model's classification as an automatic rejection, the responsible financing officer would review the available evidence, examine the main factors influencing the assessment, and determine whether additional information is necessary. The institution would retain responsibility for validating the assessment and documenting any decision to accept, modify, or reject the model's recommendation. This procedure illustrates the application of controlled delegation and human oversight without treating AI as an independent contractual agent.

Once the applicant's financing circumstances have been reviewed, the institution may consider whether a permissible guarantee, collateral arrangement, or combination of the two is appropriate. Under *Kafalah*, an eligible third-party guarantor may undertake a defined obligation subject to the applicable contractual conditions [14]. Alternatively, *rahn* may provide security through an identifiable pledged asset, with the extent of security determined according to the underlying obligation and relevant contractual requirements [19]. These mechanisms should not be imposed automatically or assumed to be simultaneously necessary. Their suitability depends on the applicant's circumstances, the financing product, the enforceability of the arrangements, and the institution's assessment of exposure. The *Kafalah–rahn* pairing allows the institution to examine how different forms of financial protection could complement one another without creating overlapping recovery beyond the enforceable obligation. Meanwhile, the *Kafalah–Wakalah* pairing clarifies who is authorized to approve and administer guarantee-related activities, while *Wakalah–rahn* identifies the responsibilities associated with delegated valuation and collateral management [17]. AI may support these assessments, but contractual obligations and approval authority must remain attributable to the relevant parties. Table 4 summarizes the proposed interaction between financing activities, AI functions, contractual mechanisms, and governance responses.

Table 4. Illustrative AI-Assisted Financing Scenario and Governance Responses

Financing stage	AI-supported activity	Relevant contractual mechanism	Potential governance risk	Proposed governance response
Financing application	Processing financial records and alternative data	*Wakalah*: authorized assessment activities	Incomplete information, privacy exposure, and unauthorized processing	Defined data access, documented processing purposes, and institutional responsibility
Credit assessment	Predicting repayment risk and generating recommendations	*Wakalah*: accountable decision-making	Algorithmic bias, model errors, and unjustified rejection	Model validation, explanation of material factors, and human review
Guarantee assessment	Evaluating exposure and supporting guarantee-related recommendations	*Kafalah* + *Wakalah*: guarantee and agency accountability	Unclear approval authority and inappropriate attribution of liability	Authorized approval, defined guarantee obligations, and traceable decisions

Collateral assessment	Estimating asset value and evaluating security adequacy	*Kafalah* + *Rahn*: guarantee and collateral risk protection	Valuation errors, excessive collateral, and overlapping recovery claims	Independent review where necessary, proportionate security, and clear liability boundaries
Collateral administration	Monitoring pledged assets and identifying valuation changes	*Wakalah* + *Rahn*: delegated collateral governance	Unauthorized decisions, inaccurate valuations, and weak documentation	Defined mandates, valuation verification, audit records, and human authorization
Financing decision and monitoring	Supporting approval, exception detection, and ongoing risk monitoring	Integrated contractual governance	Unreviewable decisions, model deterioration, and fragmented accountability	Documented approval, customer review procedures, continuous monitoring, and *Sharīʿah* oversight

The scenario illustrates how the proposed framework may respond when an automated financing assessment produces a questionable recommendation. Suppose an applicant receives an unfavorable credit classification because relevant transaction information is missing from the model's assessment. Rather than immediately rejecting the application, an authorized officer may review the available evidence and determine whether reassessment is justified. If financing remains appropriate, the institution can consider a permissible guarantee or proportionate collateral arrangement according to the applicant's circumstances and contractual requirements. The three contractual pairings support different aspects of this process: *Kafalah–Wakalah* clarifies authorization and guarantee-related responsibility, *Kafalah–rahn* coordinates financial safeguards, and *Wakalah–rahn* governs delegated collateral assessment. These mechanisms do not guarantee financing approval, but provide a basis for examining decisions that may otherwise be affected by unreliable automated outputs. Accountability must also continue after financing approval. Institutions should retain appropriate decision records, protect customer information in accordance with relevant privacy considerations [30] and applicable data-protection requirements [31], and monitor model performance for material changes. The NIST AI Risk Management Framework [10] and lifecycle-oriented Islamic AI governance literature [9] provide references for organizing monitoring and corrective action. The illustrative scenario demonstrates the potential interaction of contractual and technological safeguards, although its implications for financial inclusion and resilience remain conceptual rather than empirically established.

