UKR Journal of Arts, Humanities and Social Sciences (UKRJAHSS)
Homepage: https://ukrpublisher.com/ukrjahss/
Email: submit.ukrpublisher@gmail.com
Volume 2, Issue 11, 2026
ISSN: 3107-359X (Online)

AI-Driven Transformation in Islamic Banking in Fragile States: Integrating Applied Linguistics, Sharia-Aligned Governance, and Financial Reconstruction in Yemen

Dr. Sameer Ahmed Awadh Boset

Faculty of Languages and Translation, University of Aden, Yemen.

***Corresponding Author**: Dr. Sameer Ahmed Awadh Boset

DOI: *https://doi.org/10.5281/zenodo.24103956*

Article History

Original Research Article

Received: 09 September 2026

Accepted: 18 October 2026

Published: 10 November 2026

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Citation: Dr. Sameer Ahmed Awadh Boset. (2026). AI-Driven Transformation in Islamic Banking in Fragile States: Integrating Applied Linguistics, Sharia-Aligned Governance, and Financial Reconstruction in Yemen. UKR Journal of Arts, Humanities and Social Sciences (UKRJAHSS), 2(11), 26-40.

Abstract

Purpose: *This paper develops a context-sensitive framework for responsible artificial intelligence (AI) adoption in Islamic banking in fragile and conflict-affected settings, using Yemen as its principal case. It positions applied linguistics and translation studies as core dimensions of AI governance. Design/methodology/approach: An integrative conceptual–analytical design combines thematic synthesis of interdisciplinary scholarship, analysis of public institutional and policy documents, cross-context policy benchmarking, and a capability–needs gap assessment. No primary bank-level or participant data are claimed.* ***Findings:*** *The proposed AI-Integrated Islamic Banking Transformation Framework (AI-IBTF) comprises six interdependent pillars: regulatory harmonisation; ethical and Sharia-aligned governance; digital infrastructure; human and institutional capacity; cybersecurity and digital-risk management; and controlled innovation. A cross-cutting Language-Sensitive Governance Layer (LSGL) addresses terminology, translation fidelity, pragmatic clarity, AI-generated financial discourse, user comprehension, and contestability. The framework prioritises assistive applications before high-stakes automated decisions. Originality/value: The paper integrates fragile-state reconstruction, Maqasid-oriented governance, AI risk management, and applied linguistics in a capability-and-sequencing architecture. It conceptualises linguistic quality as a governance mechanism connecting system outputs with comprehension, procedural fairness, and accountable service delivery. The framework and propositions require empirical validation.*

Keywords: *artificial intelligence, Islamic banking, fragile states, applied linguistics, Yemen.*

JEL classification: *G21; G28; O33; O55*

1. Introduction

Artificial intelligence (AI) is becoming relevant to financial services through anomaly detection, compliance support, document processing, customer service, risk analysis, and decision support. Yet technical performance cannot be separated from data governance, model risk, cybersecurity, third-party dependence, explainability, and institutional accountability. The Financial Stability Board (FSB, 2024, 2025) identifies third-party concentration, cyber risk, model risk, data governance, and fraud or disinformation as important vulnerabilities associated with expanding AI use in finance. The Bank for International Settlements (BIS, 2025) similarly highlights confidentiality, model behaviour, hallucinations, reputational exposure, and institutional capacity in AI adoption by central banks. Responsible adoption is therefore a governance challenge, not simply a technology-purchasing decision.

These challenges become more consequential in fragile and conflict-affected economies. Fragmented institutions, constrained fiscal and technical capacity, unreliable infrastructure, incomplete data systems, regulatory uncertainty, and low public confidence can make otherwise useful technologies unsafe or ineffective. The relevant question is not whether AI can improve banking in the abstract, but under what institutional, technological, ethical, communicative, and regulatory conditions it can contribute to financial reconstruction.

Yemen is an important case. The IMF's 2025 Article IV assessment, published in 2026, documents severe financial-sector pressures: deterioration in key financial soundness indicators, liquidity challenges, foreign-exchange exposure, deposits moving from formal banks to unregulated money exchangers, and the relocation of major banks to Aden (IMF, 2026). The World Bank's Yemen Financial Market Infrastructure and Inclusion Project supports digital-payment infrastructure, including a Fast Payment System and a Real Time Gross Settlement System, interoperability, anti-money-laundering compliance, and wider access to digital financial services (World Bank, 2025). These reforms indicate that digitalisation is already part of the recovery agenda. AI should be considered one layer within a wider financial ecosystem, not a substitute for foundational institutional reform. Recent work illustrates the growing but still fragmented evidence base. A Yemen-focused quantitative study examines AI and managerial decision-making in private banks (Alsyaghi & Alarshani, 2025), while another study considers smart and sustainable Islamic finance in Yemen during 2014–2022 (Gamal, 2024). Recent conceptual contributions address AI-driven risk management in Islamic banks (Alrashidi, 2026), Maqasid-based operational auditing (Sulistyowati et al., 2026), and Shariah governance for generative AI (Zafar & Ali, 2026). These studies establish the relevance of AI and Islamic-finance governance, but they do not, on the evidence considered here, provide the same integrated fragile-state capability sequence with applied linguistics and translation quality embedded as cross-cutting governance controls.

Islamic banking adds a normative and institutional dimension. Sharia governance concerns the permissibility and implementation of financial products, while Maqasid al-Shariah offers a broader lens for considering justice, protection of wealth, welfare, accountability, and avoidance of harm (Kamali, 2008). AI may assist monitoring, compliance, service continuity, and risk analysis, but the legitimacy of an AI-enabled service depends on how its data, outputs, procedures, and consequences are governed and explained. Recent work on generative AI in Islamic financial institutions reinforces the need to embed Sharia review across the AI lifecycle and to connect Sharia oversight with AI governance (Zafar & Ali, 2026).

A further dimension is often underdeveloped in AI-and-finance research: language. Banking is mediated by contracts, product disclosures, compliance records, customer-service exchanges, complaint narratives, and explanations of decisions. AI systems increasingly classify, summarise, generate, and translate these texts. Applied linguistics and translation studies therefore offer methods for assessing whether institutional meanings survive translation, whether explanations are pragmatically clear, whether specialised terminology is consistent, and whether customers can understand and challenge consequential outputs. These concerns are not peripheral communication issues: they affect how governance is enacted in practice. This paper treats linguistic quality as a cross-cutting capability within responsible AI adoption, while recognising that the prevalence and effects of language failures in Yemeni banking require empirical investigation.

