JOURNAL OF MANAGEMENT AND BUSINESS SOLUTIONS

Application of Machine Learning in Prioritizing the Components of Islamic Financial Management

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ABSTRACT

Prioritizing the influential components of Islamic financial management is one of the fundamental challenges facing researchers and policymakers in this field. Traditional methods are often based on expert judgment and qualitative approaches and are subject to limitations such as bias and lack of reproducibility. The present study aimed to provide a quantitative, data-driven approach for prioritizing the components of Islamic financial management using the XGBoost algorithm and the SHAP method. Data were collected from 382 questionnaires and analyzed using k-fold cross-validation. The findings showed that the XGBoost model achieved an accuracy of 89.2% and an AUC-ROC of 92.4%, indicating excellent predictive performance. SHAP-based prioritization showed that "distributive justice" (0.452), "prohibition of riba" (0.381), and "information transparency" (0.347) had the highest priorities, whereas "accountability to investors" (0.189) and "moderation in consumption" (0.207) had the lowest priorities. The findings demonstrate that a machine-learning approach can be used as a complementary tool and, in some cases, as an alternative to traditional prioritization methods in Islamic finance and can contribute to greater accuracy and objectivity in managerial decision-making.

Keywords: component prioritization, Islamic financial management, machine learning, XGBoost, SHAP, multi-criteria decision-making.

Introduction

Islamic financial management has increasingly developed into a distinct field of managerial and financial inquiry in which economic efficiency, institutional accountability, ethical conduct, and Shariah compliance are expected to operate simultaneously rather than as independent objectives. Unlike conventional financial management, which generally evaluates financial decisions primarily through criteria such as profitability, risk, liquidity, and shareholder value, Islamic financial management incorporates a broader normative framework derived from principles such as justice, prohibition of riba, avoidance of gharar, risk sharing, trustworthiness, social responsibility, transparency, and responsible consumption. Accordingly, the effectiveness of an Islamic financial system cannot be assessed solely by conventional financial indicators; it must also be examined in terms of the extent to which financial practices contribute to equitable economic relations, legitimate transactions, ethical governance, and socially responsible allocation of financial resources. Contemporary scholarship on Islamic banking and finance has therefore increasingly emphasized the need to move beyond formal compliance and to evaluate whether financial institutions actually reflect the substantive purposes of Islamic finance (1-3).

Article history:
Received 09 July 2025
Revised 27 August 2025
Accepted 14 October 2025
Published online 01 November 2025

How to cite this article:
Fazlollahi, A., Soufi, M., & Kheradiar, S. (2025). Application of Machine Learning in Prioritizing the Components of Islamic Financial Management. *Journal of Management and Business Solutions, 3*(6), 1-18. https://doi.org/10.61838/jmbs.449

This broader understanding is particularly important because Islamic finance is not merely a collection of contractual prohibitions or permissible financial instruments. Rather, it represents an integrated financial system in which economic activities are expected to be consistent with the objectives of Shariah and with principles of distributive justice, financial responsibility, ethical intermediation, and protection of stakeholders. Research on Islamic financial systems has emphasized that the legitimacy and efficiency of Islamic finance depend on the simultaneous fulfillment of economic and normative requirements (4, 5). From this perspective, the prohibition of riba is fundamental, but it is not sufficient by itself to establish an effective Islamic financial management system. Other dimensions, including transparency, accountability, avoidance of excessive uncertainty, fair distribution of resources, and responsible ownership, are also relevant to the quality of financial governance. The contemporary critique of Islamic finance has similarly argued that excessive concentration on the formal replication of conventional financial products through Shariah-compliant contractual structures may weaken the social and ethical foundations of the Islamic financial paradigm (2, 3).

The increasing complexity of financial institutions has further intensified the need for systematic approaches to evaluating and prioritizing these components. Islamic financial institutions operate in environments characterized by technological transformation, financial innovation, changing customer expectations, new governance requirements, and increasingly complex regulatory structures. Shariah governance has consequently emerged as a central institutional mechanism for ensuring that financial activities remain consistent with Islamic principles while also maintaining organizational credibility and stakeholder confidence. Research has shown that effective Shariah governance depends not only on the presence of supervisory boards or formal compliance procedures but also on institutional transparency, independence, disclosure quality, internal control, and accountable decision-making (6, 7). Shariah-related disclosure is particularly important because stakeholders cannot evaluate the religious and ethical legitimacy of financial practices without access to sufficient, reliable, and understandable information (7). Thus, information transparency and Shariah supervision are not merely complementary administrative practices but essential components of the institutional architecture of Islamic financial management.

At the same time, the expansion of Islamic banking and Islamic financial technology has created new opportunities and new governance challenges. Digitalization, blockchain, artificial intelligence, and financial technology applications are transforming financial intermediation, customer services, reporting systems, risk assessment, and decision-making. Blockchain-based systems, for example, have been discussed as mechanisms that can enhance transparency, traceability, and trust while supporting broader sustainability objectives (8, 9). Similarly, Islamic FinTech has expanded access to financial products and introduced new forms of digital financial interaction, although its adoption depends on factors such as perceived usefulness, trust, compatibility, regulatory support, and religious legitimacy (10). These technological developments make the prioritization of Islamic financial management components even more consequential because institutions must determine which ethical, governance, and financial principles should receive the greatest managerial attention when designing digitally enabled financial systems.

