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Article

Brand Identity and Halal in Malaysia's Food SMES: One Tale from Two Model Analyses

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Abstract: Corporate identity has played a vital role in the halal industry to create a strong foundation for its reputation in the long run. This paper used two modelling analyses for two different datasets. The first analysis aimed to predict the relationship between internal brand (antecedent) and corporate culture (antecedent), and employee brand support (consequence), mediated by corporate identity management (CIM) using partial-least squares-structural equation modelling (PLS-SEM). A total of 206 employees from Malaysia's halal food SMEs took part in the survey. The second analysis identified topic proportions patterns using the topic modelling approach on halal brand identity. Machine learning approach of topic modelling was applied for this analysis. Metadata of 1091 articles were mined from the Scopus database on halal studies across all social science fields. The result of the first analysis revealed thatthere was a partial relationship between internal brand (antecedent) and employee brand support (consequence) mediated by CIM. The second analysis supported these findings by pointing out a weak topic proportion on the halal brand identity discussion globally. Interestingly, the result also found the halal brand identity discussion involving the halal food industry is almost non-existent in Malaysia's halal food SMEs. The contributions of this paper were apparent in three major areas, which are methodology, theoretical and future suggestions. The utilization of two different model analyses was able to confirm the consistency of the discussions of major findings in the literature review and propose possible studies for future researchers.

Keywords: brand identity; corporate identity management; food SMEs; halal; machine learning; structural equation modelling; structural topic modelling

1. Introduction

Corporate identity has played a vital role in the halal industry to create a strong foundation for its reputation in the long run. Corporate identity is one of the major catalysts that contribute to more impactful outcomes for the organisation to reap from it, which includes promoting transparency in the communication among stakeholders and contributing to positive morale and retention of the highly skilled employee [1].

Halal (permissible) and Thoyyibban (wholesome) are two (2) fundamental pillars of Islam, both of which are clearly mentioned in the Holy Quran (Al-Baqarah, 2:168–174). Halal is an Arabic term that implies acceptable or accepted under Sharia (Islamic) law [2].

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Thoyyibban, on the other hand, denotes the high quality, safety, cleanliness, nutrition, and authenticity [3].

Corporate identity management (CIM) in the corporate industry has been extensively discussed and acknowledged, in literature as well, as an important area of study [1, 4]. In the Malaysia Halal Industry Master Plan 2030 (HIMP 2030), four major objectives to be achieved are a robust and diversified domestic halal industry; ease of doing business; competitive business participation; and internationalisation of the halal Malaysia brand.

Corporate identity management (CIM) is crucial in organisations, and much research has been conducted on it. Unfortunately, few studies have been conducted to demonstrate the influence of CIM in the halal industry. Most of the research in the halal food production business centred on supply chain management and halal certification as a procedure [5, 6, 7].

According to the State of the Global Islamic Economy Report (2018/2019), the identity of halal is crucial to be understood as a core value for the company's brand identity. A strong brand identity is important in upholding the global halal industry and its aim to become one of the biggest industries in the world. However, the under-par performance of organisations, especially Small and Medium Enterprises (SMEs), has become the biggest obstacle in achieving the aim. In Malaysia's halal industry setting, poor adoption of communication technology, confusion on halal information, and obscurity in the understanding of halal management process among SMEs are some of the challenges in achieving a good brand identity [8].

According to Safiullin, Galiullina, and Shabanove (2016) [9], the manufacturing of goods and services in accordance with halal criteria is currently a global trend, with an acquisition of 21.1% of the market share. A reputation for high-quality goods and services, a solid financial performance, harmony and an accommodating workplace atmosphere, and a reputation for social and environmental responsibility are some elements of its successful corporate identity [10, 11]. The process of globalisation of trade in separate segments of commodity markets made in accordance with the halal requirements shows table development. Hence, competition is no longer limited to national borders.

Good identity management starts from a good relationship with the internal stakeholders. Internal stakeholders have a significant influence in shaping the organisation's corporate identity. In a study of a conceptual model for corporate identity management in the healthcare industry, Rutitis, Batraga, Skiltere, and Ritovs (2014) [12], put a significant emphasis on the management of corporate identity factors with respect to the use of visual identity structures, active integration, and utilisation of regulations as a part of patient service culture, and active use of multiple communication guidelines. All of this demonstrates that internal communication has a substantial influence on information distribution via a communication channel in everyday operations. Good internal communication aims to provide access to benefits of the important employee self-service, especially for quality perceptions. Managers benefit from the functionality of electronic service delivery channels in employee self-service arrangements. Employees also have direct and quick self-directed access to their benefits and pay information, which is likely to result in higher levels of satisfaction, which may translate into considerable benefits for the organisation in terms of motivation, performance, and job retention. Consequently, a communication system is meant to assure employees' continuous and inspired commitment to the organisational objective through the direct supply of required support services and benefits goods [13].

As halal standards must become a global standard, a good identity needs to be constructed and become a halal marketing strategy for the standard akin to all Muslims as well as non-Muslims. However, this presents several challenges for the halal industry, such as coming out with a globalised identity and promotional strategies. For example, in the tourism business, hotels and places that cater to Muslim visitors do not want to attract solely the Muslim traveller demographic while leaving the other market segments, creating a conundrum over what their identity and marketing approach should be [10]. This

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motivates the halal business to create an efficient structure, such as internal communication, to assist employees in improving their marketing effectiveness. As a result, the quality and efficiency of their goods and services improve [14]. Findings of relevant studies [84] revealed that customers' perceptions of halal logistics, halal concerns, and media attention all had a favourable and significant impact on consumers' willingness to pay for halal logistics.

The willingness to pay, and the level of demand for halal logistics certification, have a favourable link [11]. However, while halal logistics is important in maintaining the halal quality of food, request for these services is minimal. This is a challenge for the halal business in setting goals for strategic planning, assessing performance, and supporting stakeholders [15]. In Malaysia, the halal industry contributed around 5.8 per cent of the country's GDP in 2020. As Malaysia aspires to be the world's top halal centre in the Third Industrial Master Plan 2006–2020, suitable infrastructure and a robust support base are critical. A well-trained staff capable of enabling knowledge and expertise is essential for a quick entry into the global halal market. Effectively maintained corporate identity may help a company gain a competitive edge over its competitors [16], and therefore Malaysia has begun to invest extensively in programmes to strengthen its halal brand in the field. As a result, an increasing number of businesses have begun to create and execute corporate identity management as part of their strategic growth and expansion [17]. Many scholars feel that one of the primary outcomes of corporate identity management is a greater understanding of its origins, such as corporate culture and internal brand. Corporate culture, employee values, and internal brand are intangible characteristics that can assist organisational health by recruiting and keeping great employees [18] and offering a significant competitive advantage to the organisation [19]. Many management studies have demonstrated the importance of such factors in the organisational structure.

Communication is paramount when it comes to building a strong employee brand support and CIM acts as a catalyst in the communication of the determinant factors. Industries invested millions in developing their brands. However, the most apparent problem in the Malaysian halal industry is a lack of attention given to developing and enhancing CIM despite the positive outcome. This is due to the reluctance of the employees to adapt to the system in internal communication [20].

Having discussed all these, the objective of this study is to examine the relationships between internal brand (antecedent) and corporate culture (antecedent), and employee brand support (consequence), mediated by corporate identity management (CIM) in the halal industry.