The paper develops the AI-Integrated Islamic Banking Transformation Framework (AI-IBTF), comprising six institutional pillars, and embeds a Language-Sensitive Governance Layer (LSGL) across them. The central proposition is that AI adoption should be sequenced around institutional and communicative readiness rather than technological sophistication alone.

1.1. Research problem and questions

The research problem is a dual-readiness paradox. Yemen's banking sector has strong reasons to pursue digital transformation to strengthen financial integrity, preserve service continuity, widen access, and rebuild confidence. Yet structural weaknesses may make advanced automation unsafe or ineffective. Institutions may lack not only technical and organisational capabilities but also the linguistic capability to ensure that AI-mediated financial information remains accurate, comprehensible, contextually appropriate, and contestable.

The study addresses four questions:

RQ1. Which AI applications offer the most contextually appropriate early-stage value for Islamic banking in Yemen's fragile and data-constrained environment?

RQ2. Which institutional, technological, human-capital, regulatory, cybersecurity, and Sharia-governance conditions should precede their responsible deployment?

RQ3. How can applied linguistics and translation studies inform governance of bilingual terminology, AI-generated financial discourse, translated disclosures, and customer comprehension?

RQ4. How can these requirements be integrated into a phased framework linking AI adoption with financial integrity, inclusion, and reconstruction without presenting conceptual propositions as empirical findings?

1.2. Contributions and scope

The paper makes four contributions. First, it connects AI governance, Islamic banking, and fragile-state reconstruction in a single capability-and-sequencing framework. Second, it operationalises Maqasid-oriented governance as a set of review questions concerning justice, protection of wealth, welfare, transparency, accountability,

and harm prevention. Third, it makes applied linguistics and translation studies integral to AI governance by identifying language-mediated risks and specifying controls for terminology, translation fidelity, pragmatic clarity, and comprehension. Fourth, it proposes a phased adoption sequence that prioritises assistive applications before high-stakes automated decisions. AI-IBTF and the LSGL are conceptual contributions; neither is presented as an empirically validated causal model.

2. Literature review and theoretical foundations

2.1. Islamic banking, resilience, and financial stability

Islamic banking is organised around contractual and governance principles that restrict interest, excessive uncertainty, gambling, and impermissible activities. Comparative research has investigated whether these features influence efficiency, stability, and risk-taking. Findings vary across countries, institutions, business models, and periods; Islamic banks should not be assumed to be inherently more stable than conventional banks (Beck et al., 2013; Čihák & Hesse, 2010). The relevant implication is that Islamic banking has a distinct governance architecture through which AI applications should be reviewed, not that a Sharia label automatically confers technological or financial resilience. In Yemen, the wider questions of institutional legitimacy, financial integrity, and access make governance design particularly important.

2.2. AI in banking and financial-sector risk

AI applications in banking span customer services, financial-crime detection, credit and risk assessment, regulatory technology, document processing, and internal operations. The FSB (2024, 2025) emphasises that benefits such as analytical capacity and efficiency coexist with vulnerabilities involving data, model risk, cyber threats, third-party dependence, concentration, and governance. The BIS (2025) similarly highlights confidentiality, model behaviour, explainability, and reputational risks in central-bank settings. Governance should therefore cover the lifecycle: purpose definition, data acquisition, development or procurement, validation, deployment, monitoring, incident response, human escalation, and retirement. In low-capacity contexts, requirements may need proportionate sequencing, but capacity constraints are not a reason to dispense with controls.

2.3. Maqasid al-Shariah as a governance lens

Maqasid al-Shariah can inform evaluation of whether financial innovation serves legitimate human and social interests while avoiding harm. In this study, it is not used to declare an AI application permissible in the abstract. Instead, it generates governance questions: Does the system protect wealth? Does it create unjust exclusion? Are material risks and obligations transparent? Can affected customers seek redress? Are decisions traceable to accountable human actors? Are benefits and harms distributed fairly? These questions should be considered alongside product-specific jurisprudential review by qualified Sharia authorities. Formalised Sharia governance remains important as generative AI becomes more deeply embedded in financial operations (Accounting and Auditing Organization for Islamic Financial Institutions [AAOIFI], 2025; Zafar & Ali, 2026).

2.4. Technology–Organisation–Environment and institutional readiness

The Technology–Organisation–Environment (TOE) framework explains adoption through technological characteristics, organisational capabilities, and the external environment (Tornatzky & Fleischer, 1990). It is useful here as an organising lens rather than a tested causal model. In Yemen, technical feasibility cannot be separated from data fragmentation, infrastructure reliability, regulatory authority, cybersecurity, staff capability, and access to specialist expertise. AI-IBTF extends TOE-oriented adoption reasoning by treating Sharia-aligned governance, fragile-state reconstruction, and language-mediated communication as explicit design dimensions.

2.5. Digital transformation in fragile and conflict-affected settings

Digital transformation in fragile settings must account for continuity under disruption, local ownership, uneven access, institutional fragmentation, and the risk of importing models designed for higher-capacity environments. The World Bank's Yemen project signals the importance of payment infrastructure, interoperability, and wider digital-finance access (World Bank, 2025). This foundational infrastructure matters because downstream AI services depend on reliable systems, governed data, and operational continuity. Cross-context benchmarking is therefore used in this paper to identify transferable functions—such as staged pilots, lifecycle controls, interoperability, and incident reporting—rather than to assume that another jurisdiction's institutional design can be copied wholesale.

2.6. Applied linguistics and institutional financial communication

Applied linguistics studies language-related problems in real-world contexts, including professional discourse, comprehension, pragmatics, multilingual communication, and language technologies. In banking, language is the medium through which products, obligations, risks, data practices, decisions, and rights are made intelligible. A decision may be technically valid yet procedurally deficient

if its explanation is ambiguous, inaccessible, or misleading. Conversely, clear wording cannot compensate for an invalid model or unjust outcome. Linguistic quality should therefore be understood as necessary but not sufficient for responsible AI governance. It can be examined at the level of texts, interactions, institutional genres, and user interpretation.