Artificial intelligence has become particularly relevant in this context. Recent studies suggest that AI can improve operational efficiency, customer analytics, reporting quality, financial decision-making, and risk management in Islamic banking, while simultaneously creating concerns regarding accountability, algorithmic bias, transparency, and regulatory oversight (11-13). The integration of AI into Islamic finance raises an important methodological and governance question: how can sophisticated predictive technologies be employed without undermining the

interpretability and normative accountability expected from Islamic financial institutions? This question is particularly significant because financial decisions influenced by opaque algorithms may be difficult for managers, regulators, Shariah scholars, and investors to evaluate. Accordingly, AI applications in Islamic finance require not only predictive accuracy but also explainability, governance standards, and oversight mechanisms consistent with both financial regulation and Islamic ethical principles (12, 13).

These developments also highlight a more general methodological challenge in Islamic financial management research. Many studies seeking to identify or rank important managerial, financial, or Shariah-related components rely heavily on expert judgments, qualitative coding, conventional weighting methods, or multi-criteria decision-making techniques. Such approaches are valuable, especially where normative judgment and specialist knowledge are indispensable, but their outputs may be sensitive to expert composition, subjective weighting, linguistic uncertainty, and methodological assumptions. Fuzzy expert-based multi-criteria models have been increasingly applied to complex financial evaluation problems and provide an important framework for incorporating uncertainty and expert reasoning (14). Likewise, research in management has long demonstrated the usefulness of structured models for identifying organizational dimensions, evaluating complex performance systems, and integrating multiple criteria into managerial decision-making (15, 16). Nevertheless, when sufficiently large empirical datasets are available, data-driven methods can provide an additional source of evidence regarding which components contribute most strongly to predictive outcomes.

The growing availability of organizational and questionnaire data therefore creates an opportunity to complement conventional prioritization techniques with machine-learning algorithms. Machine learning is particularly valuable when relationships among variables are nonlinear, interactive, or difficult to specify through traditional parametric models. Ensemble learning approaches can combine multiple predictive structures and often outperform single-model techniques in complex classification settings (17). Related applications in management and organizational research have also demonstrated that computational intelligence methods such as adaptive neuro-fuzzy inference systems and fuzzy inference systems can be used effectively for performance evaluation and the assessment of multidimensional organizational constructs (16, 18). These developments suggest that computational methods can extend beyond forecasting tasks and can support the evaluation and prioritization of managerial components.

Among machine-learning algorithms, Extreme Gradient Boosting, commonly known as XGBoost, has become particularly prominent because of its strong predictive performance, capacity to model nonlinear associations, ability to capture interactions among features, and effectiveness with structured tabular data. XGBoost iteratively builds decision trees in a gradient boosting framework in which successive learners correct errors produced by previous trees. Its regularization mechanisms and flexible hyperparameter structure can help control model complexity while maintaining high predictive accuracy. In financial applications, XGBoost has been successfully applied to prediction, classification, and risk-related problems. For example, its use in forecasting gold prices has demonstrated its capacity to model complex financial relationships, particularly when combined with interpretation techniques capable of identifying influential variables and feature interactions (19). XGBoost has likewise been used in financial fraud detection, where explainability methods have been integrated with the classifier to provide more transparent and interpretable predictions (20).

However, high predictive accuracy alone is insufficient when the research objective is to identify and prioritize meaningful components. One of the principal criticisms of advanced machine-learning models is their limited intrinsic interpretability. A model may classify observations accurately without clearly indicating why a particular

prediction was generated or why one feature was more influential than another. This limitation is particularly problematic in financial management, where decisions often require justification to managers, investors, auditors, regulators, and other stakeholders. The increasing use of artificial intelligence in finance has therefore led to the rapid development of explainable artificial intelligence (XAI), which aims to make complex computational models more understandable without necessarily sacrificing predictive performance (21, 22).

One of the most influential developments in explainable machine learning is SHAP, or SHapley Additive exPlanations. SHAP provides a theoretically grounded approach to allocating a model prediction among its input features by drawing on Shapley values from cooperative game theory. It allows researchers to examine both the magnitude and direction of each feature's contribution to a prediction and to aggregate these local contributions to estimate global feature importance (23). In tree-based models, TreeSHAP enables efficient computation of SHAP values and has therefore become particularly useful for interpreting models such as XGBoost. In financial applications, SHAP has been used not only to rank variables but also to identify interaction effects and clarify the mechanisms underlying predictions (19, 20). Recent reviews of explainable AI in finance have emphasized the importance of SHAP and related methods in increasing model transparency, although they also caution that explainability should not be confused with causal inference (21, 22).

This distinction between predictive importance and causal or normative importance is especially crucial in Islamic financial management. A component that receives a high SHAP value is influential in the model's predictions within the observed data, but this does not mean that the component is religiously superior, normatively more binding, or causally determinative. Islamic principles derive their normative status from jurisprudential and ethical foundations, not from machine-learning feature importance. Accordingly, data-driven prioritization should be understood as an empirical managerial tool that can complement, rather than replace, Shariah scholarship and expert judgment. This complementary perspective is consistent with broader management research in which technology, knowledge, leadership, organizational innovation, and ethical behavior are treated as interconnected determinants of institutional performance (24-27). In other words, algorithmic evidence may support managerial decision-making, but interpretation remains embedded in the institutional and ethical context within which the model is applied.