2. Literature Review

2.1. Corporate Identity Management (CIM)

CIM is the knowledge and understanding of identifying physical aspects that form and represent a corporate image. It is a vital part that must be incorporated into organisational symbols so that it can be delivered and understood by internal and external stakeholders [21]. Scholars discussed CIM as made of two elements, namely the intrinsic and the extrinsic. The intrinsic elements, such as behaviour, culture, and expression of the brand, influence internal members to believe and uphold the brand identity of the organization; while the extrinsic elements, such as corporate design (visual identity), symbolism, theme/visual and structure, significantly influence the construction of the organisation's identity [22-29].

2.2. Internal Brand (IB)

Internal branding refers to employees' understanding of the brand and the basic principles of the organisation to carry the brand's visions to clients in day-to-day operations [30]. Branding programs, branding activities, and training and management developments are suggested initiatives to nurture favourable behaviour of employees towards the

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identity of a particular organization. Favourable behaviour of employees towards an organisation's identity is, indeed, the fundamental indicator of healthy internal brand and good governance in identity management [31-35].

2.3. Corporate Culture (CC)

Researchers suggested fourteen aspects of a good corporate culture, namely vision, values, practices, people, narratives (history), place, liabilities of the organisation in relation to the employees, task evaluation, career planning, control system, decision making, level of responsibility, a person's interest, and shared a total of granted assumptions [36-38]. All these aspects are combined to form good identity management for the organization, which in turn forms patterns to help employees understand the function of the organization. This understanding then influences the decision-making process in achieving organisational objectives and principles, and the outcome is the product of the synchronisation of CIM and corporate culture [39].

2.4. Employee Brand Support

The notion that when employees grasp and adhere to the brand beliefs embedded in the brand promise, they will work in ways that meet or exceed the brand expectations from customers [40]. Employees understand, deliver, represent, and/or become the brand that they support [41]. He also stated that employee brand support behaviour may be determined from the norm and value-based viewpoint as well as the marketing and communication-based perspective.

2.5. Hypothesis Development

Good internal branding activities developed values for employees, provided adequate brand support, and led them to enjoy strong brand commitment and positive behaviour. Previous researchers have explored these features to determine their links and claimed that internal brand greatly affected excellent employee brand support [42-47].

Previous scholars also suggested corporate culture elements, such as vision, values, practices, people, narratives (history), place, liabilities of the organisation to influence employees' brand support, task evaluation, career planning, control system, decision making, level of responsibility, interest, and shared granted assumptions [16, 19, 36]. Corporate culture also influences greater identification from external stakeholders since the developed brand identity portrayed a desirable, proper, or socially appropriate system of norms, values, beliefs, and definitions [48-50]. As the above discussions confirmed that internal brand and corporate culture significantly influenced employee brand support, these hypotheses are therefore proposed:

H1. *There is a positive relationship between internal brand (antecedent) and corporate culture (antecedent) and employee brand support (consequence), mediated by corporate identity management.*

H2. *There is a significant topic pattern in past literature that indicates the development of studies pertaining to the impact of brand identity in Malaysia's halal SME industry.*

3. Methodology

The study used a quantitative approach with two data collection methods which are self-administered questionnaires and knowledge-mining of journal databases through a machine learning (ML) technique.

3.1. First Analysis: Partial-Least Squares-Structural Equation Modelling (PLS-SEM)

3.1.1. Sampling Procedure

A multi-stage sampling technique was used to identify the sampling for this study.

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This stage consists of at least two random sample phases depending on the nature of natural clusters within the targeted population [51]. Clusters are groups of people who share the same features or characteristics, identified by the researcher. In this study, the group of individuals chosen as respondents shared the same characteristic: they work in a halal industry SME. States were chosen randomly, followed by firms' selection in each chosen state. The states in Peninsular Malaysia were chosen for the location of the study since most of the halal SMEs are concentrated in the states of Peninsular Malaysia [51]. Table 1 summarises the clustered states based on province.

Table 1. Clustered States Based on the Provinces.

North Province	South Province	Central Province	West Coast Province
Perlis	Johor	Selangor	Kelantan
Kedah		Negeri Sembilan	Terengganu
Penang		Melaka	Pahang
Perak			

To avoid selection bias in choosing the location of data collection in this study, 'Randomised Between' function ("RANDBETWEEN") in Microsoft Excel was used to select states and halal companies for each selected state [52]. This procedure is explained in the Figure 1:

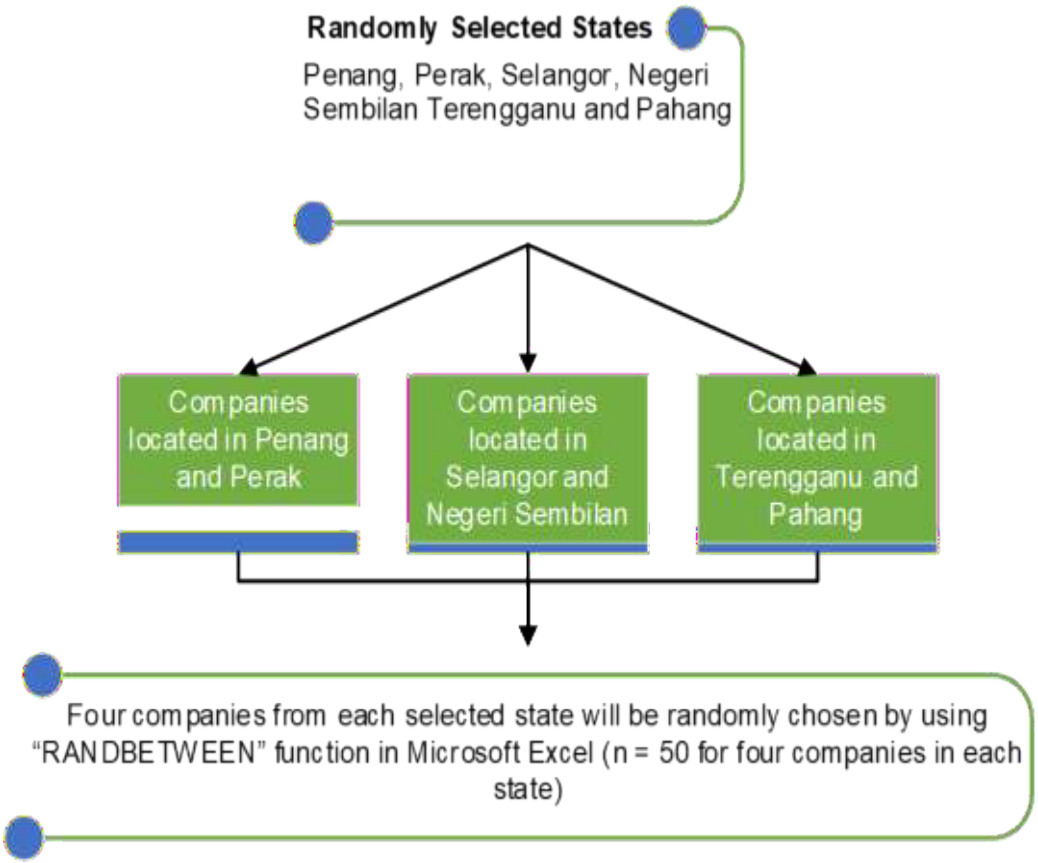

Figure 1. Multi-stage Sampling Procedure of the Study (adapted from Sedgwick, 2015, [51]).

The list of the registered halal SMEs for each state were published in IKS.my, JAKIM, and the Halal Development Corporation (HDC)'s website. Companies that fulfilled the inclusion criteria were selected. Two tests were administered to determine the appropriate sampling size, namely the power value analysis through A priori sample size estimation,

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and a Monte Carlo simulation in determining the sample size. Power analysis is based on the acceptable value of the effect size (f^2) and acceptable significant error value (α value) in determining a power value ($1-\beta$). The determined f^2, α and β values estimated the appropriate sample size to achieve a statistical significance that suited the determined f^2, α and β [53]. Since this study used partial-least squares-structural equation modelling (PLS-SEM), G*Power analysis calculator version 3.1.9.7 was used [53].