2.7. Translation studies, terminology, and financial meaning

Translation in specialised domains is not word substitution. Meaning depends on genre, institutional convention, domain knowledge, legal context, and communicative purpose (Baker, 2018; House, 2015). In Islamic finance, Arabic-English translation may involve terms whose legal, contractual, and jurisprudential implications cannot safely be reduced to a single approximate equivalent. A fluent translation may still erase a material distinction, change the force of a disclosure, or misrepresent uncertainty. Governance controls should include controlled terminology, contextual definitions, version control, bilingual expert review, and escalation for ambiguous source texts. Contractual terms, risk disclosures, compliance instructions, and explanations affecting eligibility should not be released solely on the basis of unreviewed machine translation.

2.8. Discourse, pragmatics, plain language, and comprehension

Discourse analysis can examine how institutional texts represent responsibility, risk, eligibility, uncertainty, and customer rights. Pragmatics draws attention to the meaning recipients infer in context rather than only the literal wording of a sentence; communicative implications may differ from the writer's intended message (Grice, 1975). Plain-language practices can reduce avoidable complexity, but simplification must preserve material legal and Sharia distinctions. Comprehension should be tested directly—for example, by asking users to explain a fee, obligation, data-use notice, or appeal route in their own words—rather than inferred solely from readability scores or satisfaction ratings. Comprehension, perceived clarity, fairness, trust, and religious legitimacy should be measured as distinct constructs.

2.9. Natural language processing and multilingual AI

Natural language processing (NLP) can support Arabic document classification, search, summarisation, customer support, and extraction from financial texts. Yet language varieties, specialised terminology, spelling variation, code-switching, and limited representative data may affect performance. Arabic-English systems can produce fluent but semantically incomplete or terminologically inconsistent outputs. Work on large language models warns that fluent generation can obscure limitations in grounding, data provenance, and evaluation (Bender et al., 2021). Language-system assurance should therefore assess factual correctness, semantic fidelity, domain terminology, pragmatic appropriateness, consistency, and accessibility. General-language benchmark performance is not sufficient evidence of suitability for consequential financial or Sharia-sensitive communication.

2.10. Research gap and conceptual synthesis

The relevant literatures offer complementary insights but are often treated separately: AI governance addresses technical and institutional risk; Islamic-finance scholarship addresses Sharia governance; fragile-state research addresses institutional constraints and reconstruction; and applied linguistics and translation studies address meaning, context, multilingual communication, and language technologies. The gap addressed here is an integrated architecture showing how linguistic and communicative capability should be governed alongside technical, institutional, and Sharia-related capabilities when AI is introduced into fragile-state Islamic banking. The LSGL does not replace legal, financial, technical, or Sharia review. It makes language-mediated risk visible and actionable within the wider framework.

3. Methodology

3.1. Research design. The study adopts an integrative conceptual–analytical design combining (1) thematic synthesis of interdisciplinary scholarship; (2) analysis of publicly available institutional and policy documents; (3) cross-context policy benchmarking; and (4) capability–needs gap assessment. It is a framework-development study, not an empirical survey, experiment, econometric analysis, systematic review with a preregistered protocol, or field evaluation. No interviews, surveys, experiments, customer records, or proprietary bank datasets were collected or analysed.

3.2. Source domains. The analysis drew on five source domains: (a) peer-reviewed scholarship on Islamic banking, Sharia governance, AI risk, technology adoption, translation, pragmatics, and language models; (b) policy and standards publications from the FSB and BIS; (c) IMF and World Bank documents concerning Yemen's financial conditions and digital-finance infrastructure; (d) publicly available AAOIFI governance material; and (e) recent peer-reviewed conceptual or empirical studies on AI in Islamic finance and Yemen's banking sector. Sources were selected for direct relevance to the research questions and for their ability to inform governance design. This is a purposive integrative synthesis, not an exhaustive systematic search; no claim of exhaustive coverage is made.

3.3. Analytical procedure. Stage 1 mapped Yemen-

specific constraints affecting banking, digitalisation, data, governance, and trust. Stage 2 classified candidate AI applications by potential institutional value, data requirements, decision criticality, reversibility, and risk. Stage 3 mapped the capabilities required for each use case. Stage 4 applied Maqasid-oriented questions to justice, protection of wealth, welfare, transparency, accountability, and avoidance of harm. Stage 5 benchmarked policy functions across international AI-governance and digital-finance sources, distinguishing transferable principles from institutional arrangements that may not transfer to Yemen. Stage 6 identified language-mediated risks and mapped applied-linguistic safeguards across the six AI-IBTF pillars. Stage 7 synthesised the framework, propositions, implementation sequence, and indicators for future testing.

The synthesis used a common comparison matrix across the five source domains. For each candidate AI application or governance requirement, the analysis considered (a) institutional purpose and expected organisational or public value; (b) data and infrastructure dependencies; (c) decision criticality and reversibility; (d) ethical, Sharia, legal, and cybersecurity exposure; (e) language-mediated consequences; and (f) minimum oversight and evaluation requirements. The resulting framework is a reasoned design synthesis, not a statistical model or an empirically estimated causal structure.

3.4. Analytical boundaries and rigour. The paper does not estimate causal effects of AI on financial stability, profitability, inclusion, or trust. Nor does it claim that linguistic failures have been measured in Yemeni banks. Statements about the prevalence of errors, customer effects, or the performance of Arabic-English AI systems are treated as propositions requiring empirical investigation. To reduce conceptual overreach, the framework distinguishes implementation indicators from outcome indicators, and technical correctness from communicative adequacy. Future validation should involve domain experts, transparent assessment rubrics, user-comprehension testing, and comparison of human-reviewed and machine-generated content.

3.5. Ethics. No human participants, personal data, experiments, or non-public bank records were involved. On that basis, participant research ethics approval was not applicable to this conceptual study. Any proposed future corpus or user study would need to comply with applicable ethics requirements, copyright and terms-of-use restrictions, data-protection rules, and safeguards for confidential financial information.

Table 1. Source domains and analytical use

Source domain	Examples	Analytical use	Boundary
Peer-reviewed scholarship	Islamic banking; AI governance; TOE; translation quality; pragmatics; multilingual NLP	Construct concepts and identify governance mechanisms	Purposive synthesis; not exhaustive systematic review
International policy documents	FSB and BIS AI-risk publications; NIST AI RMF	Identify lifecycle controls, systemic risks, and governance functions	Policy guidance does not establish Yemen-specific effects
Yemen institutional documents	IMF 2026 Article IV; World Bank 2025 project	Ground context, constraints, and digital-finance reform priorities	Documents do not prove that AI will improve stability
Islamic-finance governance	AAOIFI public governance material; Zafar & Ali (2026)	Inform Sharia oversight and lifecycle governance	Product-specific rulings remain with qualified authorities
Applied linguistics and translation	Baker (2018); House (2015); Grice (1975); Bender et al. (2021)	Frame terminology, semantic fidelity, pragmatics, comprehension, and language-system assurance	No Yemeni banking corpus was analysed in this study

4. Findings and discussion

4.1. Yemen's capability–needs gap

The document analysis indicates that the most consequential design issue is not the absence of AI tools but the uneven readiness of the institutional ecosystem in which they would operate. IMF (2026) reports banking-sector liquidity and capital pressures, increased exchange-rate exposure, deposits shifting toward unregulated money exchangers, and data and supervisory-capacity constraints.

