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Article

The role of AI in enhancing shariah compliance: Efficiency and transparency in Islamic finance

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Abstract: This study examines how Artificial Intelligence (AI) enhances Sharia compliance within Islamic Financial Institutions (IFIs) by improving operational efficiency, ensuring transparency, and addressing ethical and technical challenges. A quantitative survey across five Saudi regions resulted in 450 validated responses, analyzed using descriptive statistics, ANOVA, and regression models. The findings reveal that while AI significantly enhances transparency and compliance processes, its impact on operational efficiency is limited. Key barriers include high implementation costs, insufficient structured Sharia datasets, and integration complexities. Regional and professional differences further underscore the need for tailored adoption strategies. It introduces a novel framework integrating ethical governance, Sharia compliance, and operational scalability, addressing critical gaps in the literature. It offers actionable recommendations for AI adoption in Islamic finance and contributes to the global discourse on ethical AI practices. However, the Saudi-specific focus highlights regional dynamics that may limit broader applicability. Future research could extend these findings through cross-regional comparisons to validate and refine the proposed framework. By fostering transparency and ethical governance, AI integration aligns Islamic finance with socio-economic goals, enhancing stakeholder trust and financial inclusivity. The study emphasizes the need for targeted AI training, the development of structured Sharia datasets, and scalable solutions to overcome adoption challenges.

Keywords: artificial intelligence; Sharia compliance; Islamic finance; Islamic financial institutions; accounting practices

1. Introduction

Artificial The rapid advancements in AI have significantly influenced various industries, including the financial sector. For Islamic Financial Institutions (IFIs), which operate under the principles of Shariah law, AI presents both opportunities and challenges. Shariah compliance ensuring the prohibition of interest (Riba), excessive uncertainty (Gharar), and investment in unethical activities introduces a unique layer of complexity to the application of AI technologies.

Accounting practices within IFIs are particularly sensitive to Shariah guidelines, as they must align with the ethical, moral, and religious underpinnings of Islamic finance. AI has the potential to enhance the monitoring and verification processes involved in Shariah compliance by improving accuracy and efficiency. However, internalise AI into these institutions raises critical concerns regarding transparency, trust, algorithmic biases, and ethical considerations, which require careful examination (Ali et al., 2024).

This study seeks to address the growing need for theoretical and practical insights into the application of AI in Islamic finance. It aims to explore how AI can enhance Shariah compliance within IFIs by focusing on improving operational

efficiency, ensuring transparency, and addressing the ethical and technical challenges associated with its adoption. Specifically, the research investigates the following key questions:

- How does integrating AI enhance the effectiveness and efficiency of Sharia compliance monitoring in IFIs compared to traditional methods?
- What are the primary challenges associated with adopting AI for Sharia compliance in IFIs?

By examining these questions, this study provides a theoretical foundation for the practical application of AI in IFIs, a topic that remains underexplored in existing literature. While previous research has broadly discussed the role of AI in financial systems, little attention has been paid to its application in Islamic finance, particularly with respect to Shariah compliance.

This research contributes to the discourse by introducing a novel perspective on the integration of AI into Shariah-compliant practices. It emphasizes the need to consider cultural factors, stakeholder trust, and the development of ethical frameworks that align with Shariah principles. The findings aim to bridge the gap between technological innovation and religious compliance, offering a framework that supports the future adoption of AI in IFIs while upholding core ethical values.

2. Literature review and theoretical framework

2.1. Comprehensive role of AI in Islamic finance

AI's capacity to simulate human intelligence, including reasoning, learning, and decision-making, has been extensively applied across financial domains. In the context of Islamic finance, these capabilities align closely with the sector's ethical and operational requirements. For example, machine learning (ML) models are used to process vast datasets, enabling Shariah-compliant institutions to identify suitable investment opportunities with precision and speed (Azhar and Hassan, 2024; Blei et al., 2003; Hashem, 2023). Similarly, robotic process automation (RPA) has streamlined repetitive tasks like data entry and anomaly detection, improving efficiency and reducing operational costs (Dotel, 2020). These advancements offer IFIs opportunities to compete with conventional systems by enhancing productivity while adhering to ethical constraints.

Islamic finance's adherence to principles such as the prohibition of Riba, Gharar, and investments in non-compliant industries necessitates AI systems that are designed with ethical and cultural sensitivities. For example, AI's natural language processing (NLP) capabilities have been applied to automate the drafting and auditing of Shariah-compliant contracts (Bamhdi, 2024). These systems analyze contract terms to ensure alignment with Islamic law, significantly reducing time and legal complexities (Agarwal et al., 2023; Rahman, 2021; Yahya and Al-Farsi, 2023; Zain and Habib, 2018). Moreover, AI tools have facilitated the design of financial products that meet evolving market demands while respecting Shariah principles (Karim and Hassan, 2019).

2.2. Empirical insights and operational use cases

Studies illustrate the tangible benefits of AI integration within IFIs. For instance, AI-driven fraud detection systems in IFIs identify transactional anomalies in real-time, safeguarding assets while upholding transparency—a key Islamic value (Rani et al., 2023). Similarly, big data analytics powered by AI has enabled real-time risk management, enhancing decision-making for compliance with the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI) and the Islamic Financial Services Board (IFSB) guidelines (Al-Shalhoob, 2023; Bukhari and Qureshi, 2023).

However, the adoption of AI remains uneven across institutions. Smaller IFIs often struggle with the financial and technical barriers associated with AI implementation. Research highlights that over 60% of smaller institutions lack the resources to adopt advanced AI systems, which could exacerbate inequities within the Islamic financial ecosystem (Rahman and Ali, 2024). This underscores the need for scalable, cost-effective AI solutions tailored to diverse institutional capacities.

2.3. The current adoption of AI in Saudi Arabia's Islamic finance industry

The integration of AI in Saudi Arabia's Islamic finance sector is progressing rapidly, driven by the nation's strategic focus on economic transformation under Vision 2030. This ambitious vision aims to diversify the Saudi economy by harnessing cutting-edge technologies to boost productivity, foster innovation, and establish a globally competitive financial system. Within this framework, Islamic financial institutions are increasingly adopting AI solutions to streamline their operations, enhance service delivery, and ensure compliance with Sharia principles (Finastra, 2023).

Vision 2030 envisions Saudi Arabia as a leading hub for technological innovation, particularly in the financial sector. The government has actively encouraged AI adoption through national strategies and funding initiatives, fostering an environment conducive to digital transformation. In Islamic finance, AI aligns well with the sector's unique demands, such as ensuring Sharia compliance, mitigating risks, and enhancing operational efficiency. This synergy has prompted Islamic financial institutions to incorporate AI technologies to address growing customer needs while adhering to religious principles (Eurisko, 2023).

Prominent banks, including Al Rajhi Bank and Riyad Bank, have led the way in AI adoption. These banks utilize AI-powered tools like chatbots, virtual assistants, and predictive analytics to optimize internal processes and improve customer experience. AI-driven chatbots, for example, provide 24/7 customer support, offering instant responses to inquiries and enabling seamless transactions. Predictive analytics further enhances customer service by analyzing data to offer tailored financial products that align with Islamic ethical standards (Alkhowaiter and Alsharif, 2022).

AI has also transformed credit risk assessments by analyzing large volumes of customer data to accurately gauge creditworthiness, reducing the likelihood of non-performing loans. This is crucial in Islamic finance, where interest-based practices

are prohibited, and profit-sharing agreements must be evaluated for fairness and compliance with Sharia principles (Khan et al., 2023).

Fintech startups in Saudi Arabia are also playing a significant role in implementing AI-driven solutions tailored to Islamic finance customers. Companies have developed AI-based platforms that offer digital payments, automated investment management, and real-time financial insights. These platforms deliver ethical, convenient financial services while addressing complex compliance requirements (Ibrahim and Hassan, 2024). For instance, AI tools in these fintech applications are used to automate contract screening, ensuring that agreements comply with Sharia laws by identifying prohibited elements such as Riba or Gharar (Khan et al., 2023).

Ensuring Sharia compliance in financial transactions is a significant challenge in Islamic finance, and AI is increasingly becoming a crucial tool in addressing this issue. Advanced AI systems monitor and assess transactions in real time, flagging activities that may conflict with Islamic law. These automated compliance processes reduce human errors and enhance regulatory adherence (Finastra, 2023). AI-powered governance tools also assist Sharia boards in decision-making, analyzing data from market trends, customer behavior, and regulatory changes, providing valuable insights that support the integrity of Islamic finance operations (SAMA, 2023).