By estimating that this study will yield an absolute effect size (f^2) value of 0.15, alpha (α) value for significant error of 0.05, and determine power (β) value of 0.8 (a minimum value required for statistical significance), a minimum of 77 samples were required to achieve statistical significance for the proposed model in this study [53].

The second test to confirm the number of samplings was the Monte Carlo simulation experiments using the inverse square root and gamma-exponential approaches [54]. This approach requires a minimum sample number of 160, whereas the gamma-exponential method requires a minimum sample number of 146. The inverse square root technique tends to slightly overestimate the minimum necessary sample size, but the gamma-exponential method offers a more exact estimate [54]. Thus, after a careful evaluation based on the confirmed values mentioned, the appropriate sample size for this study was 200. The actual data collection was able to collect a total of 206 respondents.

3.1.2. Validity and Reliability

As proposed by Churchill, an instrument for self-administered surveys was designed in four stages [18]: item generation from existing scales; operationalization of variables from previous literature; scale of content; and face validity. A panel of judges certified the representativeness and clarity of the instrument. Items with a low score were eliminated.

The reliability test was carried out using a total of 43 samples from the pilot test. Cronbach's alpha calculated high at 0.9. This result was consistent with the characteristics of a dependable instrument; hence, the instrument is verified.

3.1.3. Operationalisation of Variables

The Tables 2–5 summarise the items and references for all the variables of this study.

Table 2. Employee Brand Support (EBS) Instrumentation.

Construct	Items	Reference
	EBS	
Employees' brand support	I am confident in my ability to clearly explain the brand values I use my knowledge of my institution's brand values to better organize my time The brand values influence my decisions on customer (student) requests I know what skills are necessary to deliver on the brand value I include information on brand values in my day-to-day operation	Adapted from original items from the study by Aurand et al. (2005)

Table 3. Internal Branding Instrumentation.

Construct	Items	Reference
Internal brand communication	Brand messages (values) are communicated to employees individually (one-to-one).	Joudson et al. (2006), based on Ind (1997)

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Brand training ant	Brand messages (values) are explicitly communicated to each group (segment) of employees. Brand messages (values) are communicated to (all) employees through internal mass communications, for example, newsletters, memos, and brochures. The brand messages (values) are reinforced through training activities. Training is provided to help employees use these values. The skills necessary to deliver these values are considered in staffing decisions. Annual performance reviews include metrics on having the values. Departmental plans include employees' roles in living the brand values.	Adapted from original items of the study by Aurand et al. (2005)

Table 4. Corporate Culture Instrumentation.

Construct	Items	Reference
	Corporate Culture	
Corporate culture	Generally, a long-term vision of things is valued more (R). The focus on problems mainly considers their effects on economic factors, with little consideration of the impact on people. Human relations are principally based on cooperation, consensus, and group well-being (the contrary of competitiveness and individual well-being) (R). The most important bases for promotion are personal friendships and family ties. Creativeness and capacity of innovation are valued in employees (R). In this company, it is often heard "it has always been done like that" or "this is the proper way of doing it". The aims of systems of evaluation and control are to punish more than to reward. Conflict is treated as a normal aspect of company life, from which valuable experience can be gained (R). The structure is highly centralized, i.e., the majority of matters have to pass through very few hands. The structure is flexible, i.e., it adapts quickly and successfully to changes that may affect its survival (R).	Adapted the original items from Bonavia (2006)

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	The rules and regulations favour unnecessary bureaucracy that must be rigorously respected.	
	There is a constant concern to keep the technology up to date (R).	
	Marketing strategies, such as segmentation and market research, are used (R).	
	My company is really concerned about the conservation of nature and takes measures to this respect (R).	

Table 5. Corporate Identity Management (CIM) Instrumentation.

Construct	Items	Reference
Mission and value dissemination (MVD) Consistent image implementation (CII) Visual identity implementation (VII)	There is total agreement on our mission across all levels and halal business areas.	Simoes, Dibb & Fisk (2005)
	All employees are committed to achieving the company's goals.	
	The company's values and mission are regularly communicated to employees.	
	Senior management shares the corporate mission with employees.	
	Employees view themselves as partners in charting the direction of the company.	
	We do have a well-defined mission.	
	Our company name is part of our image.	
	Our corporate symbols (logo, slogan, colours/visual style, signage) constituent our image.	
	Our facilities are designed to portray a specific image.	
	Much of our marketing is geared toward projecting a specific image.	
	Our employees and staff understand the symbols (or visual branding) of our company.	
	Employees are dressed in a manner to project the company image.	
	A visual audit of our facilities is undertaken periodically.	
	Our company has formal guidelines for brand/visual elements.	
	Our company transmits a consistent visual presentation through facilities, equipment, personnel, and communication material.	
	Our consumables (e.g., books) and stationery are designed to match our company's overall visual elements/image.	

3.1.4. Statistical Analysis

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This study used PLS-SEM because it tested a model in a different setting which is Small and Medium Enterprises (SMEs) in Malaysia's halal industry. Exploratory Factor Analysis (EFA) was used to verify instrument (Marsh et al., 1988). The data analysis was divided into two parts: (1) assessing the measurement model for convergent and discriminant validity, and (2) assessing a structural model using structural equation modelling (SEM), as recommended by Henseler et al. (2009), [55] .

Outer loading (>0.7), Cronbach's alpha (>0.7), Dijkstra–Henseler (Rho-a) (>0.7), composite reliability (>0.7), and average variance extracted (AVE) (>0.5) were tested for convergent validity in PLS-SEM, followed by the measurement of discriminant validity Fornell–Larcker criterion and heterotrait–monotrait value (<0.9).

The second part was conducted to examine the structural model for all constructs by using SmartPLS 3. It started with the measurement of the outer loading of the observed variables, in which the measurement must be more than 0.7 (>0.7). Then, Cronbach's alpha value was determined, and the value must be more than 0.7 (>0.7). Dijkstra–Henseler (Rho-a) value needed to be more than 0.7 (>0.7), and the value of composite reliability (CR) needed to be greater than 0.7 (>0.7). Finally, the average variance extracted was measured for convergent validity and the value needed to be greater than 0.5 (>0.5).

The next process in the assessment of the measurement model for PLS-SEM was determining the discriminant validity of the measurement model. The three criteria that needed to be fulfilled by the measurement model were cross-loading, Fornell–Larcker criterion, and heterotrait and monotrait (HTMT) value. For cross-loading, the value of each indicator representing its variable must be larger than the sum of all cross-loadings [55, 56]. According to the Fornell–Larcker criteria (Fornell & Larcker, 1981), a latent variable has more variance with its assigned indicators than with any other latent variable. Statistically, the AVE of each latent variable should be larger than the greatest squared correlation of the latent variable with any other latent variable [55].

Heterotrait and monotrait (HTMT) value is a new criterion in determining the discriminant validity of measurement models in PLS-SEM [46]. HTMT value should be significantly lower than one (<1), or a good value of HTMT should be lower than 0.9 (<0.9) [55, 56].