The World Bank (2025) project addresses payment-system foundations, interoperability, AML compliance, and access to digital finance. Together, these documents support a sequencing argument: AI should be introduced downstream of core infrastructure, governance, data quality, staff capability, and service-continuity arrangements. They do not establish that AI itself will restore financial stability.

4.2. Application prioritisation: integrity and augmentation before automation

AI applications should not be prioritised by sophistication alone. A more suitable decision criterion combines expected institutional value, data feasibility, decision criticality, governance burden, reversibility, and likely customer impact. Early-stage use cases should generally augment human work and improve institutional integrity rather than autonomously determine high-stakes customer outcomes. AI-assisted anomaly detection, document search, compliance triage, operational forecasting, and staff-facing summaries may be considered where data controls and human review are adequate. Alternative-data credit scoring, automated eligibility decisions, and autonomous customer-facing advice require stronger evidence, fairness testing, explainability, appeal mechanisms, and independent validation.

4.3. The language-mediated risk map

The synthesis identifies five language-mediated functions. First, product and contractual communication expresses the structure and obligations of financial arrangements. Second, disclosures and warnings communicate costs, uncertainty, data use, and risks. Third, AI-assisted customer service interprets questions and generates responses. Fourth, translation and summarisation transform information across languages, genres, and audiences. Fifth, complaints and appeals enable customers to challenge outcomes. Failure in any of these functions can weaken the practical value of otherwise capable systems. This is a conceptual risk map, not a claim that all five failures have been documented in Yemen.

4.4. Linguistic quality as a governance mechanism

The proposed Language-Sensitive Governance Layer (LSGL) contains five connected controls: (1) controlled terminology; (2) communicative accessibility and plain-language disclosure; (3) quality assurance for AI-generated and translated content; (4) traceability, correction, and human escalation; and (5) comprehension and contestability testing. The layer is cross-cutting rather than a seventh pillar. Regulatory harmonisation can establish minimum expectations for accessible disclosures; Sharia governance can review material terminology and explanations; infrastructure can support version control and provenance; capacity-building can combine AI literacy with financial communication and translation expertise; cybersecurity can address data leakage and prompt injection; and controlled innovation can pilot language systems in low-risk settings before consequential use. The position of the LSGL as a cross-cutting governance mechanism, rather than a seventh pillar, is represented in Figure 1.

4.5. Terminological integrity and translation assurance

Institutions should maintain approved Arabic-English terminology for material Islamic-finance and AI-governance concepts, including definitions, contextual usage notes, authoritative source links, and version histories. The objective is not to impose one universal equivalent in every context but to document institutional choices and preserve consistency. High-impact texts should undergo bilingual review by appropriately qualified specialists, with legal, financial, and Sharia input where necessary. Quality assurance should distinguish grammatical fluency from factual accuracy, semantic fidelity, pragmatic appropriateness, and preservation of material contractual meaning. If the source text is ambiguous, the workflow should escalate the ambiguity rather than conceal it through a confident translation.

4.6. Plain-language communication and user comprehension

Customer-facing explanations should allow the intended audience to identify what a service does, what information is used, what decision may follow, what obligations or risks apply, and how to request human assistance. Simplification must not conceal uncertainty or remove material contractual or Sharia distinctions. Comprehension testing should ask representative users to explain key content in their own words. The study proposes that such testing is more informative than treating readability or satisfaction as proxies for understanding. The proposed relationship between communicative quality and perceived fairness or trust remains a hypothesis, not an established causal finding.

4.7. Sharia governance as a lifecycle control

A Sharia board reviewing an AI-enabled service should be able to examine not only the underlying contract but also the data sources, system purpose, output limitations, customer effects, and traceability of consequential decisions. This does not require Sharia scholars to become data scientists. It requires a governance structure that enables Sharia expertise to interact with technical, legal, financial, linguistic, and risk expertise. Consistent with emerging conceptual work on generative AI governance in Islamic finance (Zafar & Ali, 2026), the proposed structure links Sharia oversight and AI governance while preserving their distinct responsibilities.

4.8. Conceptual propositions

The propositions below are theory-guided statements intended to structure subsequent empirical inquiry. They are not statistical hypotheses tested in the present study. Accordingly, the figures show conceptual and governance relationships rather than regression paths, mediation coefficients, moderation effects, or estimated structural-equation models.

Proposition 1—Readiness proposition: Responsible AI adoption in fragile-state Islamic banking is more likely when regulatory, organisational, data, infrastructure, human-capital, and cybersecurity readiness develop at least as quickly as technical deployment.

Proposition 2—Integrity-first proposition: Where institutional trust and data capacity are constrained, assistive AI for financial integrity and service continuity is a lower-regret initial pathway than autonomous high-stakes decision systems, provided that adequate controls exist.

Proposition 3—Maqasid-governance proposition: The legitimacy of AI-enabled Islamic banking depends not only on product permissibility but also on whether system design and use protect wealth, avoid unjust harm, support accountability, and preserve meaningful human responsibility.

Proposition 4—Language-governance proposition: The risk of misunderstanding in multilingual AI-enabled banking may be reduced when material terminology, translation fidelity, pragmatic clarity, and human review are governed as part of the AI lifecycle.

Proposition 5—Comprehension-and-contestability proposition: Procedural fairness is more likely to be supported when customers can understand material explanations and access meaningful correction and appeal routes.

Proposition 6—Contextual-validity proposition: Performance on general-language benchmarks is insufficient to establish the suitability of Arabic-English AI systems for specialised Islamic-finance communication; domain-specific evaluation is required.

Proposition 7—Reconstruction proposition: AI is more likely to contribute to financial reconstruction when it strengthens durable capabilities—interoperability, financial integrity, data governance, professional skills, and service continuity—rather than merely automating existing processes.

