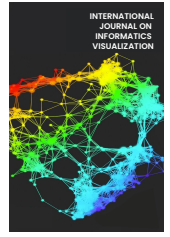




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Utilization of Business Analytics by SMEs in Halal Supply Chain Management Transactions

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Abstract— Halal supply chain management has transformed beyond food and beverage certification. However, extant literature shows that Halal transaction management still has much to improve in terms of transaction permissibility, with the main gap in understanding Halal businesses and their transactions limited to a system that separately defines e-commerce and financial technology data into its IT business environment. This study aims to demonstrate the usefulness of managing Halal transactions and its permissibility analysis through a proposed Halal Supply Chain Management Transactions (HSCMT) model and prototype by applying a business analytic approach to integrate both e-commerce and financial technology data. The study uses literature analysis to ensure the correct structure of the integrated datasets, before modeling the transaction's permissibility and prototyping its analytics into decision-making analytics. The developed HSCMT prototype uses a payment gateway that can be embedded into a Halal SME owners' e-commerce site. This creates a holistic Halal Financial technology (FinTech) transaction permissibility dashboard, increasing the effectiveness of HSCMT for Malaysia Halal SME Owners (MHSEO) by an average usability score of 83.67%. Results also indicate that the key basic mechanisms to verify transactional permissibility are the source of the transaction, the use of the transaction, transaction flow, and transaction agreement. Furthermore, its mechanisms must be mapped onto a submodule post-transformation and modeling of the transaction dataset. Further improvements in multisource data points can be further considered, as this research only focuses on local data points from one payment gateway service. This is due to restrictions in data policy when involving overseas supply chain and transaction documentation. This research utilizes available data in business through data management, optimization, mining, and visualization to measure performance and drive a company's growth. The competency of business analytics can be beneficial to Halal SMEs players because it can provide them with insights into the permissibility decision-making process.

Keywords— Halal transaction; halal supply chain management; business analytics; small medium enterprise; halal fintech.

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I. INTRODUCTION

Businesses are increasingly turning to a field known as business analytics (BA) to obtain insights and make future decisions based on a statistical data analysis. One of business analytics's main benefits is understanding past, present, and future business operations. Instead of intuition or guesswork, organizations can use data for marketing, finances, sales, and internal procedures. It can revolutionize product promotion, customer interaction, and financial management, especially for SME companies. It can provide actionable insights into user behavior, save costs, drive income, and provide a unique customer experience that makes customers remain.

In every sector connected to halal, the most significant obstacle is halal supply chain management [1]. The halal supply chain integrates numerous functional elements of an organization, such as manufacturing operations, procurement and logistics, and value-adding activities, into the halal framework. A revolving connection begins with the supplier, continues with the makers, and concludes with the consumers of halal goods.

The expansion of the Halal ecosystem in Malaysia is being supported by the use of financial technology and the presence of Halal Small and Medium Enterprises (SMEs) [2], which serve as the ecosystem's backbone. Nevertheless, making the right choices in business is becoming increasingly difficult.

The literacy and understanding of the interventions to enable Malaysian Halal SME Owners (MHSOs) to handle Halal transactional decision management is low, even though the Halal business is expanding. Big data analytics is indispensable in digitization and has risen to the forefront of resource maintenance, management, and decision-making. Malaysia, widely regarded as the worldwide Halal leader, has incorporated big data analytics into its operations to advance the sector towards Halal Industry 4.0 [3]. This step has helped the burgeoning Halal industry's complicated decision-making management. However, some sectors of the industry can still profit from this technology. The most influential sectors within the industry are financial and transactional decision-making.

The Islamic finance industry is the highest-earning sector in Malaysia's Islamic economy, with an expected value of RM14.7 trillion by 2024 [4]. This number is achievable if Financial Technology (FinTech) [5], digital banking, cryptocurrency, and other technologies are incorporated into their governance and businesses. Nevertheless, during the stages of expansion, the industry continues to rely on traditional banking services and products. The sector analyses Islamic viewpoints regarding Islamic commercial operations but does not explicitly specify the essential requirement processes that a single online Shariah-compliant transaction needs in the same way as the permissible physical transactions.