A further reason for adopting a data-driven prioritization framework is the growing emphasis on evidence-based management. Financial managers increasingly operate in environments where decisions must be supported by reproducible analytical evidence rather than intuition alone. Digital transformation initiatives, blockchain implementation, knowledge-based management, and technology-driven organizational change all require structured frameworks for identifying the factors that contribute most strongly to desired outcomes (24, 28). Research on blockchain implementation in organizational and supply-chain contexts similarly illustrates the importance of integrating technological, structural, managerial, and governance considerations rather than evaluating new technologies as isolated technical tools (28). For Islamic financial institutions, the same logic implies that new analytical technologies should be incorporated in ways that enhance rather than weaken accountability, transparency, and Shariah consistency.

Despite the expanding literature on Islamic banking, Shariah governance, Islamic FinTech, financial AI, and explainable machine learning, relatively limited attention has been devoted to using supervised machine-learning models specifically to prioritize the constituent principles of Islamic financial management on the basis of empirical questionnaire data. Existing Islamic finance research has extensively addressed institutional development, Shariah governance, disclosure, FinTech adoption, financial instruments, and the substantive objectives of Islamic banking

(1, 5, 6, 10). Meanwhile, computational research has developed advanced tools for prediction, performance evaluation, and model interpretation (17, 19, 23). The intersection of these two streams remains comparatively underdeveloped. In particular, there is a methodological gap concerning whether an interpretable machine-learning framework can identify the relative predictive importance of principles such as distributive justice, prohibition of riba, transparency, Shariah supervision, trustworthiness, risk sharing, social responsibility of ownership, avoidance of gharar, moderation in consumption, and accountability to investors.

Addressing this gap has both theoretical and practical significance. Theoretically, an interpretable machine-learning approach can provide empirical evidence regarding the relative predictive contribution of Islamic financial management components without assuming linear relationships among them. Practically, such an approach can help managers and policymakers identify which dimensions carry the greatest information for distinguishing the target outcome and can therefore guide the allocation of attention, monitoring capacity, training, and governance resources. At the same time, the use of SHAP can reduce the opacity normally associated with complex machine-learning models by showing how individual features contribute to model predictions. This is particularly important in a field where transparency, accountability, and ethical legitimacy are themselves substantive elements of good financial governance (7, 12). The methodological integration of XGBoost and SHAP therefore offers a potentially useful bridge between high-performance predictive analytics and the interpretability requirements of Islamic financial management.

Accordingly, the aim of the present study is to develop and evaluate an XGBoost–SHAP-based machine-learning framework for prioritizing the components of Islamic financial management according to their relative predictive importance.

Methods and Materials

The data were analyzed in Python using the XGBoost library (version 1.7.5). The analytical process was designed in four main stages: data preparation, model training and validation, performance evaluation, and interpretation of model results (Kamali et al., 2025).

Stage 1: Data Preparation

In the first step, the data were examined for response completeness, missing values, and outliers. Multivariate outliers were identified using Mahalanobis distance, and after statistical and substantive examination, the identified cases were excluded from the final analysis. Subsequently, the data were standardized using z-scores. Although standardization is not required for tree-based algorithms such as XGBoost, this step was performed to ensure consistency in the data-preparation procedure. To prevent data leakage, all parameters related to outlier identification and standardization were calculated exclusively from the training data and were subsequently applied to the test set.

Following preprocessing, the data were stratified and divided into training and test sets, with 80% of the data allocated to model training and 20% reserved for final model evaluation. The test set remained completely untouched throughout the model-training and tuning process. To enhance the reproducibility of the results, the random seed was set to 42.

Stage 2: Model Training and Validation

At this stage, the XGBoost classification model was used to identify nonlinear patterns and potential interactions between the components of Islamic financial management and the target variable. The main model settings are presented in Table 1.

Table 1. Main Settings of the XGBoost Model

Hyperparameter	Value	Role in the Model
n_estimators	100	Number of decision trees in the gradient boosting process
max_depth	6	Maximum depth of each tree, controlling model complexity and feature interactions
learning_rate	0.1	Learning rate determining the contribution of each new tree to correcting previous errors
subsample	0.8	Proportion of randomly sampled training observations used to construct each tree
colsample_bytree	0.8	Proportion of randomly selected features considered for splitting in each tree
random_state	42	Random seed used to control stochastic processes and enhance reproducibility

To assess model stability, five-fold stratified cross-validation was performed on the training set. In each iteration, four folds were used for training and one fold for validation, and the mean and standard deviation of the performance metrics were calculated across the five folds. After completion of the cross-validation procedure, the final model was fitted using the entire training dataset, and its performance was evaluated on the independent test set.

Stage 3: Model Performance Evaluation

Model performance was evaluated using accuracy, precision, recall, F1-score, and the area under the receiver operating characteristic curve (AUC-ROC). Accuracy represents the proportion of correct predictions among all predictions:

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

Precision represents the proportion of correctly predicted positive cases among all cases predicted as positive:

$$\text{Precision} = \frac{TP}{TP + FP}$$

Recall indicates the model's ability to identify actual positive cases:

$$\text{Recall} = \frac{TP}{TP + FN}$$

To simultaneously evaluate precision and recall, the F1-score was calculated as their harmonic mean:

$$F1 = 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

In addition, AUC-ROC was calculated based on the predicted probability of the positive class and reflects the model's ability to discriminate between classes across different decision thresholds. Therefore, AUC should not be interpreted as classification accuracy. Other label-based metrics, including accuracy, precision, recall, and F1-score, were calculated based on the decision threshold specified in the model.