Table 2. Indicative AI application prioritisation

Application	Potential value	Prerequisites / risks	Initial priority
Document search and staff-facing summaries	Faster retrieval and internal knowledge access	Approved source documents; privacy controls; human verification	Early, low-to-moderate risk
AI-assisted anomaly detection / AML triage	Supports scarce compliance and investigation capacity	Data quality; false-positive review; audit trail; accountable investigators	Early, conditional on controls
Operational forecasting and continuity support	May improve planning and disruption response	Reliable historical data; model monitoring; fallback procedures	Early-to-intermediate
AI-assisted customer service drafts	May improve service availability and response speed	Approved knowledge base; Arabic quality assurance; human escalation; no unsupported Sharia rulings	Pilot with human approval
Digital onboarding / e-KYC assistance	May reduce friction and improve access	Identity, privacy, security, accessibility, and error-correction controls	Intermediate
Alternative-data credit scoring	May expand assessment options where conventional data are limited	Representativeness, fairness, explainability, appeals, validation, data protection	Later, high scrutiny
Autonomous high-stakes eligibility or product advice	Potential efficiency but significant customer and governance impact	Strong validation, independent oversight, legal/Sharia review, contestability, robust evidence	Defer until mature controls

5. The AI-Integrated Islamic Banking Transformation Framework (AI-IBTF)

AI-IBTF is a layered governance-and-capability framework, not a linear technology checklist. Its six pillars are interdependent; each is necessary but no single pillar is sufficient. The LSGL operates across all six pillars and makes communication, translation, and comprehension part of operational governance. The overall architecture, including the six pillars, the cross-cutting LSGL, the governance-and-capability sequence, and the intended system-level contributions, is summarised in Figure 1.

Pillar 1—Regulatory harmonisation: clarify supervisory responsibilities, minimum AI-governance expectations, data-sharing boundaries, customer protection, AML/CFT controls, incident reporting, and cross-institution coordination. Where full harmonisation is not immediately feasible, minimum common safeguards can reduce the risk that regulatory fragmentation becomes another layer of financial fragmentation.

Pillar 2—Ethical and Sharia-aligned AI governance: establish board-level accountability, risk classification, lifecycle review, qualified Sharia oversight, human responsibility, fairness assessment, explainability, and appeal. Maqasid principles should inform review questions and evaluation criteria, not serve as unsupported blanket certification of an AI system.

Pillar 3—Digital infrastructure and data foundations: strengthen reliable payments, interoperability, data quality, access controls, digital identity where appropriate, secure records, and continuity arrangements. Shared infrastructure can reduce duplication but creates concentration and third-party risks that require explicit governance.

Pillar 4—Human and institutional capacity: develop staff skills in AI literacy, data governance, model-risk interpretation, cybersecurity, Islamic-finance principles, and customer communication. Cross-functional capability should include language and translation expertise for high-impact bilingual content.

Pillar 5—Cybersecurity and digital-risk management: address access control, privacy, vendor dependence, model vulnerabilities, prompt injection, data leakage, incident response, business continuity, auditability, and exit strategies. Institutions should maintain an AI-use register so that existing and planned systems are visible to risk owners and supervisors.

Pillar 6—Controlled innovation: use bounded pilots, explicit entry and exit criteria, risk-based testing, human oversight, and independent review. Start with reversible assistive use cases; expand only when evidence demonstrates acceptable performance, fairness, resilience, and governance maturity.

The LSGL is embedded in each pillar through five controls: A—terminological governance; B—communicative accessibility; C—language-system assurance; D—traceability and correction; E—comprehension and contestability. The extension is not a seventh pillar because linguistic quality depends on, and contributes to, each existing capability.

The framework uses a minimum-control principle. Before a language-enabled AI system is used in a consequential setting, the institution should define its purpose and audience, identify material risks, establish approved source information, set human-review requirements, test output quality, provide escalation, and monitor errors. If these conditions cannot be met, the use case should remain internal and low-impact or be deferred. The operational application of these requirements across purpose definition, data selection, development or procurement, validation, deployment, monitoring, and retirement is illustrated in Figure 2.

The recommended policy sequence for Yemen is adaptive rather than calendar-driven: (1) establish minimum governance and cybersecurity baselines; (2) strengthen payment interoperability and data foundations; (3) deploy assistive AI for integrity, compliance, service continuity, and operational analytics; (4) conduct supervised pilots of higher-impact inclusion applications; and (5) scale only after independent evaluation. Each phase should have explicit entry and exit criteria, and institutions should be able to pause or reverse deployments when unacceptable risks emerge. The overall architecture and its intended system-level contributions are summarised in Figure 1.

Table 3. Six AI-IBTF pillars and embedded language-sensitive controls

AI-IBTF pillar	Core capability	Language-sensitive control embedded
1. Regulatory harmonisation	Common minimum rules, supervision, consumer safeguards	Accessible disclosures; minimum standards for translated and AI-generated material; incident reporting
2. Ethical and Sharia-aligned AI governance	Accountability, Maqasid-oriented review, human responsibility	Review of material terminology and explanations; documented approval; human escalation

3. Digital infrastructure and data	Payments, interoperability, data quality, secure records	Version-controlled approved sources; traceable bilingual terminology and content provenance
4. Human and institutional capacity	Skills, governance roles, interdisciplinary capability	Training in AI literacy, financial communication, translation review, and comprehension testing
5. Cybersecurity and digital-risk management	Privacy, vendor risk, model risk, continuity, incident response	Controls for prompt injection, data leakage, misleading outputs, and safe escalation
6. Controlled innovation	Bounded pilots, validation, monitoring, reversibility	Domain-specific Arabic-English evaluation; user comprehension testing before scaling