A system needs input, processing, and output as its primary components. The same principle can also be applied in Islamic finance, where the fundamentals of each business dealing should be traced back to its transactions. The fundamentals of a transaction are the same regardless of the business size, but the frequency, effects, and results may vary. Therefore, when the core digital transaction mechanisms of each Malaysia Halal SME owner's (MHSO) transactions are described and synchronized utilizing FinTech and the big data analytics approach, it is thought that halal businesses have an extraordinary potential for growth.

A. Literature Analysis

Integration of suppliers, manufacturers, distributors, and consumers is the basis of supply chain management. In this model, raw materials are sourced from suppliers and sent to manufacturers, who transform them into completed goods before coordinating their shipment to distributors [6]. The primary issue in this study is the restricted scope of knowledge intervention and exploration utilization of a business model for MHSO due to poor technical model studies [7], [5]. Many extant models lack conceptual studies, are not viable long-term, do not dynamically consider new variables into existing business models, and are either theoretical or less complete concepts with limited implementation and transformation phases.

B. Problem Identification

A previous study on content analysis of Islamic research papers related to business, finance, management, and marketing revealed that Halal publications focused more on the research component than the conceptual studies aspect in the last ten years. The study assessed indexed journals from the Clarivate Analytics and Scopus databases, of which only one article within the research analyses involved Islamic

banking in Halal terms [8]. It indicated that the previous business models developed for Halal research articles carried limited conceptualization, particularly in finance and transaction. Hence, the research findings are difficult to be applied to real-world circumstances.

The other conceptual models in Halal business transactions and Halal finance that utilize a societal-based approach offer models that are improved and those that include conceptual unit trust structures [9]–[11]. These models, however, possessed data security concerns regarding the Personal Data Protection Acts (PDPA), authorization issues surrounding the transfer of linked data sources, and limited resources to extend the concept further.

The current local Halal trading landscape enabled many local MHSOs to showcase their e-marketing solutions to increase competitiveness and business presence via export data, such as price fluctuation data [13], [14]. Thus, developed short-term models could not be modified whenever new factors emerged. As a result, short-term models do not ensure the viability of a business [12]. Therefore, a long-term sustainable strategy must be developed to address the inadequate coverage of literacy and knowledge intervention in the Halal transactional decision management of MHSOs.

C. Review Protocol

The review protocol utilized in this study aims to determine the efficacy of existing transactional-based models in Malaysia. The effectiveness of the models was examined to identify their limits and potential viable remedies. The efficacy criteria for this study were reviewed and measured based on data collecting methods, source of data collection, preparation, and transformation procedures [12]. Data acquisition from proper resources is critical in a study as it determines the presence of statistical biases during processing.

The processing and conversion of data can also impact the final analysis. Moreover, the efficacy was evaluated based on its compliance procedure. Each computing process and wrangling ensured the data and system requirements were met [4], [13]. Besides the underlying model, the analytical output that was performed to assess the model's efficacy included accuracy, precision, recall, and F1 score [14]–[16]. The confusion matrix was also employed to represent the model's efficacy metrics.

The other factors that were examined included the categorization objective, comprehensive conceptual research, and the implementation of the commercialization framework [17], [18]. Conceptual studies can introduce the strategies, tools, and process flows from the deployment of a study. It provides a thorough perspective and the extent of the study. This research can also help secure the knowledge needed to efficiently construct a functioning prototype that meets users' needs by combining technological advancement with existing policies. [11]. With the proper execution and marketing strategies in place, an idea prototype that has already been validated may be converted into a pilot study.

The results indicated that the overall theme of transaction analytics in Malaysia covered finance and economy, the Halal industry; SME business and owners; Islamic or shariah compliance; and the general concept of transaction analytics. Of these, 29 were predictive analytics, 8 were hybrid analytics, and the remaining were sentiment analytics. The data

classifications involved numerical type data (mostly), followed by categorical and hybrid data. These articles used ten base research analytics models, with Neural Network being the most and k-Nearest Neighbour being the least explored.

D. Content Analysis

Based on further investigation, only 6 of the 42 papers reviewed for transactional analytics models in the last five years in Malaysia were successfully developed and deployed with a good concept study and execution plan. The fundamental flaws discovered in the other unsuccessful models include confidentiality issues, restricted scope, and a small sample size. At the same time, one of the models required enhancement of the current data structure. It also lacked adequate tagging criteria, resulting in assumption tagging, which may cause bias throughout the wrangling process [19].