Stage 4: Model Interpretation and Component Importance

To interpret the model and determine the relative importance of the components, the SHAP method and the TreeSHAP algorithm were employed. A SHAP value indicates the magnitude and direction by which each feature

changes the model's predicted output relative to the baseline value, that is, the mean model prediction. The overall importance of each component was calculated based on the mean absolute SHAP value:

$$\text{Importance}_j = \frac{1}{n}\sum_{i=1}^{n}|\phi_{ij}|$$

In this equation, Importance_j represents the overall importance of component j, n represents the number of observations, and ϕ_{ij} represents the SHAP value of component j for observation i. The relative importance of each component was then calculated using the following equation:

$$\text{Relative Importance}_j = \frac{\text{Importance}_j}{\sum_{j=1}^{p}\text{Importance}_j} \times 100$$

Accordingly, the components were ranked on the basis of their mean absolute SHAP values. It should be emphasized that this ranking represents only the predictive importance of the components within the model and the dataset under investigation and should not be interpreted as indicating causal relationships, normative weights, or definitive priorities under Islamic law. In addition, to interpret the direction of each component's effect, the signs of the SHAP values and the corresponding plots were examined, as presented below.

Algorithm 1: XGBoost–SHAP-Based Prioritization Procedure

Input:

D = Dataset containing 382 valid questionnaire records

Q = 37 questionnaire items grouped into 10 Islamic finance components

Y = Binary target variable

θ = XGBoost hyperparameters:

n_estimators = 100

max_depth = 6

learning_rate = 0.1

subsample = 0.8

colsample_bytree = 0.8

random_state = 42

Output:

M = Model performance metrics

R = SHAP-based ranking of the components

1. Remove incomplete and invalid responses from D.
2. For each observation i in D:

Calculate the Mahalanobis distance MD_i.

3. Identify and remove multivariate outliers according to the predefined Mahalanobis criterion.
4. Aggregate the questionnaire items into ten component scores and construct the feature matrix X.
5. Divide (X, Y) into:

Training set = 80%

Test set = 20%

using random_state = 42.

6. Apply five-fold stratified cross-validation to the training set.

7. For k = 1 to 5:

Train an XGBoost classifier using θ on four training folds.

Predict the validation fold.

Calculate Accuracy_k.

8. Calculate:

Mean_CV_Accuracy = mean(Accuracy_1, ..., Accuracy_5)

SD_CV_Accuracy = standard deviation(Accuracy_1, ..., Accuracy_5)

9. Train the final XGBoost model on the complete training set.

10. Generate class probabilities and class predictions for the test set.

11. Calculate the following performance metrics:

Accuracy

Precision

Recall

F1-Score

AUC-ROC

12. Initialize a TreeExplainer for the final XGBoost model.

13. Calculate SHAP values for the test observations.

14. For each component j = 1, ..., 10:

Importance_j = mean absolute SHAP value of component j

15. Calculate the relative importance of each component:

Relative_Importance_j =

(Importance_j / sum of all Importance values) × 100

16. Sort the components in descending order according to Relative_Importance_j.

17. Return:

Model performance metrics

Cross-validation results

SHAP-based component ranking

Findings and Results

To evaluate the performance of the XGBoost model, accuracy, precision, recall, F1-score, and AUC-ROC were calculated. As shown in Table 2, the model achieved an accuracy of 0.892 on the test set, indicating that 89.2% of the observations were correctly classified. The precision value of 0.875 indicates that, among the observations classified by the model as positive, 87.5% actually belonged to the positive class. Furthermore, the recall value of 0.863 indicates that the model successfully identified 86.3% of the actual positive observations.

The F1-score was 0.869, indicating an appropriate balance between precision and recall. This is important because evaluating model performance solely on the basis of accuracy may provide an incomplete representation when class imbalance exists. In addition, the AUC-ROC value of 0.924 indicates that the model had a strong ability

to discriminate between the two target classes across different decision thresholds. Because AUC is independent of any single decision threshold, this value reflects the model's high discriminatory power and should not be interpreted as "92.4% classification accuracy."

The results of five-fold cross-validation further showed that the model had a mean accuracy of 0.890 with a standard deviation of 0.006. The low standard deviation indicates that model performance was relatively stable across different data folds. However, this result alone does not establish the complete absence of overfitting; rather, it indicates only the stability of the model's performance during the cross-validation procedure. For a more definitive assessment of model generalizability, the performance of the training and test datasets, the confusion matrix, and, where possible, external validation should also be reported.

Table 2. Performance Evaluation Metrics of the XGBoost Model

Metric	Value	Interpretation
Accuracy	0.892	Proportion of correct predictions among all predictions
Precision	0.875	Proportion of correct positive predictions among all positive predictions
Recall	0.863	Proportion of actual positive cases correctly identified
F1-Score	0.869	Harmonic mean of precision and recall
AUC-ROC	0.924	Ability of the model to discriminate between classes across different thresholds
Mean five-fold cross-validation accuracy	0.890	Mean model performance across the five validation folds
Standard deviation of accuracy	0.006	Variability of model performance across different folds

Overall, the combined findings indicate that the XGBoost model demonstrated satisfactory predictive performance in the dataset used in this study. However, the model's favorable performance does not imply that the identified components have causal relationships with Islamic financial management; rather, it indicates that these components provided useful information for predicting the target class.