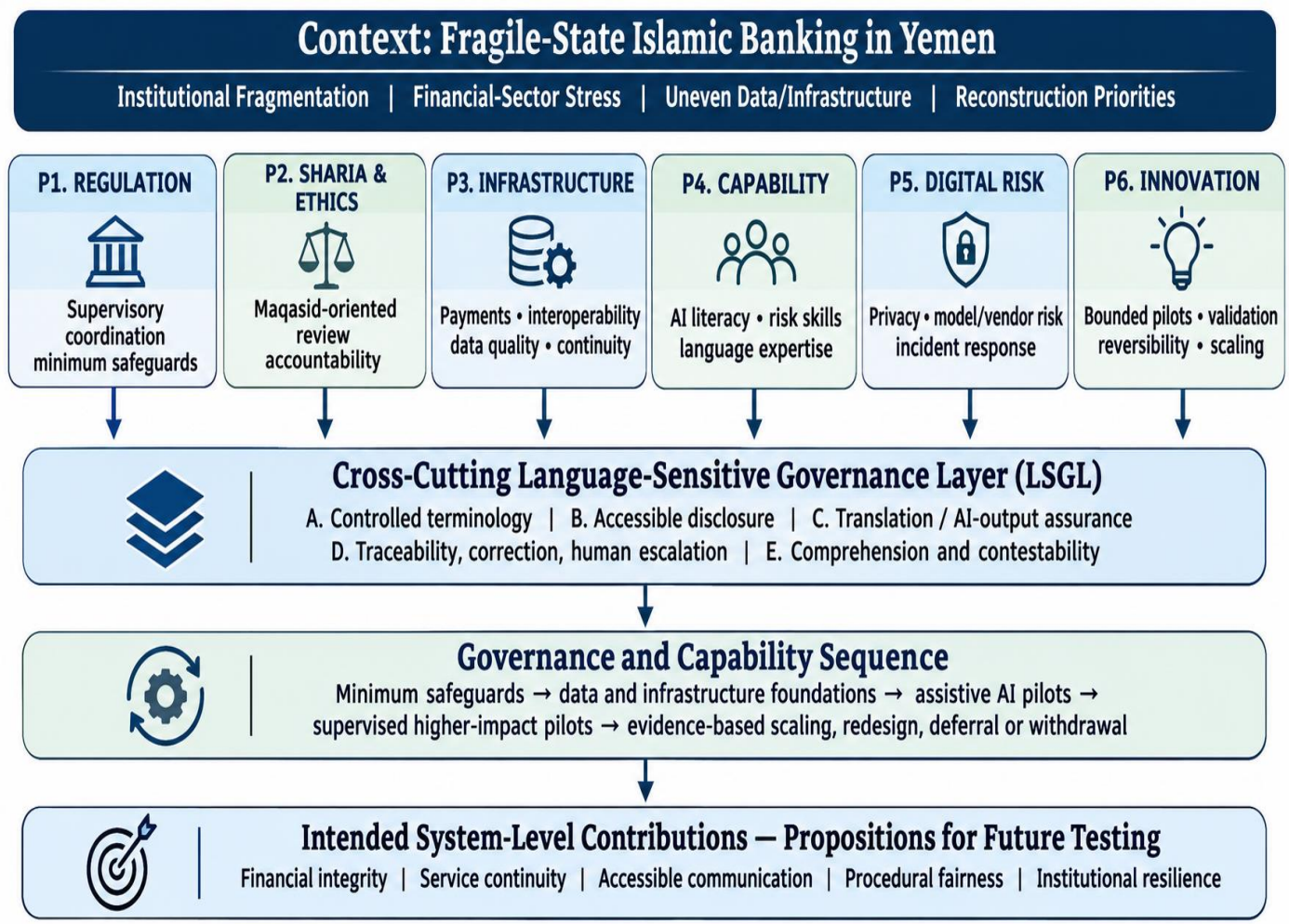


Figure 1. AI-Integrated Islamic Banking Transformation Framework (AI-IBTF) and its cross-cutting Language-Sensitive Governance Layer (LSGL).

Note. The figure presents a conceptual governance architecture and an indicative implementation sequence; it does not depict statistically estimated causal paths.

Table 4. AI lifecycle controls and language assurance

Lifecycle stage	**Minimum AI governance control**	**Language / translation control**
1. Purpose and impact	Define intended use, affected users, materiality, prohibited uses	Identify audience, language varieties, source genres, and consequences of misunderstanding
2. Data and source selection	Document provenance, permissions, quality, representativeness	Verify terminology, source-text authority, translation rights, and version control

Lifecycle stage	Minimum AI governance control	Language / translation control
3. Development or procurement	Vendor due diligence, documentation, privacy and security review	Check language coverage, known limitations, domain performance, and output provenance
4. Validation and testing	Independent testing, robustness, fairness, explainability	Assess semantic fidelity, terminology, pragmatic clarity, readability, and comprehension
5. Deployment	Human oversight, staff training, clear responsibility	Human review of high-impact outputs; accessible explanations and appeal route
6. Monitoring and incident response	Monitor drift, failures, complaints, security incidents	Code language-related errors; correct misleading content; track repeat misunderstandings
7. Retirement or replacement	Exit plan, records retention, safe fallback	Preserve approved source materials and notify users when material communication changes