4.4 Implications for Financial Inclusion and Resilience

The proposed framework has distinct implications for financial inclusion and financial resilience, although the two objectives may influence one another. Inclusion concerns access to appropriate financing under fair and affordable conditions, whereas resilience reflects an institution's ability to manage financial exposure and maintain essential operations during disruptions. These objectives may create competing demands. Expanding access to applicants with limited credit histories can introduce additional assessment uncertainty, while restrictive collateral policies may protect institutional interests at the expense of otherwise viable customers. The framework therefore examines both outcomes without assuming that contractual integration or AI adoption necessarily improves either one. For financial inclusion, the three contractual pairings offer complementary opportunities to reconsider how applicants are assessed and supported. Alternative financial information may assist institutions in evaluating customers with limited conventional records, as demonstrated by research on digital footprints [21]. Nevertheless, such assessments require scrutiny because algorithmic models may reproduce existing inequalities [4]. The *Kafalah–rahn* combination allows institutions to consider permissible guarantees alongside proportionate collateral arrangements rather than relying exclusively on pledged assets. Meanwhile, *Kafalah–Wakalah* supports accountable financing decisions, and *Wakalah–rahn* clarifies responsibility for collateral-related assessments. Their potential contribution lies in reducing avoidable exclusion through fairer evaluation and more suitable contractual safeguards. Practical limitations remain, including guarantee costs, the availability of eligible guarantors, and the resources required for meaningful human review.

Financial resilience follows a different pathway. Clear contractual obligations, reliable security arrangements, and effective oversight may help institutions manage financial losses and technological disruptions. Raouf and Ahmed [33] examine the relationship between risk governance and financial stability in conventional and Islamic banks, showing that governance arrangements do not necessarily produce uniform stability outcomes across banking models. This cautions against equating formal governance structures with demonstrated resilience. Within the proposed framework, *Kafalah–rahn* addresses financial protection, *Kafalah–Wakalah* supports traceable decision authority, and *Wakalah–rahn* strengthens accountability in collateral administration. These functions require reliable technological processes and institutional capacity to respond when automated assessments become inaccurate or operational systems fail. The risk-management principles outlined by NIST [10] provide a basis for organizing such monitoring and corrective action. The normative relationship between inclusion and resilience can be examined through *maqāṣid al-sharīʿah*, particularly the protection of wealth (*ḥifẓ al-māl*), justice, and the prevention of avoidable harm. Risyantika et al. [34] discuss the relevance of *maqāṣid*-based risk management to the sustainability of Islamic banking, emphasizing the connection between normative objectives and institutional risk-management practices. This perspective suggests that financial protection should not be pursued through disproportionate obligations imposed on vulnerable applicants. Equally, expanding financing access without adequate risk controls may threaten the institution's ability to serve customers over time. Normative evaluation therefore requires attention to both the fairness of financial decisions and the sustainability of the arrangements supporting them. These implications can be examined through separate governance indicators. Inclusion-related assessment may consider financing accessibility, collateral proportionality, transparency of adverse decisions, and opportunities for customer review. Resilience-

related assessment may focus on the clarity of contingent liabilities, reliability of collateral valuations, response to model failures, and continuity of essential services. The proposed indicators are intended for future evaluation rather than presented as empirical findings. Their separation enables institutions to identify potential trade-offs between responsible financial access and institutional protection. Whether the framework can improve either outcome will depend on contractual suitability, technological reliability, regulatory conditions, and the effectiveness of institutional oversight.

4.5 Integrated Five-Layer Islamic Risk Governance Framework

The proposed five-layer architecture brings together the contractual relationships and technological safeguards identified in the preceding analysis. Unlike the pairwise mechanisms, which explain how two contractual functions may complement one another, the integrated framework establishes how these relationships can be organized within institutional risk governance. Its first three layers address contractual authority, contingent risk allocation, and collateral-based protection through *Wakalah*, *Kafalah*, and *rahn*, respectively. The legal boundaries of these functions remain grounded in their applicable contractual standards [17], [14], [19]. Their integration does not create new contractual obligations or require every financing arrangement to employ all three mechanisms. Instead, it provides a structure for identifying which responsibilities and safeguards are relevant to a particular financial activity. The relationship among the contractual layers becomes significant when automated assessments influence more than one financing decision. A credit-risk recommendation, for example, may inform both guarantee requirements and collateral adequacy. The institution must therefore distinguish the authority to approve the recommendation from the obligations and security arrangements that may result from it. Technological governance supports this coordination through model validation, decision traceability, data management, and human oversight. The NIST AI Risk Management Framework [10] and ISO/IEC 42001:2023 [11] provide organizational references for establishing these controls. Their function within the proposed architecture is to make AI-assisted processes reviewable and accountable without allowing technological outputs to replace contractual authorization.