The reliance on AI is also driven by its potential to improve cost efficiency and mitigate risks. AI allows for the automation of routine tasks such as data entry and document processing, enabling institutions to allocate resources more effectively. Predictive analytics helps identify potential risks, such as market fluctuations or non-compliance issues, allowing institutions to take proactive measures to safeguard financial stability (Ibrahim and Hassan, 2024). AI systems assess market conditions and predict economic trends, equipping financial institutions with the insights necessary to adapt their strategies and maintain resilience (Khan et al., 2023).

The increasing adoption of AI in Saudi Arabia's Islamic finance sector is not only transforming operational landscapes but also revolutionizing how financial institutions ensure Sharia compliance and governance. AI technologies are being integrated across various functions, including auditing, accounting, documentation, regulatory compliance, risk management, and operational efficiency. By embedding AI solutions, Islamic financial institutions can automate complex processes, improve accuracy, and uphold strong governance while adhering to Sharia law (Eurisko, 2023).

AI is making significant strides in the auditing and financial reporting processes in Islamic finance. Traditionally, auditing required extensive human involvement, including manual reviews to ensure Sharia compliance. AI tools, however, automate auditing tasks such as detecting discrepancies and identifying potential violations of Islamic law. Machine learning algorithms play a vital role in flagging transactions involving prohibited practices like Riba or Gharar, which would otherwise require manual intervention (Alkhowaiter and Alsharif, 2022). AI-driven audit tools continuously monitor financial transactions, providing real-time data analysis and enhancing transparency in financial reporting (Finastra, 2023).

AI is also being used to automate accounting tasks such as bookkeeping, financial reconciliation, and compliance checks. In Saudi Arabia's Islamic finance

sector, AI-powered platforms handle large volumes of data, ensuring accurate recording of transactions in compliance with Islamic principles. This is especially important for financial products like Murabaha (cost-plus financing) and Mudarabah (profit-sharing), which must be meticulously tracked to avoid violating Sharia rules (Ibrahim and Hassan, 2024). Moreover, AI assists in optimizing asset management and portfolio allocations by analyzing vast datasets to identify investment opportunities that are both financially profitable and Sharia-compliant (Khan et al., 2023).

In documentation and contract management, AI is playing a transformative role by automating contract reviews to ensure compliance with Sharia law. Using NLP and machine learning, AI systems can identify clauses that involve prohibited elements such as interest or uncertainty and provide recommendations for modification, enhancing operational efficiency (Alkhowaiter and Alsharif, 2022).

AI also plays a crucial role in regulatory compliance and risk management. AI-powered compliance tools help institutions automatically detect and align with evolving regulations, ensuring activities comply with both local and international standards. These tools analyze real-time data, monitor regulatory changes, and adjust processes to remain in line with the latest financial regulations and Sharia guidelines. In risk management, AI systems assess financial and operational risks, forecasting market fluctuations, credit risks, and liquidity issues, enabling institutions to make informed decisions and manage risks related to non-compliance with Sharia principles (Ibrahim and Hassan, 2024).

AI's role in operational efficiency is also noteworthy. Automating routine tasks such as data entry, customer service, and transaction processing reduces operational burdens, allowing institutions to focus on strategic activities such as customer relationship management and Sharia compliance oversight. AI applications, including chatbots and robo-advisors, enhance customer experience by providing instant support and personalized advice, improving service delivery while maintaining ethical standards (Khan et al., 2023). AI also optimizes workflows, reduces human error, and enables financial institutions to maintain high compliance with Sharia law and regulatory standards (SAMA, 2023).

The adoption of AI in Saudi Arabia's Islamic finance sector is particularly prominent in banking and Takaful (Islamic insurance). Islamic banks have rapidly integrated AI to enhance customer service, streamline operations, and ensure regulatory compliance. Tools such as chatbots, predictive analytics, and automation are widely used by Islamic banks like Al Rajhi Bank to improve efficiency and customer engagement (Finastra, 2023). AI applications, including robo-advisors, provide personalized, Sharia-compliant financial advice, processing large amounts of data to recommend suitable products while ensuring compliance with Islamic principles (Khan et al., 2023).

The Takaful industry is also adopting AI, albeit at a slower pace. AI tools are enhancing risk assessment, pricing models, claims management, and customer service by automating claims processing and identifying fraudulent claims. AI-driven analytics also help predict future risks, enabling Takaful providers to create more precise, ethical insurance products (Alkhowaiter and Alsharif, 2022; Eurisko, 2023).

AI adoption in securities and financial markets is still emerging but is expected to grow rapidly. AI tools are used to automate trading strategies, analyze market trends, and detect anomalies to identify Sharia-compliant investment opportunities. AI can help avoid investments in prohibited activities such as alcohol production or gambling, ensuring that investments align with Islamic law (Ibrahim and Hassan, 2024). AI is also increasingly used to analyze financial market data, providing insights into price fluctuations and market risks, thus supporting Sharia-compliant investment decisions.

2.4. Ethical frameworks and challenges in AI implementation

Islamic finance, founded on the principles of justice, fairness, and equity, necessitates a robust ethical governance structure in the adoption of AI. A major challenge in this domain lies in the potential for algorithmic biases that could contravene the fairness essential to Shariah compliance. Biases in AI algorithms, especially in decision-making processes such as loan approvals or investment recommendations, may lead to outcomes that are unjust and inconsistent with Islamic ethical standards (Karim and Hassan, 2019). To address these risks, AI frameworks must incorporate Islamic concepts such as Maslahah (public benefit) and Adl (justice) (Saad, 2017). A key approach in ensuring AI systems align with these ethical considerations involves human oversight, where Shariah scholars provide interpretive guidance, ensuring that AI systems conform to the complex ethical nuances of Islamic law (Ahmad and Shabbir, 2018; Almutairi and Quttainah, 2020; Ashraf, 2023; Salim, 2020).

Another critical element in the ethical use of AI within Islamic finance is transparency. It is essential that AI systems operate in a manner that is explainable to all stakeholders, fostering accountability and aligning with Islamic principles of clarity and openness (Seddiq, 2023; Zheng and Liu, 2020). The establishment of global ethical frameworks, such as the Global AI Ethics Guidelines, provides a foundational structure for ethical AI deployment. However, there remains a significant need to adapt these general frameworks to the specific ethical constructs embedded in Islamic finance, a gap that requires further exploration.

The implementation of AI within Islamic finance is increasingly shaped by regulatory policies that aim to ensure both Sharia compliance and ethical implementation. In Saudi Arabia, for example, the Saudi Arabian Monetary Authority (SAMA) has put forth regulatory frameworks that guide the adoption of AI technologies in the banking and finance sectors, with a strong focus on adherence to Sharia law. These frameworks emphasize the importance of confidentiality, transparency, and accountability when utilizing AI technologies (SAMA, 2023). Additionally, the Saudi Vision 2030 initiative has encouraged the integration of AI across various sectors, including finance, while promoting the adoption of ethical practices that align with Islamic values.

The Saudi Data and Artificial Intelligence Authority (SDAIA) plays a significant role in setting standards for data privacy and cybersecurity. Through the enforcement of the Personal Data Protection Law (PDPL), SDAIA mandates financial institutions to implement stringent data protection measures when utilizing

AI, ensuring the safeguarding of customer information against unauthorized access and misuse. These regulations underscore the importance of maintaining confidentiality and securing explicit consent for data processing, reflecting Islamic principles of trust and privacy.

Ethical considerations in AI deployment within Islamic finance require a multifaceted approach to ensure that AI systems comply with both Sharia law and global ethical standards. Critical factors include fairness and non-discrimination, where AI systems should be designed to avoid biases that may lead to unjust outcomes, particularly in areas such as loan approvals or investment decisions. Upholding the Islamic principles of fairness and public benefit is essential in these contexts (Karim and Hassan, 2019). Moreover, the principles of transparency and accountability must be integrated into AI applications in Islamic finance to ensure that stakeholders can understand and scrutinize the decision-making processes, aligning with Islamic principles of clarity (Seddiq, 2023; Zheng and Liu, 2020). The continued involvement of human oversight, particularly by Shariah scholars, ensures that AI systems remain aligned with Sharia law while benefiting from the efficiencies introduced by these technologies (Ahmad and Shabbir, 2018; Almutairi and Quttainah, 2020).