On the other hand, 8 out of 10 Islamic and Halal-based models were categorized as ineffective because they were only addressed conceptually and were not subjected to simulation, demonstration, or experimental representation. Meanwhile, the other two models had either insufficient analytical performance development or incomplete application and commercialization discussion. Overall, all ten models suffered from confidentiality concerns, a lack of compliance procedures, conceptual research and implementation plans.

As for more profound analytical performance, ineffective models predominantly lack coverage of accuracy measures, precision-recall measures, and F-measures. However, eight models employed statistical approaches to compensate for the inadequate coverage of deeper analytical performance measures. Nevertheless, they were ineffective.

Several other factors also influence the limitations of the ineffective models. The first few articles on transactional-based analytics were published in 2016 and 2017, while big data analytics was introduced in Malaysia in 2015. The first Malaysian policy was created in 2018 [20]. Subsequently, analytic models were developed in a relatively young sector (Big Data analytics) with limited references in Malaysia. Previous studies which adapted study designs from worldwide research publications were only applicable for surface evaluation comprising prospective concepts and future implementations.

From 2019 until 2021, a study on Islamic and Halal-based transactions was compiled, briefly covering compliance methods. The other studies at that time did not perform a thorough study on compliance practices as they focused on enhancing fraud detection. One of the most effective and layered compliance procedures built into sub-modules in 2018 was the Anti-Money Laundering (AML) system [21]. The multi-faceted compliance system assesses fraudulence risk through behavior profiling, average transaction tracking, and transaction source disclosure. In addition, the system used the average of each layer's ratings to detect and forecast fraud. The incorporation of machine learning in AML systems allowed 18 other studies to have increased their effectiveness score from 2018 forward.

II. MATERIALS AND METHOD

This research analyzed recent literature. An authorized payment gateway analyzed 500 active MHSOs' transaction data. Before developing a machine learning model, the acquired dataset was preprocessed and turned into the core transaction dataset. Next, the model was saved as an HSCMT classification model. Next, the model was deployed into a prototype HSCMT analytics dashboard and was verified using expert and user roundtable sessions.

A. Data Preprocessing and Transformation

Datasets were cleansed and transformed using Jupyter Notebook, Python programming language, and XLStat software. The calibration measurements were performed through statistical approaches and data visualization. Since the datasets did not display missing values, they were converted to numerical data from categorical data. The variables retained in this study were the industry and bank names. Following purification, the skewness of both datasets was assessed.

A multi-layered data structure verification must guarantee that the dependent variable's skewness is normal and bell-shaped. In addition, it ensures that the dataset is consistent when displayed so that it has no outliers and can be modeled accurately [22], [23]. When the primary dataset was verified, the transaction data exhibited high skewness, 17.21. Irregularly distributed data and numerous outliers usually cause high skewness values. Moreover, inconsistency in data charting is also caused by skewness. Therefore, the data was transformed into a benchmark data structure using log transformation. Log transformation yielded a significant degree of skewness, 16.57. Consequently, the standard deviation was disproportionately more significant than the mean.

For that reason, the dataset was reorganized and split by SME size. A model was then chosen based on the dataset with the most transactions. This splitting procedure demonstrated that HSCMT analytical models would only succeed if they were developed independently based on the SME's sizes. The dataset included 353 micro MHSOs, 132 small MHSOs, and 15 medium MHSOs. This study focused on micro MHSO users. An approach for addressing skewness was applied to the dataset. The model skewed to the right at 10.21 following a log transformation. Nevertheless, the processed data yielded a statistically valid structure. Upon verification, the data was prepared and wrangled using compliance scoring. The compliance scores consisted of Halal usage, source, and total HSCMT permissibility scores. The full dataset is summarised in Table 1.

B. Machine Learning Model Development and Selection

Measurement was initially established through the use of k-fold cross-validation (k-CV), which is an iterative validation method that uses several iterations to test for model competence across multiple partitions of the dataset [14], [16], [24]. The accuracy of 10 models from the 42 analyzed models in the literature review was compared using the first iteration and recorded. These models were then evaluated and compared in terms of their performance.

The findings indicated that five of the ten models highly predicted HSCMT classification probability. The models

include Logistics Regression (LR), Decision Tree (DT), Naïve Bayes (NB), Random Forest (RF), and k-Nearest Neighbor (KNN). The models' performance was evaluated

using 3, 4, and 5 cross-validations, as depicted in Table 2. Based on the results, the most suitable model for HSCMT classification was the RF.