The data analysis permitted the link between continuous or discrete independent variables and dependent variables in a PLS-SEM structural equation model. As a result, SEM provides the most relevant, versatile, and competent estimating approach for combining several different multiple regression equations into a single statistical test [53]. The variance of a group of indicators that may be explained by the existence of one unobserved variable (the common factor) and individual random error is used by PLS-SEM to determine the overall path coefficients and significance (structural model) [58] and generating estimation on common factors and composites, which makes it a good data analysis option for behavioural constructs as well as design constructs [55]. PLS-SEM can verify the consistency of a theoretical model and the estimated model [53].

The first step for structural assessment for PLS-SEM analysis is to assess the multicollinearity through Variance Inflation Factor (VIF). The value of inner and outer VIF should be lower than 3.3 (<3.3) [54].

Next, the assessment of the path coefficient significance is determined through *p*-value ($p < 0.05$) and T value ($T > 1.96$; 95% CI) [54]. After path coefficient significance was determined, the mediating effect will be analysed. The full mediation effect is determined if the *p*-value for the total effect is less than (<0.05) and the t value is more than 1.96 (>1.96) [54]. Next, the effect size is determined based on Cohen's effect size rule of thumb (1988) as below:

1. 0.02 represents a "small" effect size
2. 0.15 represents a "medium" effect size
3. 0.35 represents a "high" effect size

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The predictive accuracy is determined based on these criteria, substantial (≥0.75), moderate (0.5–0.74), weak (0.25–0.49) and non-accurate (≤0.24) [55].

The final analysis for structural model assessment is to determine the predictive relevance. The determining criteria are below as suggested by Henseler, Ringle and Sinkovics (2009) [55]:

$$0.02 \leq Q^2 < 0.15 = \text{Low Relevancy} \quad (1)$$

$$0.15 \leq Q^2 < 0.35 = \text{Medium Relevancy} \quad (2)$$

$$Q^2 \geq 0.35 = \text{High Relevancy} \quad (3)$$

3.2. Second Analysis: Machine Learning Approach of Topic Modelling

The outstanding improvement of AI in machine learning is a revelation to data accessibility, affecting all types of human tasks. The availability of these massive amounts of data spawned new methods for processing and extracting valuable, task-oriented information from them [59]. Knowledge mining, one of the methodologies that gained its foundation in social science studies, is the machine-assisted reading of text corpora to discover patterns through recorded knowledge in a database. This methodology is crucial in identifying the evolution patterns of knowledge, confirming discovery, and supporting newly explored novelty in research [60, 61].

The second data collection method was the knowledge-mining technique of a journal database through the machine learning (ML) technique to mine the massive amount of text data from the Scopus database. Knowledge mining is one of the methodologies that gained its foundation in social science studies is the machine-assisted reading of text corpora to discover patterns through recorded knowledge in a database. This methodology is crucial in identifying the evolution patterns of knowledge, confirming discovery, and supporting newly explored novelty in research [60-62]. In this study, upon establishing the study model using the first analysis, knowledge mining was applied to confirm similar patterns of discussions through topic patterns of past literature surrounding the halal field.

The programming language of R for statistical computing and graphics in Integrated Development Environment (IDE), called RStudio, was used [63]. The combination of packages started with the creation of text corpus and ended with result visualisation. A total of 1091 articles from the years 1992–2021 were retrieved from the Scopus database. The Scopus database was the only database used in retrieving the articles. It has a massive number of articles and was enough to identify a strong topic pattern related to the halal field. Only a single keyword was used which was ("halal") in the article retrieval process, since its aim was to retrieve as many articles as possible across all fields of studies.

Topic modelling through Latent Dirichlet Allocation (LDA) in "topic models" of R was used in developing topic models in this study. LDA is the generative probabilistic algorithm developed by Blei et al. in 2003 [64], used in machine learning for collections of discrete data, such as text corpora. This three-level hierarchical Bayesian model represents each item in a collection as a finite mixture over an underlying set of subjects. Each subject was thus represented as an infinite mixture over a collection of topic probabilities. The topic probabilities gave an explicit representation of a document in the context of text modelling [64]. The text corpus (a document containing plain unformatted text files) was built in R by configuring the file path's directory source. All articles included were combined into one text corpus to ensure the programming software able to run the process algorithm across all articles without any bias in the number of occurrences of each word [64].

The next process was the pre-processing stage involving the cleaning of structures of words in the corpus. All punctuation, extra blank spaces, numbers, stop words, capital letters and signs were eliminated and replaced with the appropriate lowercase and white space. This was performed to ensure only valuable words were left in the corpus with a

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uniform structure. A corpus with massive data size will need to repeat the process until the corpus is clean and the researcher can detect and interpret the word frequency in the document-term matrix (see Appendix A).

Topic modelling through the knowledge mining process recorded 1091 articles in the Scopus database, dated from 1992 to 2021. 'Gibbs' sampling algorithm was executed to calculate the estimated topic derived from the document-term matrix (see Appendix B). Once the calculation iterations were completed (default iterations are used, which are 500) the estimated topics with terms were visualised (see Appendix C).

4. Result

4.1. First Analysis: Partial-Least Squares-Structural Equation Modelling (PLS-SEM)

4.1.1. Descriptive Analysis

The demographic profile of the respondents include gender, ethnicity, age, education level, marital status, work position, working status, income, and year(s) of work, and each are tabulated in the Table 6:

Table 6. Demographic Profile of the Respondents

Profile	Frequency	Percentage (%)
Gender		
Male	79	38.30
Female	127	61.70
Ethnicity		
Malay	188	91.262
Chinese	15	7.282
Indian	3	1.456
Age		
16–22	54	26.214
23–29	74	35.922
30–36	30	14.563
37–43	12	5.825
44–50	17	8.252
52–58	13	6.311
≥ 59	6	2.913
Education Level		
No Formal Education	1	0.485
Primary School	4	1.942
PMR/SRP/LCE	17	8.252
SPM/SPMV/MCE	95	46.117
Tertiary Education (Certification, STPM, Bachelor Degree, Master Degree, Ph.D.)	89	43.204
Marital Status		
Single	116	56.311
Married	84	40.78
Divorced	6	2.913
Working Position		
Higher Management	32	15.534
Middle Management	45	21.845
Operational	105	50.971
Executioner	24	11.65

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Working Status		
Permanent	158	76.699
Contract	48	23.301
Household Income		
≤1000	45	21.845
1001–2000	83	40.291
2001–3000	33	16.019
3001–4000	22	10.68
≥4001	23	11.165
Working Year (s)		
1–9	176	85.437
10–18	21	10.194
19–27	6	2.913
28–36	2	0.971
≥37	1	0.485

Most of the respondents who took part in the data collection process were female with a total of 127 (61.70%). This signalled that the workforce in halal SMEs is dominated by female (61.70%), and Malay ethnic (91.262%). This is expected since the majority of the Muslim population in this country is Malay.

About half (50.97%) of the respondents were the operational workers. The operational workers received input on organizational identity, followed upper management instructions, and acted in accordance with the identity communicated. Their understanding and compliance led them to support the brand. Most of the respondents (76.70%) hold permanent posts, with 40.29% of them having a total household income between 1001–2000 monthly. Most of them (85.44%) had also worked in the industry between 1 and 9 years.

4.1.2. Assessment of Measurement Model

The Table 7 shows all accepted variables to confirm the convergent validity.

Table 7. Convergent Validity of the Constructs.

	AVE	**CR**	**Rho-A**
Internal Brand	0.649	0.881	0.825
Corporate Culture	0.575	0.931	0.919
Corporate Identity Management (CIM)	0.574	0.89	0.853
Employee Brand Support	0.64	0.879	0.818

A total of 24 indicators of the constructs were accepted and all values fulfil the requirement for convergent validity of constructs. Following that, the discriminant validity of notions was established. The Fornell–Larcker discriminant validity criterion was used to assess the discriminant validity of this investigation. The square root of AVE occurs in the diagonal cells of the Fornell–Larcker criterion table, and correlations appear below it. In absolute value words, discriminant validity exists if the top number (which is the square root of AVE) in any factor column is greater than the numbers (correlations) below it.