Global AI frameworks such as the OECD AI Principles and the Global AI Ethics Guidelines offer a broad ethical structure for AI deployment but need to be specifically tailored to the ethical demands of Islamic finance. This adaptation includes integrating Islamic principles such as justice, equity, and public benefit into the guidelines governing AI use in the financial sector. To maintain compliance with both Sharia law and contemporary ethical standards, it is essential that AI systems undergo regular audits and continue to benefit from the oversight of human experts, particularly Shariah scholars (Ashraf, 2023; Salim, 2020).

By aligning AI implementations with both Islamic ethical principles and international best practices, Islamic financial institutions can foster trust, ensure fairness, and maintain strict compliance with Sharia law. In doing so, they can harness the potential of AI to improve operational efficiency and enhance customer service without compromising their ethical obligations.

2.5. Shariah principles in AI-driven financial models

Theoretical foundations in Islamic finance are inherently value-driven, prioritizing socio-economic justice and community welfare. Integrating these principles into AI systems requires a multidisciplinary approach that combines technology, jurisprudence, and ethics. For instance, Gharar is addressed in AI-powered investment platforms by minimizing speculative risks through real-time data analytics. Similarly, AI's ability to ensure transparency in profit-sharing contracts resonates with the Islamic principle of mutual consent and equitable sharing of risks and rewards (Iqbal and Mirakhor, 2017).

The role of Shariah scholars remains indispensable in this context. While AI can automate compliance checks, scholars provide the interpretive depth necessary for dynamic and context-sensitive decision-making. Research underscores the value

of collaborative AI models that augment, rather than replace, human judgment in Shariah compliance monitoring (Rahman, 2021).

Based on the reviewed literature, two hypotheses have been formulated to align with the research focus on the integration of AI within IFIs. These hypotheses aim to examine critical factors influencing the adoption of AI and its impact on Shariah compliance and operational efficiency.

H1: Greater knowledge of AI techniques among stakeholders in IFIs positively influences the perceived effectiveness of AI in enhancing Shariah compliance and operational efficiency.

This hypothesis is founded on the notion that a robust understanding of AI techniques significantly enhances their practical application within the unique operational and regulatory framework of IFIs. Previous studies (Hashem, 2023; Rahman, 2021) highlight the pivotal role of stakeholders' familiarity with AI tools and methodologies in enabling their effective utilization. Stakeholders with higher levels of AI knowledge are better equipped to recognize and harness AI's capabilities, facilitating compliance with complex Shariah requirements and improving operational workflows.

H2: Structural challenges negatively affect the level of AI adoption in Islamic financial institutions.

This hypothesis explores the impact of organizational and infrastructural barriers on the adoption of AI within IFIs. Research findings (Ahmad and Shabbir, 2018; Elmarzouky et al., 2023; Karim and Hassan, 2019) have identified financial and operational constraints as primary obstacles to AI integration. These challenges include insufficient resources, lack of technical expertise, and resistance to change, all of which can impede the adoption process. By investigating these structural impediments, this hypothesis seeks to provide insights into how addressing these barriers can enable more widespread and effective implementation of AI technologies in IFIs.

2.6. Conceptual framework for AI in Islamic finance

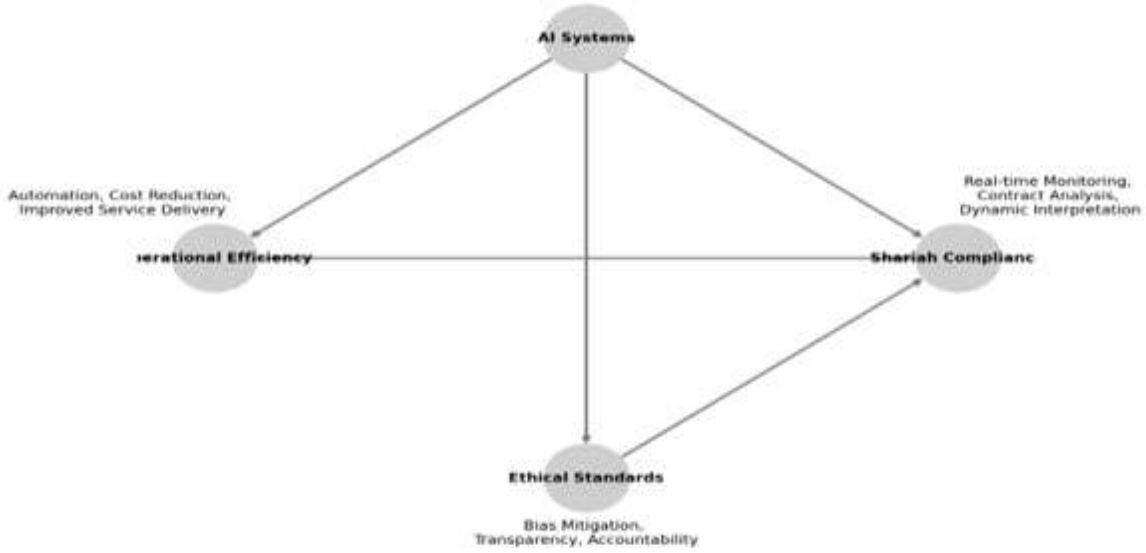

Figure 1. Conceptual framework for AI in Islamic finance.

A conceptual model integrating AI into Islamic finance can be envisioned as a triadic relationship between technology, ethical governance, and Shariah principles as shown in **Figure 1**. This framework addresses how AI can be harnessed to meet both operational and ethical needs while adhering to the moral imperatives of Islamic law, as follows:

- Ensure Operational Efficiency: AI-driven solutions can revolutionize operational efficiency in Islamic finance by automating repetitive tasks, enhancing data analytics, and optimizing resource allocation. Automated systems such as Robotic Process Automation (RPA) and AI-based financial analysis tools can significantly reduce transaction times and operational costs (Hamadou and Suleman, 2024). These systems improve the speed and accuracy of tasks like risk assessment, fraud detection, and compliance checks (Altaf et al., 2022). For instance, automated Shariah audits can ensure faster and more reliable assessments of contracts and transactions (Bamhdi, 2024; Khan et al., 2021).
- Adhere to Ethical Standards: Ethical governance is central to the integration of AI in Islamic finance. AI systems must be designed to mitigate bias, enhance transparency, and ensure accountability, all while aligning with Islamic values. The concept of Adl is pivotal in Islamic finance and must be incorporated into AI systems to avoid discriminatory outcomes that might arise from algorithmic bias (Sadiq, 2019). Transparent AI processes, where decisions are explainable and auditable, are necessary to meet the ethical standard of accountability (Fauziah et al., 2024). For example, AI models should be trained on diverse and representative data to avoid reinforcing existing societal biases, ensuring they operate within the principles of justice and Adl as emphasized in Islamic teachings (Ahmed and Shabbir, 2018).
- Facilitate Shariah Compliance: One of the core components of the conceptual framework is ensuring AI systems facilitate Shariah compliance. This includes the real-time monitoring of transactions and contracts, where AI systems can be employed to automatically detect violations of Islamic principles such as Riba, Gharar, and Maysir (gambling). Tools such as NLP and machine learning models can be used to analyze financial documents and flag potential breaches of Shariah law, offering dynamic and real-time compliance monitoring (Abdullah et al., 2020; Mansoori and Sadeghi, 2023; Zain and Habib, 2018). Moreover, AI could also support the Ijtihad (independent legal reasoning) process by offering dynamic interpretations of Islamic legal principles based on changing market conditions, helping to ensure that financial practices evolve with time while remaining consistent with Shariah guidelines (Nasir and Rahman, 2021).

The relationships between these nodes illustrate that while AI can enhance operational efficiency, it must also adhere to ethical standards and ensure compliance with Islamic law. The arrows between operational efficiency and Shariah compliance, as well as ethical standards and Shariah compliance, further emphasize that these elements must align for successful integration into the Islamic finance ecosystem.