TABLE I
DESCRIPTIVE STATISTICS OF THE DATASET

Category	count	mean	std	min	max
Index	361	265.15	123.92	24	490
Bank Name	361	9.00	2.16	1	12
Industry	361	2.24	1.79	1	7
Start After COVID-19	361	0.47	0.34	0	1
Active Month	361	6.52	3.26	1	19
Active Status	361	1.49	0.55	1	3
Total Frequency	361	6.10	1.26	0	9.57
Total Amount (RM)	361	11.75	0.42	10.53	12.60
Average Amount (RM) Per Month	361	10.02	0.63	8.16	12.28
Average Amount (RM) Per Sale	361	5.65	1.24	2.85	11.91
Fiat Halal Source	361	0.78	0.10	32.16	98.13
Fiat Halal Usage	361	0.81	0.19	27.97	94.55
Permissibility Score	361	0.58	0.07	35.90	99.29

TABLE II
FULL COMPARISON OF TOP FIVE MODELS

Model	Number of Iterations											
	k=3				k=4				k=5			
	Accuracy	Precision	Recall	F1-Score	Accuracy	Precision	Recall	F1-Score	Accuracy	Precision	Recall	F1-Score
RF	100.0	100.0	90.0	94.7	100.0	100.0	94.2	97.0	100.0	100.0	96.0	98.0
DT	100.0	100.0	89.0	94.2	100.0	97.7	90.4	93.9	100.0	100.0	93.1	95.3
KNN	83.8	66.7	41.0	50.8	83.0	76.4	50.0	60.4	91.7	89.4	71.2	73.7
NB	100.0	92.7	86.0	89.2	100.0	95.2	89.0	92.0	98.6	95.9	90.3	92.7
LR	100.0	73.1	50.0	59.4	100.0	100.0	92.1	95.9	100.0	90.9	93.0	96.4
AVG. (%)	96.8	86.5	71.2	77.7	96.6	93.9	83.2	87.9	98.1	95.2	88.7	91.2

C. Prototype Design

The prototype was designed based on the requirements gathered from a survey involving 200 of the 353 micro MHSOs. The respondents asked for an analytics dashboard that is a part of their existing payment gateway's services. Buyers of the respondent's products or services can visit their e-commerce website. This website has an e-commerce plugin that directs consumers who wish to purchase items or services from the website to pay using their linked payment gateway.

When a payment is made for the purchase of products, some compliance files are sent to the payment gateway and e-commerce system for transaction compliance. The micro MHSOs then receive the payment and the relevant compliance files before completing the business transaction. Finally, they deliver the goods or services and submit their compliance documentation as verification. When describing a system's functionality and how its users interact with it, use-case diagrams focus on use cases and actors rather than the underlying system architecture. Fig. 1 shows a use case

diagram for the HSCMT model. This diagram shows system-actor interactions. The workflow was divided into two sections, with the top indicating micro MHSOs and buyers who utilized a payment gateway and the bottom storing data for HSCMT analytics.

Consumers shopped for goods and services offered by micro MHSO by visiting their respective online marketplaces. Due to e-commerce plugins, customers may pay for their purchases through the website's integrated payment gateway. The buyer must submit official information related to the transaction to the micro MHSO before payment is made. The micro MHSO payment gateway then confirms its compliance, receives money, and concludes the transaction by delivering the agreed-upon goods or services and uploading the relevant compliance documentation. When the prototype HSCMT analytics system was ready to process the data, it retrieved all transaction data and accompanying documents. Finally, the prototype HSCMT analytics dashboard allowed micro MHSOs to get an overview of their current transactions and make decisions based on HSCMT analytics.