After training the XGBoost model, the SHAP method was used to interpret the model output and determine the relative importance of the components of Islamic financial management. The components were ranked based on the mean absolute SHAP values. This measure indicates the extent to which each component contributes to changes in the model's predicted output, irrespective of whether the direction of its effect is positive or negative.

According to the results presented in Table 3, "distributive justice," with a mean absolute SHAP value of 0.452, was the most important component in the model. It was followed by "prohibition of riba," with a value of 0.381, and "information transparency," with a value of 0.347, which ranked second and third, respectively. "Shariah supervision," "trustworthiness," and "risk sharing" ranked fourth through sixth, respectively.

At the lowest positions in this ranking were "accountability to investors," with a value of 0.189, "moderation in consumption," with a value of 0.207, and "avoidance of gharar," with a value of 0.228. The lower ranking of these components does not imply that they are unimportant from either an Islamic jurisprudential or managerial perspective; rather, it indicates only that their relative contributions to predicting the target variable were smaller in the dataset examined in this study.

Table 3. Ranking of Components Based on Mean Absolute SHAP Values

Rank	Component	Mean Absolute SHAP	Relative Importance (%)
1	Distributive justice	0.452	15.6
2	Prohibition of riba	0.381	13.1
3	Information transparency	0.347	12.0
4	Shariah supervision	0.315	10.9
5	Trustworthiness	0.284	9.8

6	Risk sharing	0.256	8.8
7	Social responsibility of ownership	0.243	8.4
8	Avoidance of gharar	0.228	7.9
9	Moderation in consumption	0.207	7.1
10	Accountability to investors	0.189	6.5

The results indicate that the three highest-ranking components—distributive justice, prohibition of riba, and information transparency—collectively accounted for 40.7% of the model's normalized importance. This concentration indicates that, among the components examined, principles related to economic justice, the Shariah legitimacy of transactions, and access to transparent information had the greatest predictive power in explaining the target class.

The first-place ranking of distributive justice reflects the importance of the distributive consequences of financial activities in the evaluation of Islamic financial management. From this perspective, Islamic finance is not limited merely to the elimination of interest-based transactions; it should also address the reduction of discrimination, the equitable distribution of financial opportunities, and support for vulnerable groups. The second-place ranking of the prohibition of riba likewise confirms the position of this principle as one of the most important distinguishing features of Islamic finance. Nevertheless, this finding should not be interpreted as indicating that other contracts or Shariah principles are less important; rather, it indicates that the prohibition of riba had greater discriminatory power with respect to the model output in the study data.

The third-place ranking of information transparency highlights the importance of access to complete, accurate, and reliable information in Islamic financial management. Transparency facilitates effective supervision, reduces information asymmetry, enhances investor trust, and helps control opportunistic behavior. Furthermore, the high rankings of Shariah supervision and trustworthiness indicate that the implementation of Islamic financial principles depends on effective supervisory mechanisms and the ethical conduct of managers.

Risk sharing and the social responsibility of ownership occupied intermediate positions in the ranking. This result may indicate that respondents considered these components important but perceived their significance as being partly dependent on the realization of more fundamental principles such as justice, transparency, and Shariah supervision. In contrast, the lower rankings of avoidance of gharar, moderation in consumption, and accountability to investors may be attributable to conceptual overlap with other components, differences in respondents' interpretations, or the limited discriminatory power of these variables within the study dataset.

Discussion and Conclusion

The present study sought to prioritize the components of Islamic financial management using an interpretable machine-learning framework based on XGBoost and SHAP. The results showed that the XGBoost model achieved satisfactory predictive performance, with an accuracy of 0.892, precision of 0.875, recall of 0.863, F1-score of 0.869, and AUC-ROC of 0.924. The five-fold cross-validation results also yielded a mean accuracy of 0.890 with a low standard deviation of 0.006, indicating relatively stable model performance across validation folds. More importantly, SHAP-based analysis showed that distributive justice, prohibition of riba, and information transparency had the highest predictive importance, followed by Shariah supervision, trustworthiness, risk sharing, social responsibility of ownership, avoidance of gharar, moderation in consumption, and accountability to investors. These

findings suggest that the predictive structure of Islamic financial management in the present dataset is concentrated primarily around principles related to economic justice, transactional legitimacy, and information quality.

The favorable predictive performance of XGBoost confirms the suitability of nonlinear machine-learning methods for analyzing multidimensional financial-management data. Islamic financial management consists of interacting ethical, institutional, behavioral, and financial components whose relationships may not necessarily be linear or additive. Conventional statistical techniques may therefore fail to capture complex interactions among these dimensions. The current findings are consistent with the broader literature showing that ensemble and machine-learning approaches can provide high predictive accuracy in multidimensional decision environments (16-18). In financial applications specifically, XGBoost has demonstrated strong capacity for handling complex data structures, identifying nonlinear relationships, and producing robust predictive outcomes (19, 20). The relatively high AUC-ROC obtained in this study further indicates that the model was able to distinguish effectively between the two target classes across alternative decision thresholds rather than performing well only at a single classification cutoff.