3. Materials and methods

This The research methodology adopts a structured quantitative approach to explore the integration of AI in enhancing Sharia compliance within IFIs. The study's design is formulated to systematically collect and analyze data through a rigorously developed survey instrument, providing insights into participants' perceptions, knowledge, and experiences regarding AI technologies within the framework of Sharia-compliant financial practices. Central to the research is the proposition that AI plays a pivotal role in advancing Sharia compliance by improving the accuracy, efficiency, and consistency of compliance processes and audits. A conceptual model underpins this examination, emphasizing AI's potential to align technological innovation with Islamic ethical and legal frameworks. This study not only tests the hypotheses but also seeks to identify the operational and ethical implications of AI integration within IFIs.

Data collection is structured around a comprehensive questionnaire, divided into multiple sections to ensure thorough coverage of all relevant research dimensions. The survey incorporates Likert-scale items ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), allowing for the quantitative measurement of respondents' agreement with statements directly tied to the study's hypotheses. The initial section of the questionnaire is dedicated to gathering demographic information, including age, gender, educational attainment, professional experience, and geographic distribution. This demographic profiling facilitates an exploration of the relationship between personal characteristics and AI acceptance, establishing foundational insights into the diverse factors shaping participants' engagement with AI technologies.

Subsequent sections of the survey focus on assessing respondents' knowledge and familiarity with AI, with specific emphasis on the application of AI in IFIs. By mapping participants' understanding and awareness of AI tools and practices, the study aims to gauge the extent to which educational background and professional exposure influence AI adoption. Another critical component evaluates AI's practical contributions to Sharia compliance, addressing areas such as operational efficiency, detection of non-compliance, and enhancement of transparency. These segments collectively enable the identification of key enablers and barriers in AI deployment, providing nuanced perspectives on the technological, ethical, and institutional factors that shape AI integration.

The participant selection process is designed to ensure a diverse and representative sample, drawing from professionals across the Islamic finance sector, including IFIs employees, Sharia scholars, internal auditors, and clients. By employing purposive sampling, the study targets individuals with direct experience and vested interests in Islamic finance operations.

The geographic scope of the study encompasses the Central, Northern, Eastern, Western, and Southern regions of Saudi Arabia, ensuring a comprehensive representation of regional disparities in AI awareness and application. The selection of Saudi Arabia as the focus of this research is strategically justified due to its central role in the global Islamic finance industry and its leadership in AI adoption. With the ambitious goals set by Saudi Vision 2030, the country is prioritizing technological

innovation and economic diversification, particularly within the financial sector. Saudi Arabia's regulatory bodies, such as the Saudi Arabian Monetary Authority (SAMA) and the Saudi Data and Artificial Intelligence Authority (SDAIA), are playing a pivotal role in ensuring Shariah compliance and ethical AI practices across sectors like banking, Takaful, and financial markets. These industries are increasingly adopting AI to enhance regulatory compliance, risk management, and Shariah-based practices, making Saudi Arabia a critical context for studying AI's integration into Islamic finance. This geographic and institutional focus provides valuable insights into the intersection of AI technology and Islamic finance principles, with implications for policy and practice both within and beyond the Kingdom.

The electronic survey was distributed to approximately 1000 participants over a nine-month period from March to November 2024, yielding 450 validated responses. This response rate provides a robust dataset reflective of stakeholder perspectives across the Saudi Islamic finance landscape.

To ensure the validity and reliability of the survey instrument, a pilot study was conducted involving 100 professionals with expertise in Islamic finance. This pilot phase facilitated the refinement of survey questions, with iterative adjustments made to enhance clarity and alignment with the research objectives. Feedback from pilot participants led to the resolution of ambiguities and the restructuring of certain items, improving both comprehensibility and internal consistency. The finalized questionnaire was subsequently deployed across the target population, accompanied by follow-up communications to maximize response rates and ensure comprehensive data collection.

Of the 1000 surveys distributed, 550 were either not returned or yielded invalid responses. The reasons for non-response include factors such as participants' unavailability, lack of interest, incomplete answers, and competing priorities. Invalid responses were primarily due to incomplete or inconsistent answers, which hindered their inclusion in the final analysis. These challenges were addressed through careful screening and validation of the collected data. The analysis focused solely on the 450 valid responses, which were considered to offer a reliable reflection of stakeholder perspectives in the context of AI adoption in the Saudi Islamic finance sector. The data collection process was adjusted to address these challenges, ensuring the integrity and robustness of the final data set.

The Cronbach's Alpha value of 0.843 indicates a high level of internal consistency, suggesting that the survey instrument is reliable. No further modifications to the scale of the items were necessary, as the results demonstrate the robustness and coherence of the questions used.

Data analysis was conducted using SPSS software, with initial data compilation performed in Excel to streamline the organization and preprocessing of survey responses. The analytical process began with descriptive statistics, providing an overview of demographic variables and summarizing general trends in participants' responses. This was followed by correlation analysis to examine potential relationships between demographic factors and perceptions of AI, offering insights into how educational background, professional experience, and regional location influence AI adoption.

To further investigate differences across participant groups, ANOVA tests were employed, allowing for the identification of significant variations in AI perceptions and usage across geographic regions and professional categories. This analytical step facilitated the exploration of regional disparities in AI engagement, highlighting contextual factors that may drive or hinder AI adoption in Sharia compliance processes. Regression analysis was subsequently applied to assess the impact of perceived challenges on AI implementation, providing a deeper understanding of how institutional, technical, and ethical barriers shape the effectiveness of AI in enhancing Sharia compliance.

The methodological rigor applied throughout the study ensures that the findings contribute both to academic literature and practical advancements in the field of Islamic finance. By integrating empirical data with theoretical models, the research offers a comprehensive examination of AI's role in fostering operational efficiency, promoting ethical governance, and ensuring adherence to Sharia principles. This methodological framework not only addresses the gaps identified in existing literature but also lays the groundwork for future studies aimed at harnessing AI's transformative potential within the Islamic finance sector.

4. Results

4.1. Descriptive statistics

The descriptive analysis of AI integration within IFIs presents a holistic perspective on stakeholder perceptions concerning AI awareness, operational efficiency, and associated challenges. This analysis yields significant insights into the prevailing landscape of AI adoption, identifying key areas that warrant further development to optimize Sharia compliance through technological innovation.

Drawing on survey responses from 450 participants, the study evaluates variables encompassing AI comprehension, its role in enhancing operational processes, promoting transparency, and the barriers impeding seamless implementation. As illustrated in **Table 1**, the descriptive statistics unveil pivotal patterns and trends that reflect the current state of AI utilization and its perceived efficacy within IFIs.

Table 1. Descriptive statistics of AI knowledge, effectiveness, and challenges.

Variable	Mean	Std Dev	Min	Max	Range	Variance	Skewness	Kurtosis
Knowledge: I have a general understanding of AI techniques	2.90	1.21	1	5	4	1.45	0.12	−0.82
Knowledge: I believe AI can improve efficiency in Shariah audits	3.16	1.42	1	5	4	2.02	−0.07	−1.30
Knowledge: My institution offers training programs to familiarize employees with AI techniques	3.04	1.54	1	5	4	2.36	−0.13	−1.53
Knowledge: AI can reduce errors in compliance evaluation	3.12	1.41	1	5	4	1.99	−0.17	−1.20
Knowledge: I am interested in learning more about AI applications in IFIs	2.92	1.48	1	5	4	2.20	−0.12	−1.44
Knowledge: I believe AI is a key tool for achieving transparency	3.10	1.49	1	5	4	2.21	−0.10	−1.47
Effectiveness: AI increases the speed of Shariah audit processes	2.72	1.17	1	5	4	1.36	0.26	−0.77
Effectiveness: AI techniques help detect Shariah violations	2.80	1.39	1	5	4	1.92	0.23	−1.23

Effectiveness: AI can improve the accuracy of Shariah audits	2.98	1.34	1	5	4	1.78	−0.17	−1.08
Effectiveness: AI reduces the cost associated with Shariah audits	2.76	1.40	1	5	4	1.95	0.30	−1.23
Effectiveness: Using AI increases trust between clients and the IFIs	3.22	1.46	1	5	4	2.14	−0.23	−1.36
Effectiveness: AI improves compliance with Shariah standards overall	3.38	1.43	1	5	4	2.04	−0.44	−1.16
Effectiveness: To what extent do you believe AI can improve the performance of IFIs compared to traditional methods?	3.10	1.39	1	5	4	1.93	−0.09	−1.33
Challenges: The high cost of developing AI techniques hinders their application	2.88	1.29	1	5	4	1.67	−0.06	−1.17
Challenges: Lack of technical knowledge among employees affects the efficiency of AI application	2.82	1.55	1	5	4	2.39	0.11	−1.52
Challenges: AI does not consider Shariah complexities	3.00	1.39	1	5	4	1.92	0.00	−1.31
Challenges: Difficulty integrating AI with Shariah guidelines impacts AI adoption	3.16	1.50	1	5	4	2.26	−0.20	−1.40
Challenges: Resistance from traditional employees to change hinders AI application	3.10	1.33	1	5	4	1.77	−0.24	−1.09
Challenges: AI may be expensive for small institutions compared to large ones	2.72	1.60	1	5	4	2.57	0.23	−1.60

The analysis shows moderate levels of AI understanding (M = 2.90, SD = 1.21) and efficiency (M = 3.16, SD = 1.42), indicating that while AI is recognized as a valuable tool, there is still room for growth in terms of widespread comprehension and application. AI's effectiveness in compliance (M = 3.38, SD = 1.43) and trust (M = 3.22, SD = 1.46) emerged as the highest-rated domains, suggesting confidence in AI's ability to strengthen adherence to Sharia principles and foster greater trust in financial processes. However, the lower mean for effectiveness in speed (M = 2.72, SD = 1.17) points to lingering concerns regarding AI's ability to enhance operational efficiency at scale.