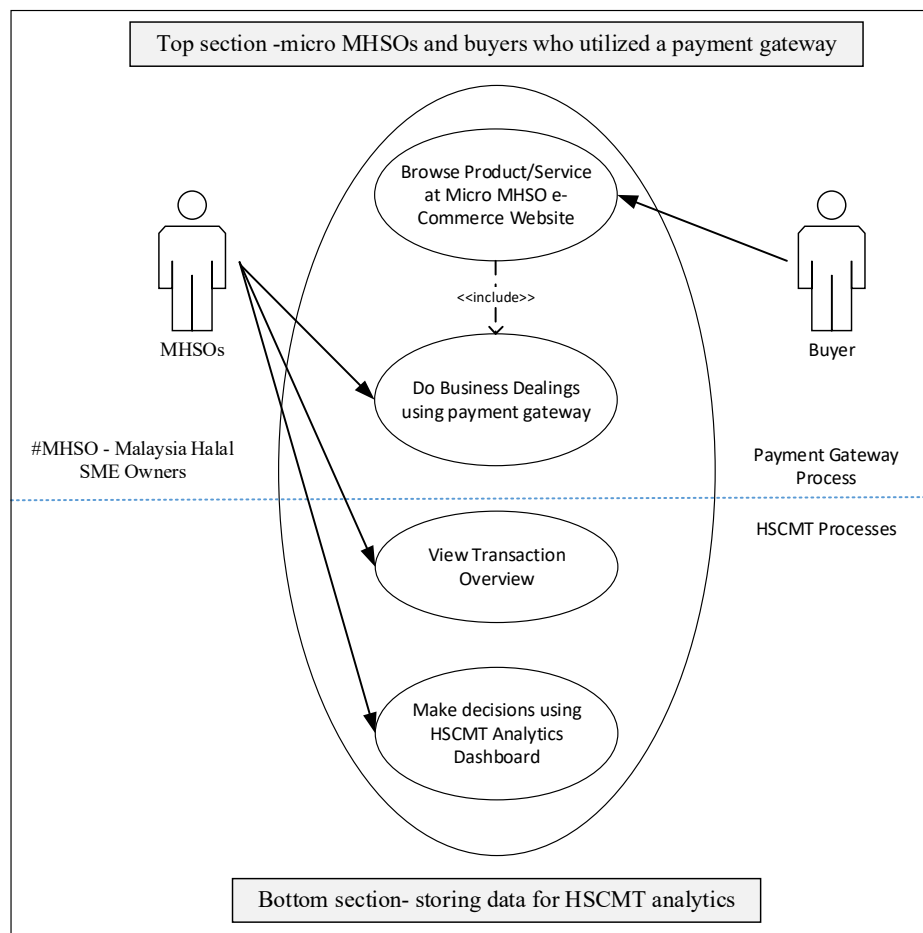


Fig. 1 Use Case Diagram of HSCMT as an embedded service of an authorized payment gateway

Next, the prototype HSCMT analytics system receives all transaction data and associated documents, and it then analyses and stores the data in its associated database. Finally,

micro MHSOs may utilize the prototype HSCMT analytics dashboard, as shown in Fig. 2, to overview their current transactions and make HSCMT analytics-based decisions.

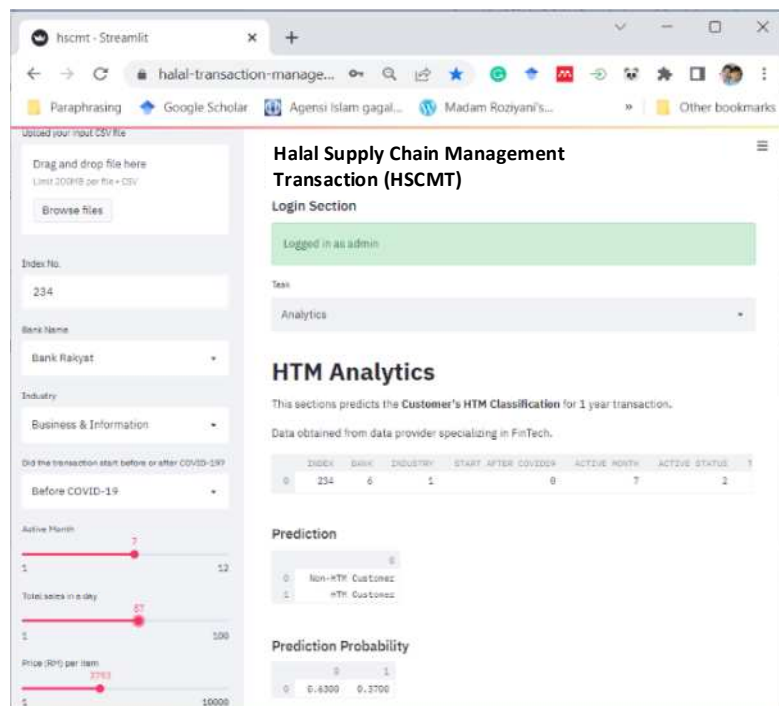


Fig. 2 HSCMT Analytics Dashboard

D. Expert and User Roundtable Verification Session

In the last phase, the conceptual framework, model, and prototype simulation were presented and validated through an online expert roundtable. The session was held for four days online, using the Google Meet platform. The roundtable discussion comprised 14 experts to assess the model's efficacy in improving transactional value and assisting MHSO in making choices via prediction categorization. The thoughts of the experts who participated in the roundtable discussion on the prototype's usability and expert consensus were documented. The usability questions were scored using a Likert scale.