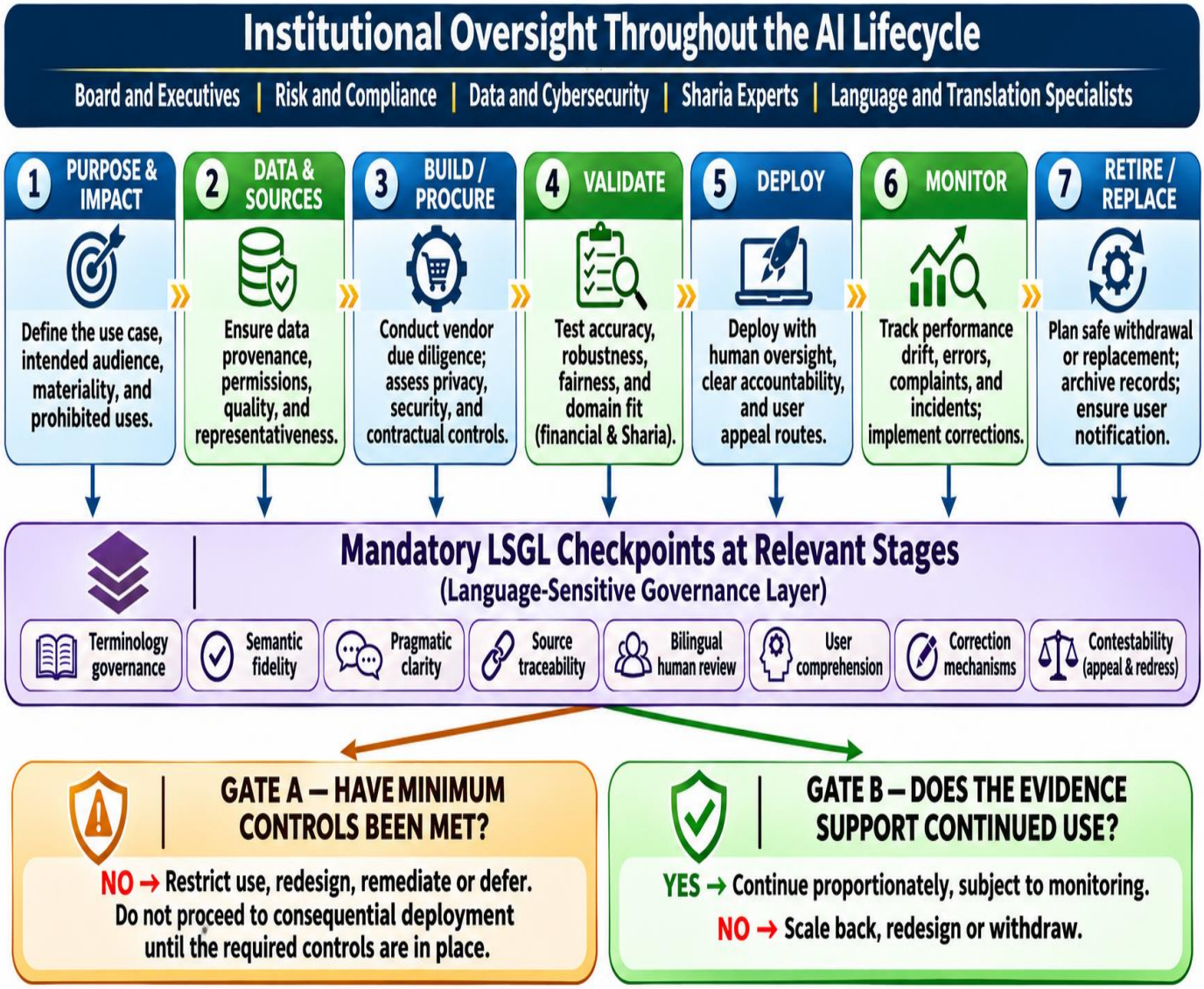


Figure 2. Institutional oversight throughout the AI lifecycle: governance stages and language-sensitive checkpoints.

Note. The lifecycle is iterative rather than strictly linear. Failure to satisfy a minimum control requires restriction, redesign, remediation, or deferral; continued use is contingent on evidence and ongoing monitoring.

6. Implementation, readiness assessment, and evaluation

6.1. Governance architecture. At the system level, regulators establish minimum rules and supervisory expectations. At the institutional level, each bank should maintain a cross-functional AI governance mechanism connecting executive management, risk, compliance, information security, data, legal, customer service, and Sharia expertise. At the application level, each AI use case should have a documented purpose, impact classification, data assessment, validation plan, human-oversight requirement, language-quality protocol where relevant, and monitoring plan. Governance cannot be delegated solely to a software vendor. Figure 2 translates this governance arrangement into seven lifecycle stages under continuing institutional oversight, with explicit gates for minimum-control compliance and evidence-based continuation.

6.2. Readiness scorecard. The proposed scorecard assesses seven dimensions on a 1–5 maturity scale: regulatory clarity; data readiness; infrastructure reliability; human and institutional capability; cybersecurity and resilience; Sharia/ethical governance; and language/communication assurance. Scores should not be averaged into a mechanical approval decision. The weakest critical dimension should trigger redesign, capability-building, or deferral. A high aggregate score cannot compensate for a critical failure in data security, Sharia oversight, or customer appeal.

6.3. Implementation indicators. Process indicators include the proportion of AI use cases recorded in the institutional register; the share with documented risk assessments; staff-training coverage; the proportion of high-impact outputs reviewed by humans; coverage of bilingual documents by approved terminology resources; the rate of detected terminology or semantic errors; the availability of human clarification and appeal; and incident-resolution time. These indicators show whether governance capacity exists, not whether AI has caused beneficial outcomes.

6.4. Outcome indicators. Metrics should be use-case specific. For anomaly detection, indicators may include detection performance, false-positive rates, investigation time, and operational losses. For digital onboarding, measures may include completion time, abandonment, access across relevant customer groups, and error rates. For alternative-data credit assessment, evaluation should include predictive validity, disparate outcomes, explainability, appeal outcomes, and human overrides. For customer-facing language systems, measures should include semantic accuracy, terminology consistency, comprehension, correction rates, escalation quality, and task completion. Trust and perceived fairness should be measured separately from actual comprehension and factual accuracy.

6.5. Negative indicators. Evaluation must include potential harms: unjustified customer exclusion, discriminatory error patterns, privacy incidents, cyber incidents, model drift, vendor outages, misleading simplification, translation-induced loss of meaning, and failures of human escalation. A system that improves speed while increasing unjust exclusion should not be classified as successful.

6.6. Empirical validation programme. A staged research programme could begin with a bilingual corpus of publicly available, non-sensitive Islamic-finance materials, subject to copyright and terms-of-use restrictions. A first study could develop a terminology and discourse-analysis protocol. A second could compare human-reviewed translations with machine translation and AI-generated explanations using expert ratings of semantic fidelity, terminology, and pragmatic clarity. A third could conduct ethically approved comprehension tests with consenting adult participants using hypothetical or de-identified materials. A fourth could examine institutional adoption through interviews with bank, regulatory, translation, customer-service, and Sharia-governance professionals. None of these data-collection activities is claimed in the present paper.

6.7. Research design for testing propositions. Institutional studies could compare readiness maturity with adoption intensity; application-level pilots could assess performance, false positives, fairness, and reversibility; and user studies could examine comprehension, perceived fairness, privacy concerns, religious legitimacy, and willingness to use AI-enabled services. Longitudinal data would be required to test system-level outcomes such as formal deposit growth, digital-payment use, remittance formalisation, and continuity of correspondent banking. The present conceptual analysis does not infer these outcomes from AI adoption alone.