Challenges to AI adoption are prominently reflected in the areas of cost (M = 2.76, SD = 1.40) and complexity (M = 3.00, SD = 1.39). The high variance in knowledge-related challenges (Variance = 2.39) suggests inconsistency in AI literacy across stakeholders, emphasizing the need for specialized training and capacity building. Similarly, barriers related to integration (M = 3.16, SD = 1.50) and operational resistance (M = 3.10, SD = 1.33) reflect structural impediments that may hinder seamless AI deployment within IFIs.

Despite these barriers, the analysis underscores AI's potential to drive meaningful improvements in error reduction (M = 3.12, SD = 1.41) and transparency (M = 3.10, SD = 1.49). The balanced skewness and kurtosis values across variables suggest symmetrical distributions, indicating that participants' responses were not heavily polarized. This provides a nuanced understanding of AI's current role and future possibilities within the Islamic finance ecosystem.

4.2. The knowledge of artificial intelligence

The relationship between demographic variables and AI knowledge was analyzed using a one-way ANOVA, examining the potential impact of gender, age, education, region, job, and experience on AI knowledge levels. The results indicate varied relationships, with certain demographic factors showing significant associations while others did not. The results are summarized in **Table 2**.

Table 2. The relationship between demographic variables and AI knowledge.

Demographic Variable	*F*-statistic	*p*-value	Significance
Gender	0.9335	0.3345	Not Significant
Age	3.5807	0.0139	Significant ($p < 0.05$)
Education	13.3519	0.0000	Highly Significant ($p < 0.01$)
Region	10.6332	0.0000	Highly Significant ($p < 0.01$)
Job	11.6091	0.0000	Highly Significant ($p < 0.01$)
Experience	9.7992	0.0001	Highly Significant ($p < 0.01$)

Education emerged as the most significant determinant, as revealed by the ANOVA results, with an *F*-statistic of 13.35 and a *p*-value of 0.0000. This strongly indicates that individuals with higher levels of education, particularly those holding PhDs, tend to exhibit greater knowledge of AI technologies. The boxplot further corroborates this, showing a higher median AI knowledge score among participants with advanced education levels. This relationship is particularly relevant within the context of Islamic finance, where advanced education may offer greater exposure to AI applications.

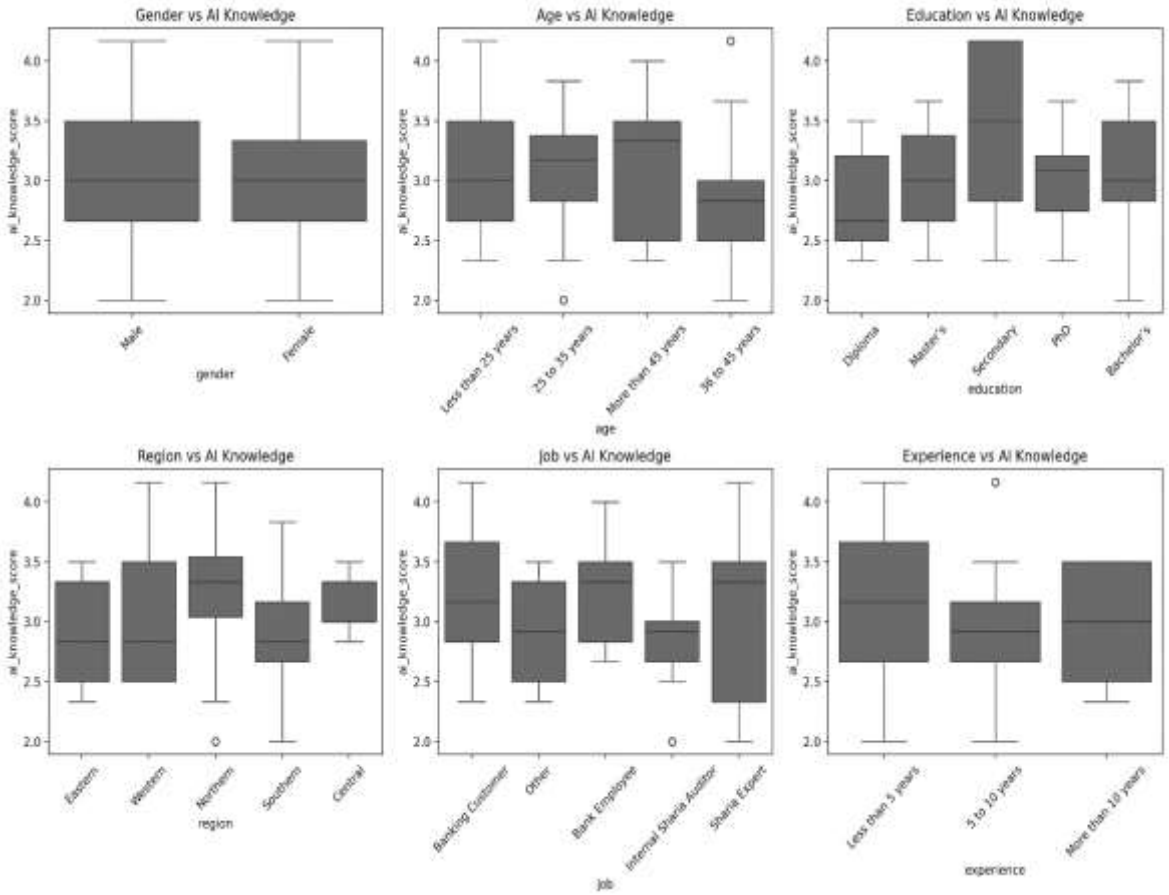

Figure 2. Boxplots for the relationship between demographic variables and AI knowledge.

Region, job, and experience also demonstrated significant relationships with AI knowledge, with *p*-values below 0.01. The boxplot analysis reflects these findings, with participants from the Northern and Eastern regions and those holding roles as

Sharia Experts or IFIs Employees displaying higher median AI knowledge scores. These variations stem from differences in exposure, resources, and institutional support available across geographic locations and professional roles. Similarly, participants with more than 10 years of experience exhibited higher AI knowledge scores, highlighting the influence of prolonged professional engagement on familiarity with AI technologies.

Age showed a significant yet less pronounced relationship with AI knowledge, as indicated by an *F*-statistic of 3.58 and a *p*-value of 0.0139. This suggests some generational differences in familiarity and comfort with technology, as reflected in the boxplot where younger age groups (25–35 years) displayed the highest median scores. Conversely, gender did not show a statistically significant relationship with AI knowledge ($F = 0.93$, $p = 0.3345$), aligning with the boxplot, which indicates similar distributions of scores between males and females. This suggests that, within the sample, gender is not a factor influencing awareness levels of AI.

4.3. The effectiveness of AI in Shariah compliance

The findings from the linear regression analysis provide insights into the relationship between AI knowledge and its perceived effectiveness in ensuring Sharia compliance. The regression model indicates that AI knowledge has a statistically significant, albeit negative, effect on the perceived effectiveness of AI in this context summarized in **Table 3**.

Table 3. The impact of AI knowledge on effectiveness.