The survey concluded with two open-ended questions on their thoughts on the proposed system and recommendations for improvement. First, the assessment determines the usability and efficacy of the results and the degree of agreeability of each expert. A usability score of 80 or more is considered good, while an agreeability score of at least 4 out of 5 is considered good [25].

The architectural methodology for this research's experimental activities was summarized in Fig.3 referred to phases from Cross-Industry Standard Process for Data Mining (CRISP-DM) process as the most comprehensive data mining method for industrial projects.

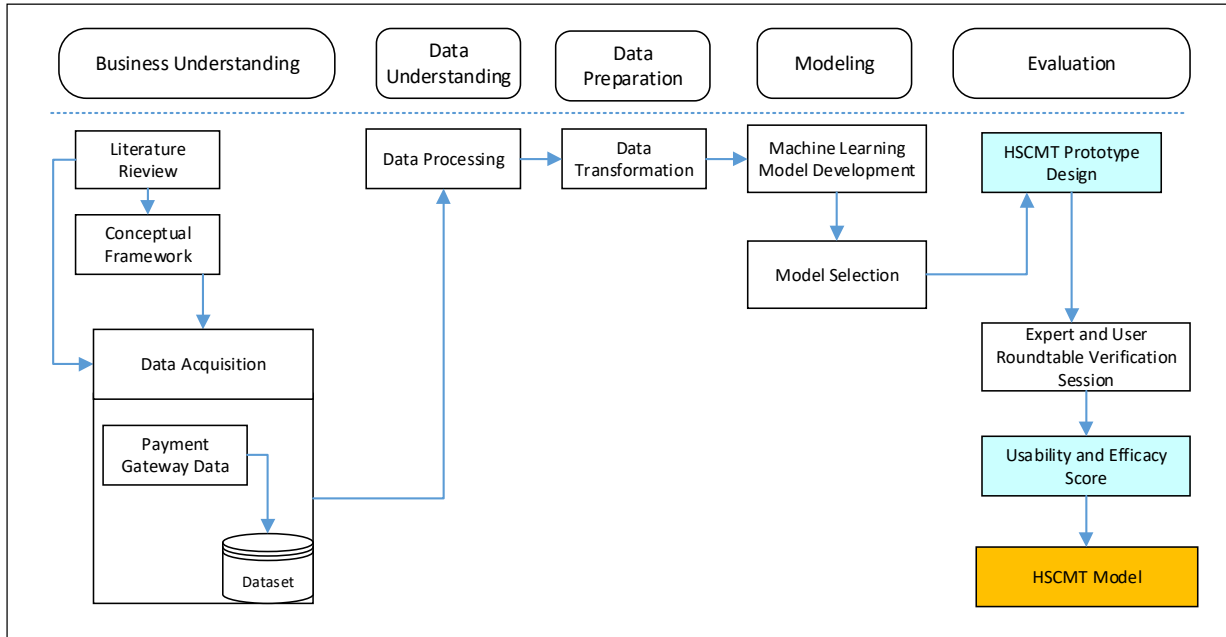


Fig. 3 An architectural methodology for this research's experimental activities

III. RESULTS AND DISCUSSION

There are three categories related to calculating the usability of HSCMT: accuracy, reliability, and validity scores. The scores are first collected from each expert based on their categories, as shown in Table 3.