Cross-loadings are also useful in establishing discriminant validity [54]. The first factor in discriminant validity is determining the cross-loading values for all variables. The value of each variable and its indicators must be higher than other variables [54]. Thus, cross-loading values for all variables and their indicators are shown in Table 8.

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Table 8. Cross-Loading Values of Variables.

	Internal Brand	Corporate Culture	Corporate Identity Management (CIM)	Employee Brand Support
IBC2	**0.736**	0.587	0.591	0.326
BTD4	**0.795**	0.412	0.474	0.141
BTD5	**0.839**	0.489	0.534	0.263
BTD6	**0.849**	0.486	0.592	0.315
CC3	0.432	**0.786**	0.517	0.425
CC4	0.444	**0.748**	0.490	0.453
CC5	0.439	**0.720**	0.401	0.333
CC7	0.418	**0.764**	0.483	0.376
CC8	0.534	**0.818**	0.560	0.410
CC9	0.536	**0.765**	0.542	0.395
CC10	0.443	**0.739**	0.529	0.407
CC11	0.535	**0.803**	0.553	0.410
CC12	0.467	**0.733**	0.526	0.405
CC13	0.455	**0.701**	0.460	0.431
MVD7	0.581	0.469	**0.727**	0.273
CII4	0.532	0.483	**0.748**	0.311
VII1	0.448	0.519	**0.741**	0.375
VII2	0.564	0.551	**0.812**	0.366
VII3	0.544	0.561	**0.798**	0.324
VII4	0.456	0.458	**0.713**	0.348
EBS2	0.296	0.422	0.335	**0.788**
EBS3	0.224	0.407	0.343	**0.798**
EBS4	0.312	0.456	0.342	**0.824**
EBS5	0.246	0.432	0.391	**0.805**

The highlighted values of cross-loading for each variable are significantly higher compared to the others. Thus, the cross-loading values are accepted.

The Fornell–Larcker discriminant validity criteria follow, in which the AVE value is compared to the prior group. Each variable's AVE value must be greater than the previous variable's AVE value in the table. The table illustrates the degree of correlation between the exogenous latent variables. The covariances table is no longer necessary because data have been standardised, making covariances equivalent to correlations [54]. The Fornell–Larcker discriminant validity criteria for all variables are shown in the Table 9.

Table 9. Fornell–Larcker Discriminant Validity Criterion.

	Corporate Culture	Corporate Identity Management (CIM)	Employee Brand Support	Internal Brand
Corporate Culture	**0.758**			
Corporate Identity Management (CIM)	0.671	**0.757**		
Employee Brand Support	0.535	0.439	**0.804**	
Internal Brand	0.622	0.689	0.336	**0.806**

The AVE value for each variable is significant compared to the previous AVE value. Thus, the Fornell–Larcker discriminant validity criterion was confirmed. Next, hetero-trait–monotrait Ratio (HTMT) was confirmed to finally confirm the discriminant validity

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for all variables in this study. The value of HTMT for each variable must be lower < 0.9 for the discriminant validity to be accepted. The Table 10 shows the value of HTMT of this study.

Table 10. Heterotrait–Monotrait Ratio (HTMT).

HTMT	Corporate Culture	Corporate Identity Management (CIM)	Employee Brand Support
Corporate Culture			
Corporate Identity Management (CIM)	0.755		
Employee Brand Support	0.615	0.527	
Internal Brand	0.705	0.814	0.395

As shown in the table above, the HTMT value for each variable is well below < 0.9 as per highlighted. Thus, the discriminant validity is confirmed.

4.1.3. Assessment of Structural Model

The Figure 2 visualises the structural model PLS-SEM of this study. The mentioned figure below also illustrates the significant path coefficient (loadings) with bolded arrows.

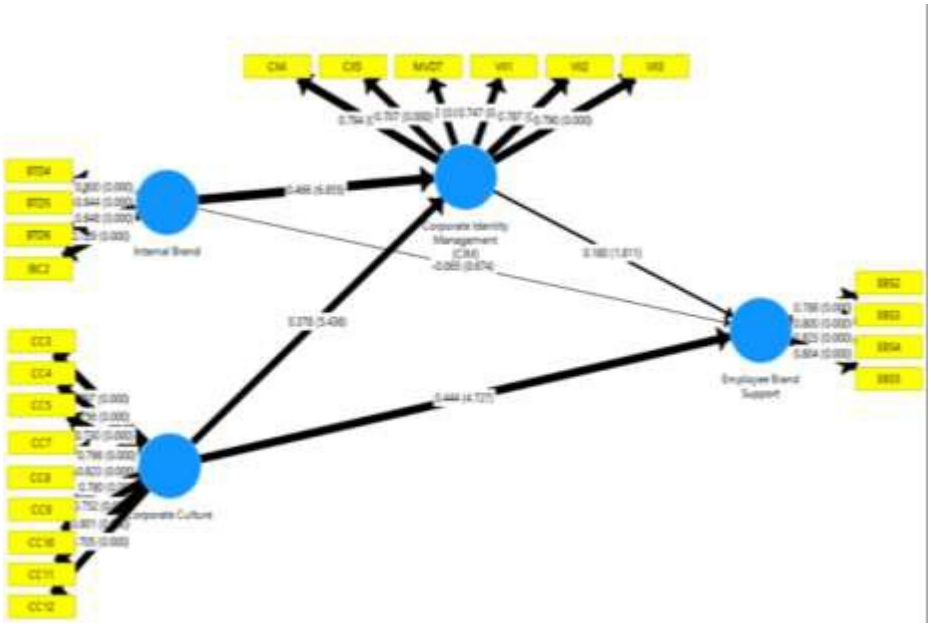

Figure2. Structural Model of the Study (source from the study).

Structural modelling of PLS-SEM in this study started with the multicollinearity assessment where inner and outer Variance Inflation Factor value (VIF) was measured.

This study used stricter indicators as proposed by Kock (2015) [54], stating that if all VIFs resulting from a full collinearity test are equal to or lower than 3.3 (≤ 3.3), the model can be considered free of common method bias. This result also indicates that common method bias (CMB) is rejected from this study as mentioned previously.

Next, the bootstrapping process is conducted to measure the path coefficient significance in this study. Structural path coefficients (loadings), illustrated in the path diagram are the path weights connecting the factors to each other. As data are standardised, path loadings vary from 0 to 1. These loadings should be significant. The path is significant if the *p*-value is lower < 0.05 and the T value is larger > 1.96 [54].

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It was predicted that CIM partially mediates the relationships between one of the proposed antecedents, which is the internal brand and the consequence in this study. The t-value and *p*-value through the bootstrapping technique in Smart PLS indicated that there was no significant indirect effect influenced by CIM as the mediation variable in this study. However, to confirm the result further, the variance accounted for (VAF) was calculated to indicate partial mediation in the proposed model. The mediation effect should be analysed further by calculating VAF if no full mediation effect occurs to identify if there is partial mediation in the proposed model [53]. Based on the result above, it was confirmed that the relationship between internal brand and employee brand support was partially mediated by CIM with a total VAF of 0.531 ($0.2 \leq 0.531 \leq 0.8$).

4.2. Second Analysis: Machine Learning Approach of Topic Modelling

The results of the developed topic modelling in this study were visualised in cloud words as the first result as shown in the Figure 3.