Term	Coefficient	Std. Error	*t*-statistic	*p*-value	95% Confidence Interval
Constant	3.3059	0.149	22.207	0.000	[3.013, 3.598]
AI Knowledge Score	−0.1083	0.048	−2.243	0.025	[−0.203, −0.013]

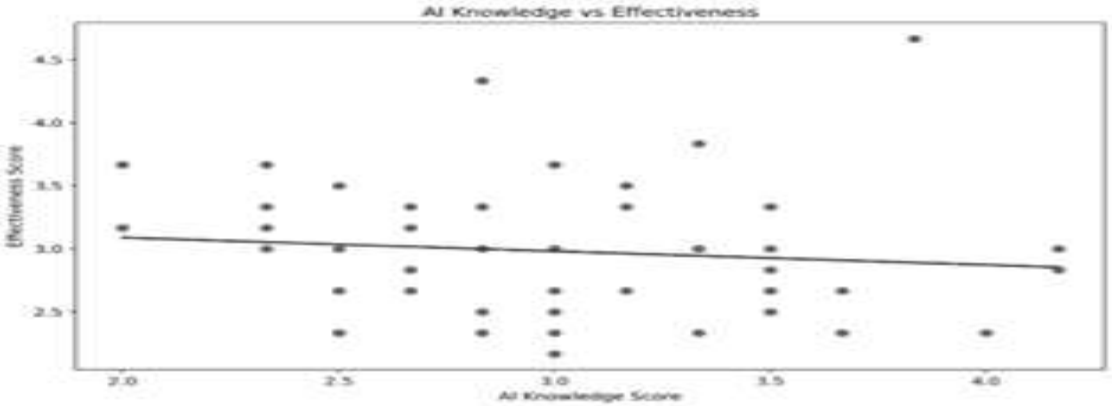

Figure 3. Relationship between AI knowledge and effectiveness.

The constant term in the regression model is 3.3059, with a standard error of 0.149, and it is highly significant ($p < 0.0001$). This suggests that the baseline level of perceived effectiveness, independent of any AI knowledge, is moderate to high. In other words, even without substantial knowledge of AI, individuals tend to view its effectiveness positively in ensuring Sharia compliance.

The coefficient for the AI knowledge score is −0.1083, with a standard error of 0.048, and it is statistically significant (p = 0.025). This indicates that as AI knowledge increases, the perceived effectiveness of AI in Sharia compliance slightly decreases. Specifically, for every one-unit increase in AI knowledge score, there is a 0.1083-unit decrease in the perceived effectiveness score. The 95% confidence interval for this coefficient ranges from −0.203 to −0.013, underscoring the robustness of this finding.

Table 4. Linear regression for AI effectiveness on IFIs performance.

Metric			**Value**		
Dependent Variable			Performance Improvement		
R-squared			0.275		
Adjusted R-squared			0.273		
F-statistic			169.8		
P-value (*F*-statistic)			3.93e-33		
Observations			450		
AIC			1432		
BIC			1441		
Variable	Coefficient	Std. Error	*t*-Statistic	*P*-value	95% Confidence Interval
Constant (Intercept)	7.1726	0.318	22.589	< 0.001	[6.549, 7.797]
Effectiveness Score	−1.3682	0.105	−13.030	< 0.001	[−1.575, −1.162]

The results of the linear regression analysis in **Table 4** indicate a significant relationship between AI effectiveness and the performance improvement of Islamic Financial Services (IFS). The negative coefficient for the AI effectiveness score (−1.3682) suggests that for each unit increase in AI effectiveness, there is a corresponding decrease of 1.3682 units in performance improvement, holding all else constant. This finding is statistically significant, as evidenced by the p-value of less than 0.001, which falls well below conventional significance thresholds.

The R-squared value of 0.275 suggests that approximately 27.5% of the variation in performance improvement can be explained by the AI effectiveness score. While this indicates a moderate explanatory power, it also implies that additional factors not captured by this model may influence performance improvement.

The F-statistic of 169.8, with an associated p-value of 3.93e-33, confirms the overall significance of the regression model. This indicates that the model as a whole provides a significantly better fit to the data compared to a null model with no predictors.

The intercept (constant) of 7.1726 represents the expected performance improvement when AI effectiveness is zero, suggesting a baseline level of performance that is independent of AI effectiveness. The confidence interval for the intercept [6.549, 7.797] and the effectiveness score [−1.575, −1.162] further reinforces the precision of these estimates.

4.4. The challenges associated with using artificial intelligence

The analysis examines the relationship between various AI-related challenges and their impact on the level of AI application in Islamic Financial Services (IFS). Pearson correlation coefficients were calculated to assess the strength and direction of these relationships, and *p*-values were used to evaluate their statistical significance. The main findings are detailed in **Table 5**.

Table 5. Correlation for AI-related challenges and AI application levels in IFIs.

Challenge	Correlation	*p*-value	Interpretation
Cost of Implementation	0.2046	< 0.0001	Positive correlation: higher costs correlate with higher levels of application.
Employee Resistance	0.0504	0.2864	Weak positive correlation; not statistically significant.
Technical Knowledge	−0.0092	0.8464	Negligible correlation: challenges in technical knowledge do not hinder application.
Shariah Complexity	−0.1537	0.0011	Moderate negative correlation: complexity decreases AI application levels.
Integration Difficulty	−0.0996	0.0347	Slight negative correlation: integration challenges weakly reduce application.
Size-related Cost	−0.0781	N/A	Weak negative correlation: size-related costs have minimal impact.

The cost of implementation shows a significant positive correlation with the level of AI application (correlation = 0.2046, $p < 0.0001$). This indicates that institutions willing to allocate higher budgets for AI technologies are more likely to adopt these systems. Despite the financial burden associated with implementation, the benefits of enhanced efficiency and Sharia compliance outweigh the costs for organizations that prioritize technological advancements. This finding underscores the importance of financial investment in overcoming barriers to adoption.

In contrast, Sharia-related complexity negatively correlates with AI application levels (correlation = −0.1537, $p = 0.0011$). This suggests that the intricate and nuanced nature of Sharia guidelines creates obstacles for AI adoption. Organizations may struggle to incorporate these complex guidelines into AI systems, particularly when structured Sharia-compliant datasets are unavailable. Simplifying Sharia frameworks and developing accessible, well-organized data repositories could mitigate these challenges and facilitate broader adoption of AI technologies.

Integration difficulties also show a slight negative correlation with AI application levels (correlation = −0.0996, $p = 0.0347$). While this relationship is weaker, it highlights the need for improved systems integration capabilities. Seamless integration of AI tools with existing processes and infrastructures is critical to maximizing their effectiveness. Addressing these difficulties may require enhanced technical support and more robust system compatibility during the adoption phase.

Other challenges play a less prominent role in influencing AI adoption. For example, technical knowledge gaps show a negligible correlation with AI application levels (correlation = −0.0092, $p = 0.8464$), indicating that this issue may not significantly deter adoption efforts. Similarly, employee resistance exhibits no statistically significant impact (correlation = 0.0504, $p = 0.2864$), suggesting that organizations have implemented effective change management practices to ease the transition toward AI adoption. Size-related costs, while exhibiting a weak negative correlation (correlation = −0.0781), also have a minimal influence on adoption levels.

Table 6. Frequency of AI-related challenges by region.

Region	High Cost	Lack of Clarity in Shariah Guidelines	Lack of Structured Shariah Data	Lack of Technical Skills	Employee Resistance	Other Challenges
Central	22.22	11.11	22.22	11.11	22.22	11.11
Eastern	10.00	20.00	30.00	20.00	10.00	10.00
Northern	25.00	16.67	25.00	16.67	8.33	8.33
Southern	20.00	20.00	20.00	30.00	10.00	0.00
Western	11.11	22.22	22.22	11.11	11.11	22.22

The frequency analysis of AI-related challenges by region reveals notable variations that further contextualize these findings. For instance, the Eastern and Southern regions report the highest frequencies of "Lack of Structured Shariah Data" and "Lack of Technical Skills," respectively. These results highlight specific areas where targeted interventions could improve AI adoption. The Northern region identifies high costs and Shariah complexity as the most significant challenges, whereas Western respondents emphasize "Lack of Clarity in Shariah Guidelines." In contrast, employee resistance and "other challenges" are more pronounced in the Central and Western regions, respectively.

Table 7. Barrier distribution to AI adoption by experience level.