Table 5. Proposed AI readiness scorecard

Dimension	1 — Weak readiness	3 — Developing	5 — Mature	Decision evidence
Regulatory clarity	Unclear responsibility and no common baseline	Partial policies and coordination	Clear roles, enforceable controls, and reporting	Mandates, policies, supervisory processes

Dimension	1 — Weak readiness	3 — Developing	5 — Mature	Decision evidence
Data readiness	Fragmented, unreliable, or unauthorised data	Partial quality controls and documented gaps	Governed, validated, secure data fit for purpose	Data inventory, provenance, quality checks
Infrastructure reliability	Frequent disruption; no safe fallback	Partial continuity and recovery capability	Tested resilience, interoperability, fallback	Uptime, recovery tests, incident records
Human/institutional capacity	No trained owners or review roles	Some training and cross-functional review	Defined accountable roles and continuing training	Training records, committee terms, escalation
Cybersecurity/ resilience	Weak controls and no tested response	Baseline controls but gaps remain	Risk-based controls, testing, response, vendor exit	Audits, penetration tests, response exercises
Sharia/ethical governance	No AI-specific review or accountability	Ad hoc review for some use cases	Lifecycle review, traceable decisions, redress	Approval records, impact assessment, appeal
Language/ communication assurance	No terminology control or output review	Partial bilingual review and correction	Controlled terminology, validated outputs, comprehension testing	Glossaries, error logs, user tests, review records

Table 6. Propositions and possible empirical operationalisation

Proposition	Candidate constructs	Possible design / measures
P1 Readiness	Institutional readiness; adoption maturity	Bank-level readiness assessment compared with use-case maturity
P2 Integrity-first	Use-case criticality; control maturity; operational outcomes	Compare assistive and high-impact use cases by risk, reversibility, and incident outcomes
P3 Maqasid governance	Accountability, fairness, protection of wealth, harm prevention	Expert review rubric and documented Sharia/AI governance assessment
P4 Language governance	Terminology consistency; semantic fidelity; pragmatic clarity	Expert rating of source, human-translated, machine-translated, and AI-generated texts
P5 Comprehension and contestability	Actual comprehension; appeal access; perceived fairness	Controlled user testing with hypothetical or de-identified materials
P6 Contextual validity	Domain-specific versus general-language performance	Arabic-English benchmark built from authorised Islamic-finance texts
P7 Reconstruction	Continuity, interoperability, formal use, service access	Longitudinal system-level analysis; do not infer causality from adoption alone

7. Theoretical, policy, and managerial implications

7.1. Theoretical implications. AI-IBTF extends TOE-oriented adoption reasoning by treating institutional fragmentation, Sharia-aligned governance, and reconstruction as constitutive design variables rather than background context. The LSGL adds a language-mediated governance dimension that links model output with institutional communication and user interpretation. The framework also distinguishes trust as an enabling condition that can be strengthened or damaged by deployment, rather than assuming it is an automatic result of digitalisation. These are theoretical propositions requiring empirical testing.

7.2. Regulators. Regulators can establish minimum expectations for AI inventories, risk classification, data governance, incident reporting, accessible customer explanations, human review of consequential automated communications, and complaint pathways. Where regulatory fragmentation persists, a minimum common baseline may be a feasible first step while longer-term coordination develops.

7.3. Islamic banks and Sharia boards. Banks should integrate AI governance into enterprise strategy rather than locate it solely in IT. Boards and executives should determine which problems justify AI; risk, compliance, cybersecurity, data, legal, language, and Sharia functions should jointly review material use cases. Sharia boards need not become technical developers, but they should be able to interrogate purpose, data provenance, output limitations, customer impact, and accountability with specialist support.

7.4. Universities and professional bodies. Universities can develop interdisciplinary training in Islamic fintech, applied linguistics, financial translation, terminology management, AI literacy, data governance, and model risk. Partnerships can support bilingual terminology resources, evaluation datasets, and practical guidance for translators and customer-service staff. Capacity building should include local ownership, documentation transfer, train-the-trainer mechanisms, and maintenance plans.

7.5. Development partners and vendors. Technical assistance should strengthen shared institutional capabilities rather than create isolated pilots that become unusable when funding ends. Vendors should provide documentation on language coverage, known limitations, evaluation methods, data handling, security, and error-reporting mechanisms. Contracts for high-impact use cases should clarify audit access, responsibility for corrections, incident notification, model updates, and exit strategies.

8. Limitations and future research

This paper is conceptual and does not report a corpus study, experiment, survey, or bank-level implementation. It cannot establish the prevalence of linguistic failures in Yemen, estimate the effect of language quality on trust, or demonstrate that AI-IBTF improves financial stability. The source selection was purposive rather than exhaustive, and cross-context benchmarking identifies design principles rather than proving that any foreign model is directly transferable. The framework should be treated as a structured proposition for policy design and empirical investigation.

Future research should test whether controlled terminology reduces errors in Arabic-English Islamic-finance communication; whether human-reviewed AI explanations improve comprehension relative to unreviewed outputs; how users interpret uncertainty and appeal routes; which language safeguards are feasible in low-capacity institutions; and whether readiness dimensions predict safer adoption. Comparative studies should avoid assuming that findings from high-capacity jurisdictions transfer directly to Yemen. Participant studies should use appropriate ethics approval, protect confidential information, and report both beneficial and adverse outcomes.

9. Conclusion and recommendations

AI offers potential benefits for Islamic banking in fragile states, but its value depends on the institutional conditions in which it is deployed. Yemen's current financial environment makes this distinction especially important. Policy efforts already address digital-payment infrastructure, financial inclusion, stronger financial integrity, and institutional reform; AI should be embedded within this agenda rather than pursued as a stand-alone technological project.

The AI-IBTF provides a capability-and-sequencing architecture built around six pillars: regulatory harmonisation; ethical and Sharia-aligned governance; digital infrastructure; human and institutional capacity; cybersecurity and digital-risk management; and controlled innovation. Its distinctive extension, the LSGL, embeds applied linguistics and translation studies across these pillars through terminology governance, communicative accessibility, language-system assurance, traceability and correction, and comprehension and contestability.

The central recommendation is to build the ability to govern AI before expanding the ability to automate. For Yemen, this means establishing minimum governance and language controls, strengthening data and payment foundations, building local interdisciplinary capability, piloting low-risk assistive applications, and scaling only after independent evaluation. The framework is not yet empirically validated. Future research must determine which safeguards work, for whom, at what cost, and under which institutional conditions.

Author biography

Dr. Sameer Ahmed Awadh Boset is an Associate Professor at the University of Aden, Yemen. His academic work spans applied linguistics, translation studies, English language education, and technology-enhanced language learning. He has more than fifteen years of experience in higher education, including teaching, research supervision, academic programme development, quality assurance, and academic leadership. His research interests include AI-mediated translation, multilingual communication, Islamic-finance discourse, and responsible technology adoption.

Declarations and Compliance Statements:

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interest: The author declares no conflicts of interest.

Ethics Approval: Not applicable as this study involves non-human, conceptual document synthesis.

Data Availability Statement: All source material analysed in this study is publicly available in referenced policy and scholarly works.

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