Figure 3. Cloud word visual of estimated topics in Halal.

The word cloud above shows the terms that were highly associated with identity as a topic of studies in halal field. The top six terms were brand, consumption, Muslim, image, branding, and model. Only the term 'brand' and 'branding' were highly relevant with the result from the first analysis of structural model assessment. The first analysis confirmed CIM as partially mediate the relationship between internal brand and employee brand support. As CIM only partially mediates the relationship, the factor therefore is not strong enough. This is consistent with the findings from the word cloud, where only two out of six top terms were found to be relevant.

The Figure 4 shows the predicted topic proportions of all articles related to Malaysia's halal food SMEs. Based on the figure below, the group of identical documents (highest green bar value in document group 2) mined listed the topic 'SMEs' together with the topics of 'certification', 'performance', 'businesses, and 'practices' in the 1091 articles related to Malaysia's halal food SMEs. Please take note that the topics 'brand' and 'identity' were not in the list.

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Figure 4. Topic proportions to documents of estimated topics in Halal SMEs.

The Figure 5 visualises the result of the predicted evolution of topic proportions in a one-decade timeline interval. All 1091 articles included in the analysis dated earliest in 1992 until the year of 2021. As a result, the figure below predicts the evolution of the identified topics up to nine decades (90 years).

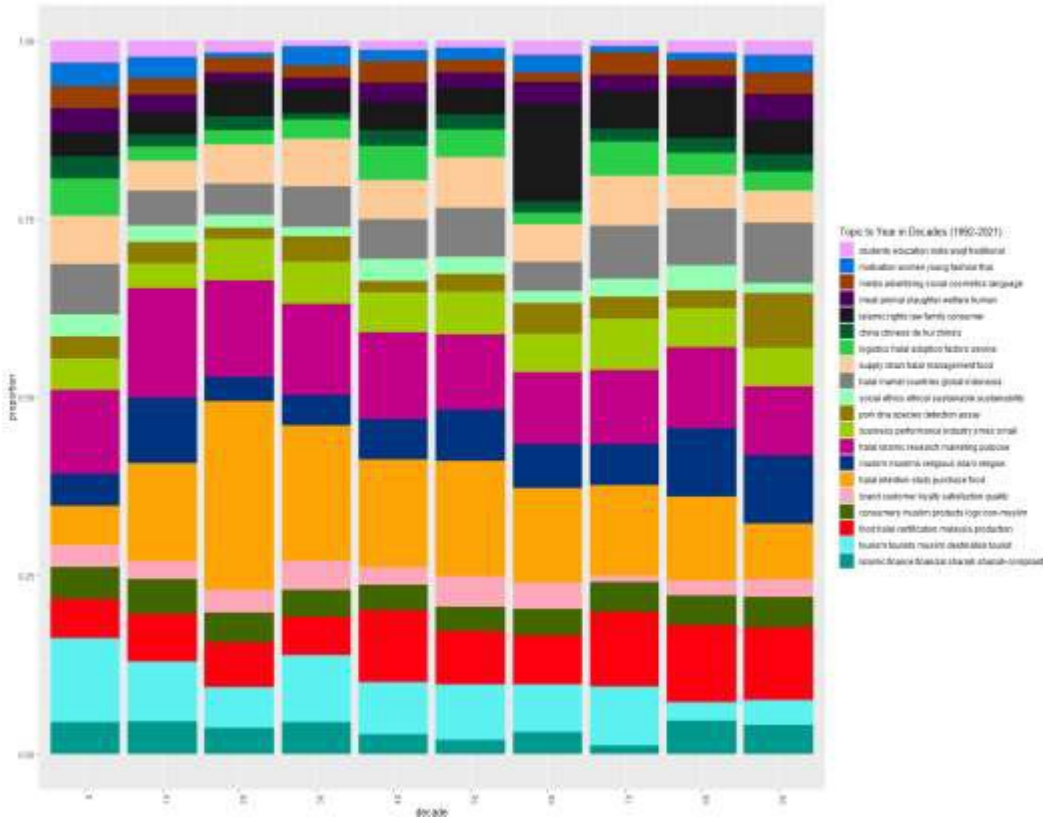

Figure 5. Predicted topic proportions evolution in decade.

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The most stable topics in the topic proportion evolution, if not the strongest, were 'Halal', 'intention', 'purchase', and 'food' (orange coloured bar). Similarly, topic proportion evolution on research involving Malaysia's context were also 'halal', 'certification', 'food', and 'production' (red coloured bar). The topic of 'identity' (which is highly associated with the topic brand) shows a weak evolution pattern (pink coloured bar) in the topic proportion evolution.

This identified topic pattern clearly points a lack of evidence in the halal related articles discussing the topics of halal brand identity in general, as well as in the Malaysian SMEs. Therefore, it was not so surprising that the result in analysis one showed only partial mediation of CIM in the relationship between one of the proposed antecedents (internal brand) and employee brand support.

5. Discussion

Based on the result of this study, it was confirmed that CIM plays a partial mediating role in the relationship between one of the proposed antecedents (internal brand) and employee brand support. Top management must notice the connection and influence of corporate identity management on employee brand support when planning for an internal brand.

In this study, all respondents reached consensus on the importance of internal branding initiatives in equipping them with extensive knowledge on halal as one of the brand positioning identities for their organisations. However, despite the importance, their expertise and knowledge on CIM and its dimensions (mission and values dissemination, consistent image implementation, and visual identity implementation) were lacking. Since CIM played a partial mediating role in this relationship, this situation caused negative feelings among the employees and them not to support the brand.

The most fundamental dimension in CIM is mission and values dissemination. The top-level management team should strategically plan the driving force for unique corporate philosophy, reflecting it in the mission, values, and goals [63-65]. Top-level management has wisdom, experience, and expertise in developing the strategic direction of the organisation which directly reflects its mission, and core values in the brand identity. The management also is responsible in planning the short- and long-term goals to sustain the brand.

A typical hierarchical structure in Malaysia's halal industry SMEs is relatively composed of basic functional units, such as human resources (HR), finance, and operation. Most halal industry SMEs, especially the micro sizes, are controlled by one leading figure in the organisation which is usually the owner, and there is no board of directors that usually comprise of experts in knowledge and experience. This encourages an autonomy management practice where decisions and strategy are not well-discussed, and therefore, creating a dilemma in their identity and deterring the organisation's marketing strategy [67].

The further challenge that emerges from this is the lack of attention given to developing and enhancing the consistent image implementation and visual identity implementation in the halal manufacturing industry, which is the most apparent problem in the halal industry. A weak direction set by the leader resulted in confusion in the organisation's brand identity, causing reluctance of the employees to adapt to the system in internal communication [20].

Based on the first finding of this study, it can be concluded that Malaysia's SMEs lack leaders with expert knowledge on halal identity, and on strategic communication management of their mission and values dissemination to the employees. This confusion on the company's identity makes the employees unable to fully understand their halal brand, nor support it.

The second finding of this study found CIM as not mediating the relationship between corporate culture and employee brand support. In other words, corporate culture directly influenced employee brand support in Malaysia's halal SMEs. The important role

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of corporate culture is confirmed here. A good corporate culture is achieved through a consistent practice of good governance in brand identity. Corporate culture is a complex phenomenon that moulds everyday organisational life, creates many success stories, and only can be achieved through a course of time [36, 48, 68]. This is a massive challenge facing Malaysia's halal SMEs.