The stability of model performance across the five cross-validation folds also strengthens confidence in the analytical framework. The low standard deviation of cross-validation accuracy suggests that predictive performance was not highly dependent on a particular partition of the training data. This is particularly relevant in questionnaire-based management research, where moderate sample sizes can make model estimates sensitive to sample composition. The use of cross-validation therefore reduced dependence on a single training-validation split and provided a more defensible estimate of predictive consistency. Similar methodological logic underlies the use of ensemble learning and computational intelligence methods in organizational and performance-evaluation studies, where validation procedures are essential for distinguishing genuine predictive structure from model-specific fitting (17, 18). Nevertheless, the present findings should still be interpreted as evidence of predictive stability rather than proof that overfitting was entirely absent.

A central contribution of this study lies in the use of SHAP to move beyond aggregate predictive performance and identify the relative contribution of individual Islamic financial management components. The highest-ranked component was distributive justice, with a mean absolute SHAP value of 0.452 and a relative importance of 15.6%. This finding indicates that differences in distributive justice provided the greatest amount of predictive information for the model among the ten examined components. Conceptually, this result is highly consistent with the broader logic of Islamic finance, which emphasizes that financial activity should contribute not merely to contractual legality but also to fairness, equitable access to economic opportunities, and balanced distribution of resources. The finding aligns with studies that conceptualize Islamic finance as an economic framework embedded in broader objectives of justice and social welfare rather than as a narrowly technical system of interest-free transactions (2, 4). It is also compatible with contemporary Maqasid al-Shariah-oriented interpretations of Islamic banking, which emphasize that the substantive legitimacy of Islamic finance depends on the realization of ethical and social objectives, including fairness and societal benefit (3).

The prominence of distributive justice can also be interpreted as evidence that respondents associate effective Islamic financial management with outcomes rather than only with formal procedural compliance. From this perspective, the Islamic character of financial management is evaluated partly in terms of whether financial resources, opportunities, risks, and benefits are distributed fairly among stakeholders. This interpretation is consistent with critiques of contemporary Islamic finance that warn against reducing Shariah compliance to legal form while neglecting broader economic consequences (2). The result therefore supports a substantive

understanding of Islamic financial management in which ethical outcomes are integrated with institutional and contractual structures. It also suggests that managers seeking to improve Islamic financial management should not focus exclusively on product-level compliance but should evaluate how financial policies affect different stakeholder groups.

The second-ranked component was prohibition of riba, with a mean absolute SHAP value of 0.381 and relative importance of 13.1%. This result is unsurprising given the foundational role of riba prohibition in distinguishing Islamic finance from conventional interest-based finance. The finding is consistent with the established Islamic banking literature, in which avoidance of interest-based transactions constitutes one of the central structural principles of Islamic financial intermediation (1). It also corresponds with research emphasizing the importance of designing financial instruments in accordance with Islamic jurisprudential requirements rather than merely replicating conventional financial contracts under different labels (5). The high ranking of riba prohibition therefore confirms that respondents continue to perceive transactional legitimacy as a defining criterion of Islamic financial management.

However, the fact that distributive justice ranked above prohibition of riba is also theoretically meaningful. It implies that, within the empirical structure captured by the model, respondents may have interpreted Islamic financial management more broadly than formal avoidance of interest. In other words, the effectiveness of Islamic finance appears to depend not only on excluding prohibited contractual elements but also on realizing desirable social and distributive consequences. This pattern is compatible with contemporary arguments that Islamic banking should be reoriented toward the higher objectives of Shariah rather than evaluated solely through legalistic compliance (3). Thus, the ranking does not reduce the jurisprudential importance of riba prohibition; instead, it suggests that distributive justice may carry greater predictive differentiation within the specific managerial perceptions represented in the present data.

Information transparency ranked third, with a mean absolute SHAP value of 0.347 and relative importance of 12.0%. This result highlights the importance of reliable, complete, and accessible information in Islamic financial management. Transparency reduces information asymmetry, facilitates monitoring, strengthens accountability, and enhances stakeholder confidence. In Islamic finance, these functions acquire additional importance because investors and other stakeholders need information not only about financial performance but also about the Shariah legitimacy of transactions and institutional practices. The finding is strongly supported by the literature on Shariah-related disclosure, which identifies disclosure quality as a critical mechanism for strengthening accountability and enabling stakeholders to evaluate compliance with Islamic principles (7). It is also consistent with studies showing that governance standards and AI-supported financial reporting can improve information quality and institutional transparency in Islamic banking (12).

The importance of information transparency is further reinforced by the ongoing digital transformation of financial services. As Islamic banking increasingly adopts artificial intelligence, blockchain, and FinTech platforms, financial decision processes may become faster and more efficient but also more technically complex. This complexity can increase informational opacity unless institutions adopt strong disclosure and explainability mechanisms. Previous research has shown that blockchain-based systems may contribute to traceability and transparency in financial transactions (8, 9), while AI can enhance financial reporting and banking operations when embedded within appropriate governance structures (11, 12). Accordingly, the high ranking of information transparency in the present

study is consistent with a broader shift toward data-intensive financial systems in which trust depends increasingly on the availability and interpretability of reliable information.