Experience Level	High Cost	Lack of Clarity	Lack of Structured Data	Technical Skills Gap	Other	Employee Resistance
Less than 5 years	26.32	10.53	21.05	15.79	10.53	15.79
5 to 10 years	16.67	27.78	22.22	22.22	0.00	11.11
More than 10 years	7.69	15.38	30.77	15.38	23.08	7.69

The results indicate that AI adoption in IFS is influenced by experience-driven perspectives, with financial constraints and operational readiness dominating early-career concerns, while data integrity and strategic alignment shape senior-level priorities. Early-career professionals (less than 5 years of experience) primarily cite high cost (26.32%) as the most significant barrier, indicating a focus on immediate financial constraints and limited exposure to long-term planning. Operational issues, such as the lack of structured data (21.05%), and employee resistance (15.79%) are also notable, highlighting concerns around resource availability and cultural inertia. In contrast, lack of clarity (10.53%) regarding AI frameworks is perceived as a less pressing issue for this group.

Mid-career professionals (5 to 10 years of experience) report lack of clarity as the most prominent challenge (27.78%), suggesting that regulatory ambiguities and unclear AI strategies hinder implementation. Technical skills gaps and structured data deficiencies (22.22% each) are equally significant, reflecting the operational difficulties faced by this group. High cost is less of a concern (16.67%), indicating greater acceptance of AI investment compared to early-career professionals. For senior professionals (more than 10 years of experience), the lack of structured data (30.77%) emerges as the dominant barrier, underscoring the strategic importance of reliable, Shariah-compliant datasets. High cost (7.69%) is viewed as a minimal obstacle, reflecting the perception of AI as a necessary long-term investment. Other complex barriers, such as governance and integration issues (23.08%), feature more

prominently, while employee resistance (7.69%) is the least concerning factor for this group.

Table 8. Primary barriers to AI adoption in IFIs.

Barrier	Count	Percentage (%)
Lack of structured Shariah data	108	24.00
High cost	81	18.00
Lack of technical skills and expertise	81	18.00
Lack of clarity in Shariah guidelines	81	18.00
Resistance from employees to change	54	12.00
Other	45	10.00

The analysis of barriers to AI adoption in IFIs reveals several critical challenges that impede the seamless integration of AI technologies into Shariah-compliant operations. The most prominent barrier identified by respondents is the lack of structured Shariah data, accounting for 24% of the total responses. This highlights the fundamental issue of data availability and organization, which is essential for developing AI systems capable of accurately interpreting and applying Islamic legal principles.

Following closely, high costs associated with AI implementation emerged as a significant barrier, representing 18% of the responses. This indicates that the financial burden of integrating AI solutions may deter IFIs, particularly smaller institutions, from pursuing technological advancements. Similarly, the lack of technical skills and expertise is a considerable impediment, also reported by 18% of respondents. This underscores the need for capacity-building initiatives and specialized training programs to bridge the knowledge gap within the Islamic finance sector.

Additionally, 18% of participants cited a lack of clarity in Shariah guidelines as a major obstacle. This reflects the complexities and interpretative challenges inherent in Islamic jurisprudence, which can hinder the development of standardized AI solutions for Shariah compliance. The absence of clear regulatory frameworks or universally accepted guidelines may result in inconsistencies, limiting the scalability of AI applications across different regions and institutions.

Employee resistance to change constitutes another notable barrier, representing 12% of the responses. This suggests that organizational culture and inertia may inhibit the adoption of AI-driven processes, necessitating change management strategies to foster a more receptive environment. Furthermore, 10% of respondents identified “Other” barriers, indicating the presence of miscellaneous or institution-specific challenges that may vary across different operational contexts.

5. Discussion

The integration of Artificial Intelligence (AI) within Islamic Financial Institutions (IFIs) offers significant potential to enhance operational efficiency, transparency, and Shariah compliance. The study underscores AI’s capability to automate complex processes and maintain adherence to ethical and operational

standards inherent in Islamic finance, aligning with previous research (Dotel, 2020; Hashem, 2023). For instance, NLP applications in automating contract drafting and compliance monitoring have shown potential to significantly reduce legal complexities and operational inefficiencies (Rahman, 2021; Zain and Habib, 2018). AI's real-time detection of Shariah violations further strengthens its role in ensuring compliance, as reflected in the works of Abdullah et al. (2020) and Al-Shalhoob (2023). However, the study highlights the moderate levels of AI knowledge and application among stakeholders, suggesting that the full potential of AI remains underutilized. This gap mirrors earlier findings that smaller IFIs encounter financial and technical barriers when adopting advanced AI systems, thereby exacerbating disparities within the sector (Rahman and Ali, 2024).

While AI's contributions to operational efficiency and transparency are well-documented (Sadiq, 2019), this study identifies a negative association between AI knowledge and its perceived effectiveness in ensuring Shariah compliance. This phenomenon may stem from a deeper understanding of the challenges involved in aligning AI systems with the nuanced interpretation of Islamic laws (Seddiq, 2023). These challenges emphasize the indispensable role of Shariah scholars in providing interpretive oversight, as discussed by Farook and Farooq (2011). The study also highlights several barriers to AI adoption, including high implementation costs, lack of structured Shariah data, and insufficient technical expertise, corroborating previous studies on the financial and technical constraints faced by smaller institutions (Ahmad and Shabbir, 2018; Karim and Hassan, 2019). The lack of clarity in Shariah guidelines, cited by 18% of respondents, underscores the complexity of integrating Islamic jurisprudence into AI systems, which aligns with calls for the development of standardized Shariah-compliant frameworks (Rahman and Ali, 2024; Yahya and Al-Farsi, 2023).

Geographic and professional disparities in AI knowledge also emerged, with participants from the Northern and Eastern regions exhibiting higher median AI knowledge scores, attributed to differences in institutional support and resource availability. These variations reflect broader structural inequalities within the Islamic financial ecosystem, as highlighted by Iqbal and Mirakhor (2017). Despite these challenges, the study reaffirms AI's transformative potential in Islamic finance, particularly in enhancing compliance and fostering trust, as AI-driven transparency and accountability align with the ethical imperatives of Islamic finance (Fauziah et al., 2024). However, to realize this potential, systemic barriers must be addressed through targeted interventions, such as capacity-building initiatives, structured data repositories, and scalable AI solutions tailored to the needs of IFIs.

While the study employs ANOVA and regression analyses to examine the relationships between demographic factors, AI knowledge, and its effectiveness, the interpretations could benefit from a deeper theoretical contextualization. To enhance the study's academic rigor and provide actionable insights for promoting AI adoption in Islamic Financial Institutions (IFIs), the findings could be framed within well-established technology adoption models.

The Technology Acceptance Model (TAM), which explains how individuals adopt new technologies based on perceived ease of use and usefulness, offers a useful lens for understanding how AI knowledge influences stakeholders'

perceptions of its effectiveness. TAM posits that the perceived ease of use and usefulness of AI systems are crucial determinants of acceptance. In this context, stakeholders with higher AI knowledge may perceive AI tools as more useful but may also recognize their limitations, leading to a more critical evaluation of their effectiveness in ensuring Shariah compliance. As AI systems evolve, perceived barriers like complexity or difficulty in use may reduce the perceived usefulness of these technologies, especially among those with more experience or education in AI. Thus, TAM can help explain how demographic factors, such as education level and prior experience, affect the adoption process by influencing the perceptions of AI systems' usefulness in IFIs.

In addition, the Diffusion of Innovation (DOI) theory provides another relevant framework, which explains how new technologies spread across social systems over time. According to DOI, the adoption process is influenced by factors like relative advantage, compatibility, complexity, trialability, and observability. In the context of IFIs, AI adoption is influenced by the perceived advantages of AI in improving Shariah compliance and operational efficiency, as well as its compatibility with existing Islamic financial practices. However, if AI is seen as complex or difficult to implement, it may delay its adoption, particularly among smaller institutions with limited resources. DOI's constructs help explain how institutional factors, such as organizational support and infrastructure, contribute to the rate and extent of AI adoption in Islamic finance.