Operational integration also depends on how information and responsibilities move across institutional functions. Lubis et al. [35], in their study of a service-oriented framework within Indonesia's transportation sector, provide a conceptual perspective on coordinating distinct services within an integrated environment. Although their findings do not establish the effectiveness of Islamic financial governance, the underlying organizational perspective is relevant to the present reconstruction. Financing assessment, guarantee administration, collateral management, and risk monitoring may operate through separate processes while requiring consistent information exchange and identifiable authorization points. The proposed architecture therefore favors coordination without dissolving responsibility boundaries. Technical integration remains subordinate to contractual obligations, institutional accountability, and applicable *Sharīʿah* requirements.

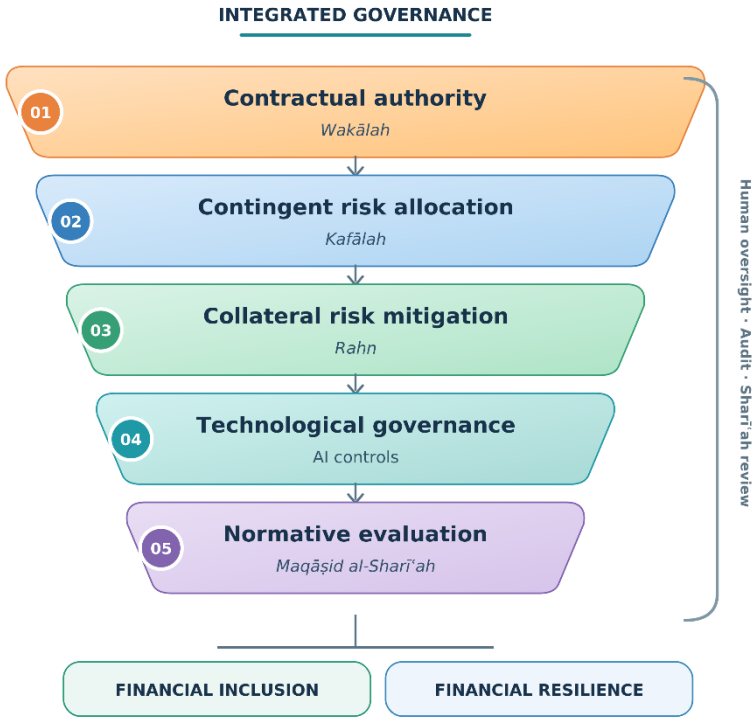


Figure 3. Integrated five-layer Islamic risk governance architecture for AI-assisted financial intermediation

Normative evaluation provides an additional basis for assessing whether these coordinated activities serve appropriate financial objectives. Laldin and Furqani [12] distinguish the purposes of Islamic finance from the instruments used to achieve them, while Risyantika et al. [34] connect *maqāṣid*-based principles with institutional risk management. Within the framework, *maqāṣid al-sharīʿah* informs the assessment of fairness, protection of wealth, and responsible financial conduct. This perspective is particularly relevant when technically reliable decisions impose disproportionate burdens or when apparently inclusive financing arrangements introduce risks that institutions cannot adequately manage. Normative oversight should therefore examine the consequences of contractual and technological decisions rather than relying solely on their formal compliance. Figure 3 presents the relationship

among the five governance layers. The diagram emphasizes that human oversight, auditability, and *Sharīʿah* supervision operate across the framework rather than belonging exclusively to one layer. Although the layers are displayed in a structured arrangement, they should not be interpreted as a mandatory chronological sequence. Financial decisions may require repeated interaction among contractual responsibility, technological assessment, and normative review. Their coordination provides a basis for examining governance problems that extend beyond the responsibilities of any single contract or technological system. The framework's contribution lies in connecting established Islamic contractual mechanisms with identifiable governance controls for AI-assisted financial intermediation. The three pairwise relationships clarify complementary responsibilities, while the five-layer architecture organizes their institutional application and normative evaluation. Nevertheless, the framework remains a conceptual proposition rather than a validated operational model. Its applicability may vary across financial products, jurisdictions, and institutional capabilities. Further assessment is needed to determine whether the proposed arrangements provide sufficiently clear responsibility allocation, feasible technological safeguards, and measurable contributions to financial inclusion and resilience. These considerations define the scope of future evaluation without diminishing the framework's role as a structured basis for examining emerging risks in Islamic finance.