Corporate culture is being echoed less in halal SMEs since there was a lack of adequate quality improvement in the practices [15]. The vast majority of Malaysia's halal SMEs are facing this massive adequality caused by two major factors, which are lack of financial strength to hire an experienced workforce to manage an organisation's brand identity, and misplaced enforcement power to the inarticulate governing body in managing the halal brand values. Malaysia has recently been challenged by the latest controversy involving imported frozen foods bearing a forged halal label. On December 28, 2020, Saiful Yazan Alwi, Director-General of the Malaysian Quarantine and Inspection Services Department (MAQIS), said in a local TV interview that 122,000 tonnes of frozen halal meat were legally imported into the nation between January and November of that year (Abdullah, 2020) [68]. This newest controversy involving imported meats bearing a bogus halal logo has sparked outrage among Malaysia's Muslim community, which constitutes the majority of the population.

The Muslim community in Malaysia started questioning the role of law enforcement and JAKIM was heavily criticized and been labelled incompetent. This scandal was heavily scrutinised by the international media agencies, such as The Straits Times, Arab News and Bloomberg. The image and reputation of Malaysia, which was considered as one of the forefronts in the global halal industry was shattered and lost global confidence in the Malaysian halal certification system [150]. Malaysian halal certification laws are already holistically adequate in determining the halal status of a product. However, a major flaw can be seen in the delegation of enforcement power and awareness of the responsibilities of authority agencies [68]. A lack of clarity by officials creates major confusion on halal food companies on how they should respond to this scandal, adding more scars to Malaysian halal brand values [69]. A major crisis, such as this will jeopardise the organisational image and reputation that have been built throughout decades. The desirable proper, or appropriate brands of Malaysian halal values were tainted since brand values are heavily embedded with the socially constructed system of norms, values, beliefs and definitions included in culture [48, 49, 70].

The latest controversy involving Malaysian halal brand values indicated that there is a need for a major overhaul in the delegation of power in managing and monitoring all aspects in its halal industry. As Malaysia's halal identity is heavily questioned not only by Muslim-majority locals but also by global stakeholders, an appropriate identity and corporate culture of the relevant authorised governing bodies and Malaysian halal industry SMEs deemed necessary and will decide the fate of Malaysian halal brand image and reputation. To achieve this, a good internal brand understanding to all internal members of the organisation, and a good governance in CIM must be achieved through strategic planning and consistent communication efforts [23, 24, 36].

Based on the data analysis, there was no direct relationship between IB (antecedent) and EBS (consequence). This study concluded that most respondents in this study agreed that an effective internal brand activity was mediated by CIM. However, because of the lack of infrastructure, expertise, and investment from SMEs in Malaysia's halal industry in developing and acquiring resources in managing corporate identity, CIM was unable to function optimally in Malaysian halal industry SME settings. Thus, this indicates a major weakness in Malaysia's halal SMEs in managing their brand.

CIM relies heavily on the abundance of resources, especially in financial, workforce, and expertise to develop an appealing and favourable corporate design for industry identity, hiring expertise for managing and monitoring organisational communication process, consistently instilling good governance in corporate culture resulting in nurturing commendable behaviour amongst internal members, providing state-of-the-art structure

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to support communication system, and appointing experience top-level management members in deciding the long term roadmap of the organisation [22-29]. With the current conditions and inability of most SMEs in the Malaysian halal industry, the mentioned conducive settings will not be achievable, especially due to the gargantuan challenge for SMEs to provide enough capital for investment.

In the current market scenario, CIM is heavily relying on technological adaptation in infrastructure that needs to be built by the organisation to create and maintain good communication in the organisation. This is crucial to nurture a good corporate culture in the pursuit of consistent expression on the brand image through communication efforts [22-29].

Topic modelling in this study was developed through a machine learning approach of 1091 articles' metadata in the study of the halal, across all journals available in the Scopus database dated from 1992 to 2021. The analysis was made possible with the R programming language of the machine learning utilisation in this study. The results yielded from the topic modelling analysis highlighted a more in-depth explanation on the result yielded from the PLS-SEM data analysis process. The predicted topic patterns show the lack of studies on the halal brand identity, implying less academic attention and discussion on the identity of Malaysian halal SMEs [15].

The image and reputation of Malaysia, which was considered as one of the forefronts in the global halal industry, was shattered and global confidence was lost in the Malaysian halal certification system [69].

These identified patterns clearly show a lack of studies on Muslim-based brands, products (closely related to food), consumers, and marketing. This finding was directly correlate with the study's primary finding, the hypothesis testing of the proposed research framework through PLS-SEM data analysis. The study results found holistic halal brand identity and values management in the Malaysian halal industry's SMEs are still a far-fetched idea since its current managerial structure is weak in numerous fundamental aspects. The biggest weakness can be seen starting from the very top hierarchy in the industry itself that shows scarce and unclear delegation of its portfolio in law enforcement in authority bodies.

6. Conclusions

The results yielded from this study have implications for the relationship between stakeholders in Malaysian halal industry SMEs. The results of this study present a strong prediction supported by past literature from the application of machine learning through topic modelling in developing the topic modelling.

Based on the findings, there are vast numbers of potential area of studies for future researchers. This study predicted the CIM model in mediating the antecedents' influence of the consequences. If the proposed environment model is accepted to be used as a blueprint for halal management, a follow-up study needs to be conducted to empirically prove the benefits of having a good CIM.

The contributions of this study can be divided into four parts: theoretical contribution, contribution to literature, practical contribution, and methodological contribution. The theoretical contribution of this study is through the formation of the proposed Halal Industry Environment Model. Based on the results obtained, it was found that CIM's relationship of antecedents and consequence was partially mediated by a lack of infrastructure and a sound communication system.

Therefore, the most crucial factor that needs to be focused on is the current halal management environment. The authority bodies need to be aligned since the halal brand values are affected significantly by the overlapping enforcement power and unstructured information channel. It is believed that the findings of this study are a crucial blueprint to the government and industrial players in strengthening their brand positioning and halal as the core identity of the brand in the market.

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Then, this study also contributes to the literature. The result of this study and the developed model can be a reference for future research about identity management in Malaysian halal industry SMEs. Knowledge to stakeholders and subsequent researchers is related to the construct of this study and a broader scope than that. The proposed Halal Management Environment Model derived from the PLS-SEM data analysis method predicted relationship of one of the antecedents and the consequence as partially mediated by CIM. The result creates a potential for CIM to be implemented in the halal industry SMEs. However, this can only be achieved with the total restructuring of the halal management structure from the top by aligning the authority bodies with one entity (commissioner) to oversee the whole aspect in the Malaysian halal industry and centralising the communication channel.

Regarding the practical contribution, it includes the proposed research framework and the result from the data that have been analysed quantitatively. A weak presence of CIM in mediating the antecedents to influence the brand support among employees indicated a good brand identity management for Malaysian halal industry SMEs is possible. However, with the current environment, the full benefits of CIM are far beyond the reach of the SMEs business owners due to the unclear and scarce communication channels from the authority bodies. Malaysia has already implemented rigorous halal management, particularly in its certification, but did not have a strong communication channel in disseminating the halal values and messages to the industry.

Thus, it is challenging for halal industry SMEs to acquire the knowledge and be left behind. Furthermore, a financial limitation is also affecting the SMEs to develop a good identity in their organisation. Finally, this study also contributes methodologically. This study utilised the PLS-SEM and machine learning approach in topic modelling. The first analysis aims to predict the relationship between corporate identity management, between internal brand and employee brand support (consequence,) mediated by CIM using partial-least squares-structural equation modelling (PLS-SEM), followed by the second analysis to identify topic proportion patterns using the topic modelling approach of machine learning.