Furthermore, the negative relationship between AI knowledge and its perceived effectiveness in ensuring Shariah compliance could be explored through cognitive dissonance theory. This theory suggests that individuals may experience discomfort when confronted with conflicting information or expectations. In this case, as stakeholders gain more knowledge about AI systems, they may become more aware of the challenges associated with aligning these technologies with the nuanced interpretation of Islamic laws. This heightened awareness could lead to a reduction in the perceived effectiveness of AI in ensuring Shariah compliance. Cognitive dissonance theory can help explain why stakeholders with advanced AI knowledge lower expectations of AI's effectiveness might have, as they are more cognizant of the limitations and challenges involved in integrating AI with Islamic jurisprudence.

The study emphasizes transparency as a key benefit of AI but does not sufficiently address ethical concerns such as algorithmic bias, which is crucial in the context of Islamic finance, where justice and public benefit are paramount principles. Algorithmic bias can lead to discriminatory outcomes, such as unequal access to financial services, which contradicts these ethical principles. Future research should focus on identifying and mitigating algorithmic bias using fairness-aware machine learning techniques and transparent model design. The role of Shariah scholars in overseeing AI systems could be expanded to ensure these technologies align with moral and social imperatives, further strengthening their ethical foundation within IFIs.

The study also finds that AI has a limited impact on operational efficiency, particularly in areas like speed and integration. However, it does not propose practical measures to address these limitations. Several strategies could be considered, including adopting modular AI systems, which allow institutions to

implement AI solutions incrementally, targeting specific operational challenges. Additionally, capacity-building initiatives, such as specialized training programs, would enhance technical expertise within IFIs and foster a culture of innovation. Improved integration capabilities, such as investing in infrastructure upgrades and developing APIs for interoperability, are also essential for maximizing AI's effectiveness. Scalable solutions, such as cloud-based AI services, could be developed to meet the needs of smaller institutions that face resource constraints.

The negative correlation between AI knowledge and its perceived effectiveness in ensuring Shariah compliance reveals the complexities of integrating AI within IFIs. Stakeholders with advanced AI knowledge often recognize the limitations and challenges associated with aligning AI algorithms with Shariah principles, including addressing inconsistencies in Islamic jurisprudence and mitigating risks such as algorithmic bias. These individuals tend to have heightened expectations regarding AI's capabilities, and when these expectations are not met, their perception of AI's effectiveness diminishes. Furthermore, the lack of structured Shariah-compliant data exacerbates skepticism among those with AI expertise. The subjective nature of Shariah compliance, which requires human interpretation, further contributes to the negative perception of AI's effectiveness. As AI systems are still in their nascent stages within IFIs, those with greater AI knowledge tend to critically evaluate their early-stage applications, often leading to a more cautious approach to AI adoption.

In conclusion, the study emphasizes the need for a balanced approach to AI adoption in IFIs, which includes technical training, realistic expectations, and collaboration between Shariah scholars and AI specialists. Addressing the underlying challenges of data quality, transparency, and interpretability will be crucial in facilitating a more informed perspective on AI's potential. With targeted interventions and a more comprehensive understanding of the ethical and operational dimensions, AI can significantly enhance the integration of Shariah-compliant solutions within Islamic finance.

6. Conclusion

This study provides a comprehensive analysis of AI integration within IFIs, examining its impact on improving operational efficiency, ensuring transparency, and addressing the ethical and technical challenges associated with its adoption.

The findings of the study corroborate the first hypothesis, demonstrating that stakeholders' familiarity with AI techniques significantly shapes their perceptions of AI's efficacy in enhancing Shariah compliance and operational efficiency within IFIs. Specifically, increased knowledge about AI correlates with heightened appreciation of its potential to meet ethical and operational demands. However, the observation that deeper familiarity with AI tends to temper initial optimism highlights a dual role for knowledge. It functions both as a driver of AI adoption and as a critical lens through which stakeholders evaluate AI's complexities and limitations. This nuanced dynamic advances theoretical discussions on technology adoption by underlining the necessity of balanced AI literacy. Such literacy fosters informed expectations and constructive engagement, bridging the evolving technological landscape with the ethical and operational frameworks of Islamic jurisprudence.

Additionally, the study validates the second hypothesis, revealing that structural barriers, including high implementation costs, inadequate technical expertise, and the inherent complexity of Shariah principles, negatively impact the adoption of AI in IFIs. These findings stress the need for tailored frameworks that align with the unique financial, technical, and jurisprudential realities of Islamic finance. Theoretical models of technology adoption must, therefore, account for the ethical and operational constraints specific to this context. By doing so, they contribute to the broader discourse on inclusive, context-sensitive innovation, ensuring that advancements in AI serve the dual purpose of enhancing efficiency and upholding the ethical imperatives of Shariah compliance.

Empirically, this study reinforces the importance of structured Shariah-compliant datasets and robust technical infrastructures to enable seamless AI integration. The lack of such foundational elements not only hinders AI adoption but also limits its scalability across diverse contexts. Addressing these gaps requires collaborative efforts among financial institutions, regulators, and Shariah scholars to develop standardized guidelines and accessible data repositories. Additionally, fostering AI literacy through targeted training programs is crucial, especially in regions and institutions where knowledge disparities persist.

From a practical standpoint, the findings advocate for a multidisciplinary approach to AI implementation in Islamic finance. This includes leveraging Shariah scholars' interpretive expertise to complement AI's analytical capabilities, ensuring that automated systems align with the ethical and cultural imperatives of Islamic law. Policymakers must also prioritize equitable resource allocation to support smaller institutions, mitigating disparities in technological access and fostering a level playing field within the sector.

Its emphasizes transparency as a key benefit of AI but does not fully address critical ethical issues, such as algorithmic bias. Algorithmic biases could inadvertently result in outcomes that violate principles of justice and public benefit, which are central to Islamic finance. Future efforts must focus on identifying, mitigating, and preventing such biases to align AI systems with Islamic ethical values. For example, integrating fairness-aware machine learning models and diverse, representative datasets could help reduce bias. Additionally, the active involvement of Shariah scholars in AI system design and oversight would provide a safeguard against ethical violations, ensuring that the principles of equity and benefit are upheld.

This study uniquely contributes to the literature by demonstrating the nuanced relationship between stakeholder knowledge and AI's perceived effectiveness within Islamic finance. It also sheds light on the distinct structural challenges faced by IFIs, emphasizing the need for solutions that are both technologically advanced and ethically grounded. These contributions provide a foundation for integrating AI into other value-driven financial systems, reinforcing the global relevance of the findings.

The study presents valuable insights but also acknowledges certain limitations that require further exploration. One of the primary constraints is the reliance on survey data, which, while informative, fails to capture the dynamic relationship between the evolving technologies of artificial intelligence and the changing market conditions within the Islamic finance sector. This limitation highlights the need for

future research to employ longitudinal studies or experimental designs that can examine the long-term effects of AI integration in Islamic finance, as well as better assess its evolving impact in real-world applications.

Although the study provides a well-detailed conceptual framework for AI integration in Islamic financial institutions, its practical utility remains largely untested due to the absence of empirical validation beyond descriptive analysis. To enhance the framework's applicability, future research should seek to test it through real-world implementations, such as pilot programs within Islamic financial institutions. This would offer empirical evidence on how effectively the framework enhances operational efficiency, transparency, and Sharia compliance. Methodologies like longitudinal studies, case studies, or experimental designs are essential to bridge the gap between theoretical propositions and practical application. Such approaches would provide robust evidence supporting the framework's efficacy, enabling it to guide AI adoption in Islamic finance in a manner that yields measurable and sustainable benefits.

Furthermore, the study acknowledges high implementation costs and the lack of structured datasets as significant barriers to AI adoption. While these challenges are identified, they remain insufficiently addressed in the study. Future research should explore more innovative solutions, such as public-private partnerships or open data ecosystems, to create accessible, standardized Shariah-compliant datasets. Additionally, comparative analyses between Islamic and conventional financial systems could offer insights into the unique ethical challenges and opportunities that arise in the integration of AI technologies. These comparisons may inform tailored solutions for Islamic finance, addressing both technological and ethical considerations in the AI adoption process.

Finally, innovative funding models, such as waqf-based financing, could offer a practical means of overcoming cost-related barriers for smaller institutions. Exploring these avenues will help ensure that AI technologies are not only scalable but also inclusive, supporting the integration of AI within Islamic finance on a broader scale. By addressing these gaps and exploring the intersections of technology, ethics, and institutional constraints, future research will be better positioned to advance the integration of artificial intelligence within the Islamic finance sector, ultimately enabling the sector to harness the full potential of these technologies while adhering to its ethical and cultural imperatives.

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