Shariah supervision ranked fourth and therefore emerged as another highly influential component. This result supports the proposition that Islamic financial management requires institutionalized mechanisms for reviewing, monitoring, and validating the conformity of financial operations with Shariah principles. Shariah governance is not limited to ex ante approval of financial products; it also includes ongoing supervision, internal control, disclosure, and accountability. The current finding is consistent with systematic evidence indicating that effective Shariah governance is central to the credibility and legitimacy of Islamic banking institutions (6). It also aligns with research emphasizing the need for stronger oversight in the application of artificial intelligence within Islamic finance, particularly where algorithmic systems may influence financial decisions that carry both regulatory and Shariah implications (13).

Trustworthiness ranked fifth, indicating that ethical managerial conduct remains an important predictive component of Islamic financial management. Trustworthiness is particularly relevant in financial relationships characterized by information asymmetry and delegated authority. Managers, financial intermediaries, and institutional decision-makers exercise control over resources belonging to depositors, investors, and other stakeholders, making ethical conduct essential to maintaining legitimacy. This result is consistent with management studies demonstrating that ethical leadership, responsible managerial behavior, and institutional culture influence organizational outcomes and employee behavior (25, 27). It is also compatible with the broader knowledge-management literature showing that organizational performance is influenced not only by formal structures but also by behavioral and relational components (26). In Islamic financial management, trustworthiness may therefore function as the behavioral counterpart to formal Shariah governance.

Risk sharing occupied the sixth position. Although it ranked below justice, riba prohibition, transparency, supervision, and trustworthiness, its position remains substantively important because risk sharing represents a fundamental economic logic of Islamic finance. Islamic financial structures are often distinguished from debt-based conventional arrangements by emphasizing the sharing of financial risk and reward among contracting parties. The result is consistent with the broader Islamic banking literature, which identifies risk-sharing mechanisms as central to the theoretical identity of Islamic financial intermediation (1). Nevertheless, its intermediate ranking may reflect the fact that respondents regard risk sharing as one mechanism through which higher-order principles such as justice and legitimate exchange are implemented rather than as an independent overarching criterion.

Social responsibility of ownership ranked seventh, suggesting that respondents recognized the social obligations associated with ownership and financial control but attributed somewhat less predictive weight to this component than to the core governance and transactional dimensions. This finding remains consistent with the normative orientation of Islamic finance toward responsible economic activity and social welfare (3, 4). It may also reflect growing attention to sustainability and social outcomes in Islamic banking. Studies evaluating the sustainability performance of Islamic banks increasingly treat economic, social, governance, and efficiency dimensions as interconnected components of institutional success (14). In this context, social responsibility of ownership can be understood as linking financial decision-making to broader stakeholder and societal consequences.

Avoidance of gharar ranked eighth. The relatively lower predictive importance of this principle should not be interpreted as evidence of reduced jurisprudential significance. Rather, it may indicate that variation in respondents' perceptions of gharar avoidance contributed less to differentiating the target classes than other components. One

possible explanation is conceptual overlap with transparency, disclosure, and transactional legitimacy. Since gharar is associated with excessive uncertainty and ambiguity in contractual relationships, improvements in transparency and information quality may already capture part of the practical variance associated with this principle. Research on Islamic financial instrument design emphasizes the need to incorporate jurisprudential criteria systematically into financial structures (5), while contemporary digital-finance research similarly highlights the importance of clear contractual structures and trusted technological environments (9, 10). Thus, the lower SHAP ranking may reflect shared predictive information rather than substantive irrelevance.

Moderation in consumption ranked ninth. This component represents a broader ethical dimension of Islamic economic behavior and may operate more indirectly than governance, transparency, or transactional principles. Its relatively low predictive contribution may be due to the fact that consumption moderation concerns behavioral orientation and value-based decision-making rather than formal financial-management structures. It may also be less directly observable in organizational settings. Nonetheless, its inclusion remains theoretically justified because Islamic financial management extends beyond institutional transactions to responsible use of financial resources. The broader Islamic finance literature increasingly calls for greater alignment between financial systems and the ethical and social purposes of Islamic economics (2, 3). Therefore, its lower predictive rank should be interpreted as a dataset-specific empirical finding rather than a normative judgment.

Accountability to investors had the lowest mean absolute SHAP value. This finding may initially appear surprising because accountability is a central principle of sound financial governance. However, the result may indicate that accountability to investors overlaps conceptually with transparency, trustworthiness, and Shariah supervision, which were ranked substantially higher. When predictors contain related information, machine-learning models may distribute predictive contribution unevenly among correlated features. Therefore, a relatively low SHAP value does not necessarily imply that investor accountability is unimportant. Previous research on Shariah disclosure and governance clearly identifies accountability as a central institutional requirement (6, 7). Similarly, research in public and organizational financial management emphasizes the importance of accountability-oriented structures in improving financial governance and performance (15). The present result therefore suggests lower incremental predictive importance rather than lower managerial or ethical value.

The methodological use of SHAP also deserves attention. Unlike conventional feature-importance measures that may provide only aggregate rankings, SHAP offers a theoretically grounded framework for assessing the contribution of each variable to model predictions. This property is particularly valuable in financial management, where the practical acceptability of machine learning depends increasingly on interpretability. The present application is consistent with the foundational work on SHAP as a unified framework for interpreting machine-learning predictions (23). It also aligns with recent financial studies that have used SHAP to interpret XGBoost models and explain the relative contribution and interaction of predictive variables (19, 20). Systematic reviews of explainable AI in finance similarly emphasize that model transparency is essential for increasing trust, regulatory acceptability, and managerial usefulness (21, 22).