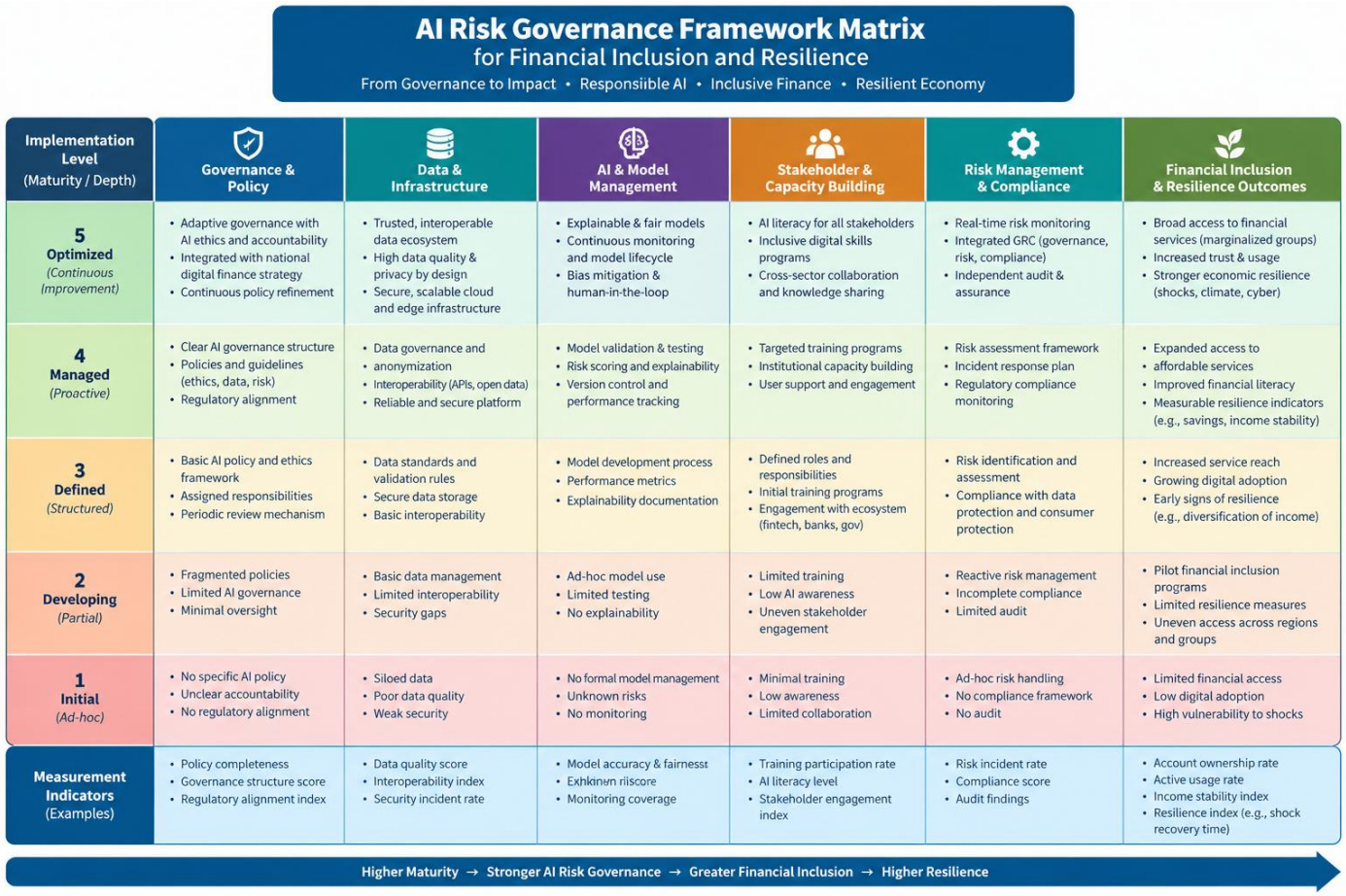


Figure 4. AI Risk Governance Framework Matrix for Financial Inclusion and Resilience

The figure 4 provides a structured instrument for assessing the maturity, implementation quality, and effectiveness of AI governance across six interrelated dimensions: governance and policy, data and infrastructure, AI and model management, stakeholder and capacity building, risk management and compliance, and financial inclusion and resilience outcomes. The matrix consists of five maturity levels, ranging from Level 1 (Initial/Ad hoc) to Level 5 (Optimized/Continuous Improvement), enabling organizations to identify their current governance capabilities, determine existing deficiencies, and establish a roadmap for progressive improvement. At Level 1, AI governance is characterized by fragmented data, unclear accountability, limited model oversight, inadequate stakeholder training, reactive risk handling, and restricted access to financial services, resulting in heightened vulnerability to economic and technological shocks. Level 2 (Developing/Partial) represents the emergence of basic governance policies, data management practices, preliminary model testing, limited capacity-building initiatives, and reactive compliance mechanisms, although implementation remains inconsistent and financial inclusion initiatives are often restricted to specific groups or locations. At Level 3 (Defined/Structured), organizations establish documented AI policies, assign responsibilities, implement data standards, formalize model development and evaluation procedures, introduce stakeholder training, and conduct systematic risk assessments, creating a more consistent foundation for responsible AI deployment. Level 4 (Managed/Proactive) reflects stronger institutional integration through explicit governance structures, reliable and interoperable data infrastructure, systematic model validation, explainability and performance monitoring, targeted capacity development, formal incident-response plans, and measurable improvements in financial accessibility and resilience. At Level 5, AI governance becomes an adaptive and