TABLE III
CATEGORIZATION OF HSMCT EXPERT USABILITY SCORES

Category	Measurement
Accuracy	QA1: Data collection point, documentation, structuring, and verification QA2: Account transactional details in determining its Halal compliance are done correctly QA3: Transaction log displays enough basic and additional data for decision-making purposes QA4: Cumulative transaction graph is displayed correctly QA5: Transactional growth comparison graph is displayed correctly QA6: Geographical Transaction point is mapped and displayed correctly QA7: Analytical process and probability are done and displayed using the correct technique

Reliability

- QR1: Data collection point is from an official, authorized, and trusted source
- QR2: Business transaction collection has proof of documentation
- QR3: Analytics model was developed using intelligence from the correct group of official and trusted experts with relevant expertise
- QR4: Analytics prototype was developed using intelligence from the correct group of official and trusted experts with relevant expertise
- QR5: Results from the transaction analytics dashboard can reliably be used by Halal SME owners to make business decisions

Validity

- QV1: The conceptual framework is developed using confirmed and proven methods
- QV2: The analytics model is developed using confirmed and proven methods
- QV3: The prototype is developed using confirmed and proven methods that mimic actual Halal SME owner's transactions
- QV4: The prototype can be proven academically and implemented within the industry through payment gateway integration
- QV5: All the results discussed have been presented to and discussed with all experts within roundtable sessions

Then, the scores are measured based on the experts' agreeability on a scale of 1-5 (Highly disagreeable to highly agreeable). Each row category will first be averaged among all the experts (eq. 1), as seen in the example in Table 4.

TABLE IV
SAMPLE CATEGORIZATION CALCULATIONS BY ROW FOR 3 EXPERTS

Measurement	Expert			Mean Agreeability Score
	Expert 1	Expert 2	Expert 3	
QA1	4	4	3	3.67
QR1	4	5	5	4.67
QV1	4	5	3	4.00

$$\text{Average Agreeability Score} = \frac{\text{Sum}(\text{Expert } n)}{\text{Total number of Experts}} \quad (1)$$

Then, each category mean is converted to a percentage and averaged to the total of its category (eq. 2, where Q(Cat)n is the measurement number, e.g., QA1), as seen in the example in Table 5. In the Table 5 sample, the mean usability score for accuracy was 78.57%, reliability was 82.86%, and validity was 82.85%.

TABLE V
SAMPLE CATEGORIZATION CALCULATIONS BY CATEGORY FOR 14 EXPERTS

Measurement	Mean Agreeability Score	Mean Category Percentage
QA1	4.14	78.57
QA2	4.07	
QA3	3.57	
QR1	4.00	82.86
QR2	4.29	
QV1	4.21	82.85
QV2	4.07	
QV3	4.14	

Average Category Percentage =

$$\frac{\text{Sum}[Q(\text{Cat})n \text{ Average Agreeability Score}]}{\text{Total number of Measurements in Category}} \quad (2)$$

So, for HSCMT, the average usability score for accuracy was 81.02%, the average usability score for reliability was 85.71%, and the average usability score for validity was 84.29%. The overall mean usability score for HSCMT was 83.67%. The full results are shown in Table 6.

TABLE VI
FULL MEAN CATEGORIZATION CALCULATIONS BY CATEGORY FOR 14 EXPERTS

Measurement	Mean Agreeability Score	Mean Category Percentage
QA1	4.14	81.02
QA2	4.07	
QA3	3.57	
QA4	4.00	
QA5	4.21	
QA6	4.29	85.71
QA7	4.07	
QR1	4.00	
QR2	4.29	
QR3	4.57	
QR4	4.57	84.29
QR5	4.00	

Measurement	Mean Agreeability Score	Mean Category Percentage
QV1	4.21	84.29
QV2	4.07	
QV3	4.14	
QV4	4.07	
QV5	4.57	
Total Average Percentage		83.67

The experts agreed that the context includes all data from the extraction of HSCMT transactions up to the MHSO internal commerce data. These data undergo transactional analytics before being categorized into decision-making information through the prototype system.

Results also indicated that the basic mechanisms to verify permissibility include the source of the transaction, use of the transaction, transaction flow, and transaction agreement. These are aligned with literature done by previous Islamic scholars, as well as aligned with Qur'an and hadith [26], [27], [28], [29], [30]. Based on these findings, it was determined that the HSCMT model and the prototype system were accurate, dependable, and valid. To further enhance the system, a few ideas were taken into consideration.

According to an Islamic finance technologist, the prototype reflected similarities to the AML system. The prototype can also adopt reinforced compliance scoring to examine further the patterns of transactions and behaviors of its SMEs and consumed through REST API. Other experts, on the other hand, concurred that an API could be provided and preserved for tech-savvy micro MHSOs, while a CSV-based database would be suitable for amateur micro MHSO users.