The findings therefore support the argument that explainable machine learning can complement conventional expert-based and multi-criteria approaches to prioritization. Traditional decision-support methods remain highly valuable because Islamic financial management contains normative dimensions that cannot be reduced to statistical prediction. Fuzzy multi-criteria models, for example, are particularly useful when expert judgment and uncertainty are central to evaluation (14). Similarly, fuzzy inference and structured management models have been used

successfully to evaluate organizational innovation, performance, and complex institutional dimensions (15, 16). The contribution of the present framework is not to replace these methods but to provide an empirical complement based on observed predictive relationships. Such integration may enable researchers to compare normative expert priorities with data-driven predictive priorities and thereby identify areas of convergence or divergence.

The findings are also relevant to the technological transformation of Islamic finance. The growing use of AI in Islamic banking creates a need for methods that are both powerful and interpretable. AI can improve operational efficiency and decision quality, but insufficient explainability may create governance and oversight risks (11, 13). The present XGBoost–SHAP framework illustrates how machine-learning models can be used in a manner that preserves a degree of transparency by explicitly identifying which factors contribute most strongly to predictions. This approach is consistent with emerging arguments that financial AI should be integrated with governance structures rather than deployed as an opaque technical mechanism (12, 21). It also corresponds with wider technological transformation research showing that successful implementation of digital technologies depends on the interaction of technical, managerial, organizational, and governance factors (24, 28).

Overall, the study demonstrates that the architecture of Islamic financial management reflected in the present data is not dominated by a single doctrinal principle. Rather, the highest predictive importance is distributed across justice, Shariah legitimacy, transparency, supervision, and ethical behavior. This pattern reinforces the view that effective Islamic financial management should be treated as a multidimensional governance system rather than a narrow framework for avoiding prohibited transactions. The results are broadly consistent with contemporary Islamic finance literature calling for greater integration of Maqasid al-Shariah, governance, disclosure, ethical conduct, and technological accountability (1, 3, 6, 13). At the same time, the study extends this literature by showing how explainable machine learning can empirically rank these dimensions according to their predictive contribution while preserving an explicit distinction between predictive importance and religious or causal priority.

This study has several limitations that should be considered when interpreting the findings. First, the analysis was based on 382 questionnaire records, and although this sample was sufficient for the implemented machine-learning procedure, the findings remain dependent on the characteristics of the sampled respondents and may not be generalizable to all Islamic financial institutions, sectors, or national contexts. Second, the study relied on self-reported questionnaire data, which may be affected by social desirability, response styles, and perceptual bias. Third, the target variable was binary, which necessarily simplified a potentially multidimensional phenomenon and may have reduced the amount of information captured by the model. Fourth, the ranking was based on mean absolute SHAP values and therefore represents predictive contribution rather than causal effects, jurisprudential significance, or normative priorities. Fifth, conceptual overlap among components such as transparency, accountability, avoidance of gharar, and Shariah supervision may have influenced the distribution of feature importance. Finally, although cross-validation indicated stable performance, the model was not evaluated using an external dataset, and therefore its transportability to different institutional or cultural settings remains uncertain.

Future studies should replicate the proposed framework using larger and more heterogeneous samples drawn from Islamic banks, investment institutions, insurance companies, public financial organizations, and FinTech platforms in different countries. Researchers could also employ multiclass or continuous outcome variables rather than binary targets to capture more nuanced levels of Islamic financial management effectiveness. Comparative analyses between XGBoost and other algorithms, including random forests, LightGBM, CatBoost, neural networks, and stacked ensemble models, would help determine whether the observed rankings are robust across alternative

modeling strategies. Future research should also examine SHAP dependence and interaction values to identify nonlinear thresholds and interactions among principles such as distributive justice, transparency, and Shariah supervision. Longitudinal designs could be used to assess whether the predictive importance of components changes over time or following regulatory and technological reforms. In addition, studies could combine machine-learning rankings with expert-based techniques such as fuzzy AHP, DEMATEL, or Delphi methods to compare empirical predictive importance with normative expert judgment. External validation across different countries and Islamic jurisprudential environments would also be valuable for assessing the stability and generalizability of the proposed prioritization framework.

Managers of Islamic financial institutions should use the findings as a decision-support framework rather than as a fixed normative hierarchy. Particular managerial attention should be given to distributive justice, prohibition of riba, information transparency, and Shariah supervision because these components demonstrated the greatest predictive contribution in the present analysis. Institutions can translate these priorities into clearer policies for equitable access to financial services, stronger screening of interest-related practices, enhanced disclosure systems, and more effective Shariah monitoring. Investment in transparent data infrastructures and explainable analytical systems may also improve accountability when machine-learning tools are introduced into financial decision-making. Managers should periodically reassess component importance using updated institutional data rather than relying on static priorities, because predictive relevance may change with regulation, technology, customer behavior, and market conditions. Finally, algorithmic outputs should always be reviewed alongside professional judgment and Shariah expertise so that data-driven prioritization strengthens, rather than substitutes for, the ethical and jurisprudential foundations of Islamic financial management.

Acknowledgments

We would like to express our appreciation and gratitude to all those who helped us carrying out this study.

Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

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