continuously improving capability characterized by integrated regulatory alignment, high-quality and secure data ecosystems, explainable and fair AI models, continuous monitoring and bias mitigation, independent assurance, cross-sector collaboration, and evidence-based policy refinement. The matrix further operationalizes these maturity levels through a set of measurement indicators that can be used to evaluate progress within each dimension, including policy completeness, governance structure scores, regulatory alignment, data quality, interoperability, security incidents, model accuracy and fairness, monitoring coverage, AI literacy, stakeholder engagement, risk incident rates, compliance scores, audit findings, financial account ownership, active service usage, income stability, and resilience measures such as recovery time following adverse shocks. These indicators should be measured using appropriate data sources, including governance documents, model audit reports, system logs, regulatory assessments, financial institution records, user surveys, and national financial inclusion statistics. To improve methodological rigor, organizations should define operational definitions, measurement scales, data collection frequencies, baseline values, and target thresholds for each indicator, while distinguishing process indicators, such as model validation and compliance, from outcome indicators, such as affordable service access, financial stability, and recovery capacity. The matrix can subsequently support a weighted or unweighted maturity assessment, depending on the evaluation objectives, provided that any weighting scheme is theoretically justified and empirically validated. Importantly, the maturity levels should not be interpreted as proof that higher AI governance maturity automatically causes greater financial inclusion or resilience; rather, they indicate the extent to which the organizational capabilities and safeguards required to support these outcomes are established and operational. The relationship between governance maturity and socioeconomic outcomes should therefore be examined longitudinally and, where feasible, through comparative or causal empirical methods. Overall, the matrix functions as both a diagnostic assessment tool and a strategic improvement mechanism, helping regulators, banks, fintech companies, microfinance institutions, and other financial service providers evaluate their AI governance capabilities, prioritize interventions, strengthen accountability, and determine whether AI-enabled financial services are becoming more inclusive, trustworthy, and resilient.

5. CONCLUSSION

This study demonstrates how the governance functions of *Kafalah*, *Wakalah*, and *rahn* can be reconstructed through complementary contractual relationships rather than examined as separate financial instruments. The doctrinal-comparative analysis develops three pairwise mechanisms with distinct responsibilities. The *Kafalah–rahn* combination coordinates guarantee obligations and collateral-based protection, *Kafalah–Wakalah* connects contingent liability with accountable delegation, and *Wakalah–rahn* clarifies authority over collateral valuation and administration. These relationships preserve the juridical boundaries of each contract without introducing a new contractual form. Their synthesis produces a five-layer governance framework connecting contractual authority, contingent risk allocation, collateral risk mitigation, technological governance, and normative evaluation grounded in *maqāṣid al-sharīʿah*. Within this architecture, AI supports financial assessment, monitoring, and decision-making, but does not independently assume contractual responsibility. Its use requires model validation, traceable decisions, meaningful human oversight, and continuous *Sharīʿah* supervision to ensure that technological processes remain subject to identifiable institutional accountability. The framework offers different pathways through which Islamic financial institutions may pursue financial inclusion and resilience. Inclusion may be supported by fairer financing assessments, proportionate collateral requirements, and appropriate guarantee arrangements for applicants with limited financial records or assets. Resilience, meanwhile, depends on clearly allocated obligations, reliable risk assessments, effective monitoring, and the institutional capacity to respond to financial or technological disruptions. The illustrative financing scenario demonstrates how these mechanisms might operate together, although it does not establish their operational effectiveness. As a documentary and conceptual investigation, this study does not provide empirical evidence that the proposed architecture improves either outcome. Its application may also vary across financial products, regulatory environments, and institutional capabilities. Future research should examine the framework through expert assessment and prototype-based or institution-specific evaluation, particularly concerning contractual compatibility, model reliability, decision accountability, and operational feasibility. Such investigation would help determine whether the proposed integration can strengthen responsible financial access while maintaining the capacity of Islamic financial institutions to manage emerging risks.

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