An expert in Halal technology and an SME owner suggested that MHSOs are technologically advanced and have a wide variety of data points and flexible systems. Their main goals are to be able to view and download data with ease. Therefore, an accessible integration made accessible through API and CSV methods is feasible, productive, and efficient. Moreover, it is a great strategy to improve micro-MHSOs' technological readiness by making both alternatives accessible if pre-existing SaaS or internal systems currently used for their businesses are utilized.

Besides that, an MHSO present during the roundtable verification proposed reinforcing classification data with more transaction data, such as non-compliant file-sharing summary. According to the MHSO, the summary can be used as a guide to request compliance files from a non-compliant business owner or customer, securing a more Sharia-compliant transaction between both parties involved.

Moreover, a micro MHSO can re-evaluate individual transactions and choose to view the summarized transaction details. Additionally, this might gradually evolve into the compliance enhancement module of the system. This step could improve the overall compliance score of the transaction and build strong rapport for B2B and B2C relationships through transparent compliance transaction management. The Halal community can employ an intelligent yet proactive awareness strategy by requiring micro MHSOs to monitor the compliance of their business accounts. One of the SME technologists and finance experts agreed that this step could ensure the authority of micro MHSOs.

Another Halal MHSO, a technologist, added that cross-border trading data could be another reference point for future international Halal transaction studies. Thus, it gave rise to the need for a strategic international transactions guide and proper documentation, particularly in countries with different transaction policies and data-sharing acts. Data tagging can also mitigate over-profiteering locally and globally via Supply Chain transaction details and its effects on the whole Halal ecosystem.

IV. CONCLUSION

This research focuses on an effective Sharia-compliant analytics system in the Halal business and the requirement for MHSOs to become digital and financially literate through the dashboard. The prototype analytics dashboard and conceptual framework for Halal supply chain management transactions (HSCMT) provide practicable long-term solutions to MHSO's literacy and knowledge intervention limitations and help manage Halal transactional decision-making. HSCMT can effectively resolve underlying concerns present in previous models regarding confidentiality issues, restricted scope, and small sample size. Despite the pseudonymization concerns, this model also includes an extra layer of compliance to widen the comprehension of the HSCMT data structure. In addition, the model's scope was split and restricted by the SME's size, not by the industry's or specialist industries' scope.

Based on the results, the model was adaptable to serve as an annual predictive categorization model for all sectors of the same SME size. The dataset can also be tailored based on the transaction pattern or behavior of its MHSO. The sample size is generally considered more significant, with 500 active MHSOs transacting annually. However, a few outliers were found in each sample size. These outliers comprised about 2.2% of the total micro MHSOs in the P1 dataset.

There were also no issues with under or oversampling throughout the wrangling procedures. HSCMT usability can be improved by enhancing transaction dataset pseudonymization to comply with the MHSO survey, employing minimalistic yet practical data visualization tools, and employing a more user-friendly interface. On the other hand, future practitioners and researchers could compare the characteristics between a shariah-compliant and non-shariah-compliant FinTech.

This study can determine whether the present Malaysian FinTech sector has met the compliance standards and the procedures that need more coverage in both the technology and industry. Based on the comparison, the differences in transaction patterns and behavior for both users based on their SME sizes can be determined. Both types of FinTech policies to improve user transaction effectiveness may be mapped and standardized to pave the way for developing a new standard for higher-quality transaction management in Malaysia.

The use and effects of leveraging multisource data points for HSCMT can also be investigated in the future, particularly in enhancing transaction compliance scores. The existing HSCMT compliance methods were derived from a single data point calculation, and hence, the scores were acknowledged as temporary log scores. The inclusion of multisource data points could build a multisource compliance scoring module for HSCMT that must be completed to standardize the scores based on their sources successfully.

Therefore, the essential structure and methods for improving the log score table may be improved inside the existing block diagram. The multisource can also be compared between local and foreign multisource data points to record and evaluate different data-sharing regulations.

Small and medium-sized enterprises (SMEs) may benefit from supply chain management in a number of ways: it allows them to align supply chain objectives with business strategy better; it helps them better understand the stages, the time, the costs, and the value drivers; it fosters the development and maintenance of relationships; and, perhaps most importantly, it helps them identify skills and competencies, allowing them to concentrate on life-cycle management.

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