As for the implications, the results yielded from this study implicate the relationship between stakeholders in Malaysian halal industry SMEs. The results of this study can produce a strong prediction with support from past literature. This study indicates that the CIM is present in the Malaysian SMEs even with the significant weaknesses in many aspects, particularly the unclear vision and halal values communicated by the authority bodies. The implication of the results highlights the importance of having one entity to centralise and align all involved stakeholders in halal management since independent channels adapted by authority bodies create confusion to SMEs business owners.

Finally, it is suggested to future researchers to replicate this study by expanding it to different antecedents, such as crisis management, employee motivational factors and leadership quality in providing brand support to the employees in Malaysian halal industry SMEs. Having these understanding, the basic infrastructures and supports from authority bodies will be sufficient for CIM to be adapted and adopted by SMEs.

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Institutional Review Board Statement: The study was conducted in accordance with the ICH-GCP Guidelines, and approved by the Ethics Committee for Research involving Human Subjects of UNIVERSITI PUTRA MALAYSIA (protocol code JKEUPM-2019-192, 22 July 2019).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are openly available in ResearchGate at [DOI: 10.20944/preprints202204. 0238.v1].

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

```
package_list <- c(
  "dplyr",
  "ggplot2",
  "igraph",
  "irr",
  "LDAvis",
  "lsa",
  "Matrix",
  "NLP",
  "openNLP",
  "openNLPdata",
  "pals",
  "png",
  "quanteda",
  "readtext",
  "reshape2",
  "rvest",
  "topicmodels",
  "tsne",
  "webdriver",
  "wordcloud",
  "wordcloud2",
  "servr",
  "readr",
  "textdata"
)
lapply(package_list, require, character.only = TRUE)
```

```
textdata <- read.csv("scopus_tm.csv", sep = ";", encoding = "UTF-8")

corpus <- corpus(textdata2"X.U.FEFF..Title.Year.Journal.Document.Topic", docnames = textdata2"
Year")

textdata

dim(textdata)

colnames(textdata)

summary(corpus)

lemma_data <- read.csv("baseform_en.tsv", encoding = "UTF-8")
```

```
stopwords_extended <- readLines("stopwords_en.txt", encoding = "UTF-8")
```

```
corpus_tokens <- corpus %>%
  tokens(remove_punct = TRUE, remove_numbers = TRUE, remove_symbols = TRUE) %>%
  tokens_tolower() %>%
  tokens_replace(lemma_data2inflected_form, lemma_data2lemma, valuetype = "fixed") %>%
  tokens_remove(pattern = stopwords_extended, padding = TRUE)
```

```
DTM <- corpus_tokens %>%
  tokens_remove("") %>%
  dfm()
```

```
dim(DTM)
```

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Figure A1. The developed codes for the pre-processing stage.

Appendix B

```
K <- 20
topicModel <- LDA(DTM, K, method="Gibbs", control=list(iter = 500, seed = 1, verbose = 25))

# have a look a some of the results (posterior distributions)
tmResult <- posterior(topicModel)
# format of the resulting object
attributes(tmResult)

# lengthOfVocab
ncol(DTM)

# get beta from results
beta <- tmResult$terms
# K distributions over ncol(DTM) terms
dim(beta)

# rows in beta sum to 1
rowSums(beta)

# size of collection
nrow(DTM)

# for every document we have a probability distribution of its contained topics
theta <- tmResult$topics

# distributions over K topics
dim(theta)

# rows in theta sum to 1
rowSums(theta)[1:20]

terms(topicModel, 10)

top10termsPerTopic <- terms(topicModel, 10)

print(top10termsPerTopic)

topicNames <- apply(top10termsPerTopic, 2, paste, collapse=" ")
```

Figure A2. Developed codes for Topic Modelling.

Appendix C

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```
# visualize topics as word cloud
topicToViz <- 10
# change for your own topic of interest
topicToViz <- grep("brand", topicNames)[1]
# Or select a topic by a term contained in its name

# select to 40 most probable terms from the topic by sorting the term-topic-probability vector
 in decreasing order
top40terms <- sort(tmResult$terms[topicToViz,], decreasing=TRUE)[1:40]

exampleIds <- c(2, 100, 200)
cat(corpus[exampleIds[1]])

cat(corpus[exampleIds[2]])

cat(corpus[exampleIds[3]])

# load libraries for visualization
N <- length(exampleIds)

# get topic proportions from example documents
topicProportionExamples <- theta[exampleIds,]
colnames(topicProportionExamples) <- topicNames
vizDataFrame <- melt(cbind(data.frame(topicProportionExamples), document = factor(1:N)), varia
ble.name = "topics", id.vars = "document")

dim(theta)

colnames(topicProportionExamples)

ggplot(data = vizDataFrame, aes(topics, value, fill = document), ylab = "proportion") +
  geom_bar(stat="identity") +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  coord_flip() +
  facet_wrap(~ document, ncol = N)

# new alpha from previous model
attr(topicModel, "alpha")

topicModel2 <- LDA(DTM, K, method="Gibbs", control=list(iter = 500, verbose = 25, seed = 1, a
lpha = 0.2))

tmResult <- posterior(topicModel2)
theta <- tmResult$topics
beta <- tmResult$terms
topicNames <- apply(terms(topicModel2, 10), 2, paste, collapse = " ")  # reset topicnames

# re-rank top topic terms for topic names
topicNames <- apply(lda::top.topic.words(beta, 5, by.score = T), 2, paste, collapse = " ")

# What are the most probable topics in the entire collection?
topicProportions <- colSums(theta) / nrow(DTM)  # mean probabilities over all paragraphs
names(topicProportions) <- topicNames     # assign the topic names we created before
sort(topicProportions, decreasing = TRUE) # show summed proportions in decreased order

countsOfPrimaryTopics <- rep(0, K)
names(countsOfPrimaryTopics) <- topicNames
for (i in 1:nrow(DTM)) {
  topicsPerDoc <- theta[i, ] # select topic distribution for document i
  # get first element position from ordered list
  primaryTopic <- order(topicsPerDoc, decreasing = TRUE)[1]
  countsOfPrimaryTopics[primaryTopic] <- countsOfPrimaryTopics[primaryTopic] + 1
}
sort(countsOfPrimaryTopics, decreasing = TRUE)

topicToFilter <- 17  # you can set this manually ...
# ... or have it selected by a term in the topic name
topicToFilter <- grep("brand", topicNames)[1]
topicThreshold <- 0.1 # minimum share of content must be attributed to the selected topic
selectedDocumentIndexes <- (theta[, topicToFilter] >= topicThreshold)
filteredCorpus <- corpus %>% corpus_subset(subset = selectedDocumentIndexes)

# show length of filtered corpus
filteredCorpus

# append decade information for aggregation
textdata_decade <- paste0(substr(textdata, 0, 3), "0")

# get mean topic proportions per decade
topic_proportion_per_decade <- aggregate(theta, by = list(decade = textdata_decade), mean)
# set topic names to aggregated columns
colnames(topic_proportion_per_decade)[2:(K+1)] <- topicNames

# reshape data frame
vizDataFrame <- melt(topic_proportion_per_decade, id.vars = "decade")

# plot topic proportions per decade as bar plot
require(pals)
ggplot(vizDataFrame, aes(x=decade, y=value, fill = variable)) +
  geom_bar(stat = "identity") + ylab("proportion") +
  scale_fill_manual(values = paste0(alphabet(20), "FF"), name = "Topic to Year in Decades
  (1992-2021)") + theme(axis.text.x = element_text(angle = 90, hjust = 1))
```

Figure A3. Developed codes for Topic Modelling visualisation.

Reference

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