The Effect of Halal Traceability System on Halal Supply Chain Performance

Nizamuddin Zainuddin[#1], Adam Mohd Saifudin[#2], Norita Deraman[*3], Azim Azuan Osman[#4]

[#]*School of Technology Management and Logistics (STML), Universiti Utara Malaysia (UUM), Sintok, Malaysia*

[*]*School of Business and Management (SBM), Universiti Utara Malaysia (UUM), Sintok, Malaysia*

[1]nizamuddin@uum.edu.my

***Abstract*— Supply chain management represents a set of interdependent organisations that work closely together to manage the flow of goods or services and information along the value-added chain of products, in order to realise end customer value at the lowest possible costs. Halal Supply Chain performance measures can be developed based on existing measures of the conventional supply chain as long as the primary objective is preserving halal integrity rather than minimising cost or maximising profit. The objective of this paper is to see the effect of halal traceability system towards halal supply chain performance using SEM techniques. *Halal* Traceability system is a system that enables the identification of products' and product ingredients' *halal* status backward and forward, along the production chain. This article focus will be on the survey method only. The instrument development was based on a literature survey. This study focuses on the population of halal certified food and beverages (F&B) manufacturers as disclose in JAKIM Halal Portal. About 254 questionnaire sets answered by the intended respondents out of 500 being distributed and no data are detected as missing. All questions are completely answered by the respondents. This study has confirmed the effect of *Halal* Traceability system on Halal Supply Chain performance. Having demonstrated the significance of the hypothesised effect with a substantial total variance explained (i.e. above 75 percent) and sufficient predictive relevance, this study provides strong empirical evidence that a high level of Halal Supply Chain performance can be achieved through the effective implementation of *Halal* Traceability system.**

***Keywords*—** *Halal Industry, Halal Supply Chain performance, Halal certification and labelling, Halal Portal*

1. Introduction

Supply chain management has emerged to become a vital operation to support business organisations in coping up with global competition [1]. It also has been recognised as an important issue which generates a substantial amount of interest among managers and researchers. Supply chain management represents a set of interdependent organisations that work closely together to manage the flow of goods or services and information along the value-added chain of products, in order to realise end customer value at the lowest possible costs [2]. It is regarded as one of the most effective ways for organizations to improve their competitive advantage [3]. The success of supply chain management depends on the successful implementation of supply chain practices.

As per the growing interest, the Halal Industry has been growing at a rapid pace due to the growth of the Muslim population worldwide as well as industry internationalisation due to tourism and migration [4]. Based on the consumption per expenditure calculation, the global halal food market size has developed progressively from USD587.2 billion in 2004 to USD 641.5 billion in 2010 [5]. There is also a growing demand for halal foods from the non-Muslim consumer segment. Global interest in the halal products especially food from non-Muslim countries such as the USA, United Kingdom, Japan, China, Brazil and Australia is expanding [6].

The objective of this paper is to see the effect of halal traceability system towards halal supply chain performance using PLS-SEM techniques. As for the hypotheses statement will be there is significant effect of halal traceability system on *Halal* Supply Chain performance.

2. Literature Review

In general, The International Organisation for Standardisation (ISO) refers traceability as the ability to verify the history, location or application of an item by means of documented recorded identification. The elements of traceability include of product, process and customer traceability [7].

On the other hand, some scholars have proposed working definitions of traceability specifically for food supply chain [7]-[8]. Wilson and Clarke [9] as well as Jack, Pardoe and Ritchie [8] define traceability in crop production as the information necessary to describe the production history of a food crop and any subsequent transformation or process the crop might undergo on its journey from the grower to the consumer's plate. Timon and O'Reilly [10] describe traceability in meat production as the ability to identify an animal, trace its movements throughout its lifetime, and subsequently trace the meat products made from it to the final consumer. Meanwhile, Zailani, et al. [11] perceive a traceability system in *Halal* Food Supply Chain as a communication tool to ensure that information related to *halal* food and products is available along the supply chain. Furthermore, Meuwissen, et al. [12] assert that a traceability system not only involves tracing activity but also tracking process. Meuwissen, et al. [12] refers tracing as the ability to trace food and food ingredients back along the production chain (i.e. from the end user to the producer and even to the suppliers of the producer) while tracking is regarded as the ability to track food and food ingredients forward along the production chain. Concisely, tracing is a backward identification procedure while tracking is a forward recognition process. Tracing enables producer to inspect product history, for instance source or contamination, while tracking allows producer to locate and withdraw (recall) products that may pose a serious risk to the health of consumers [13]. Similarly, Codex Alimentarius also consider traceability system as forward and backward tracking process by paper or electronic means [14]. Hence, based on these definitions and descriptions this study operationally defines *Halal* Traceability System as a system that enables the identification of products' and product ingredients' *halal* status backward and forward, along the production chain.

The origins of the traceability systems in today's European meat and livestock chains date back to those set up at the start of the 1950s to eradicate animal herd diseases such as bovine tuberculosis and brucellosis. These early systems included the identification and registration of cattle herds, but gradually, the registration of animal movements, herd owner, farm and farming characteristics were also added. Most of the traceability systems that are operational today used the existing systems of identification and registration as a starting point [15]. A traceability system provides a set of data that relate to both the where (location) and when (time) about the location of products and product ingredients/components along the production chain [11]. The system allows products to be uniquely identifiable at any critical point in the production and distribution processes. The identity of product flows are logged and that the information is systematically collected, processed and stored [12].

Existing literatures have discussed various topics regarding traceability system. Such topics include; purposes and benefits of traceability system [11]-[13], [15], technology adoption in traceability system [14], [16]-[17], and framework development for effective implementation of traceability system [18]-[19]. Studies in the past have specifically explained the purposes and benefits of the traceability system in food product supply chain as summarise in Table 1.0

Table 1. *Purposes and benefits of traceability system in food supply chain*

Purposes/Functions/Benefits	Authors
To increase transparency in the supply chain More transparency is likely to increase consumers' trust in food safety and enhance food safety level due to increase amount of information and improved information flow about among other (e.g. country of origin, production processes, food safety controls, animal living conditions and use of supplements etc.).	[11], [12], [15], [20], [21]
To reduce the risk of liability claims A proper traceability system is a valuable tool for companies to counterattack liability claims and to recoup claims from other participants in the supply chain.	[11], [12], [21], [22]
To improve recall efficiency. Adequate traceability system improves the quality of recalls, thereby reducing costs and enhancing the image of the supply chain.	[11], [12], [21], [22]
To enhance the control of livestock epidemics Traceability system provides insight into animal movements between farms, hence quick overview of high-risk contacts livestock epidemics such as foot-and-mouth disease can be controlled effectively.	[12], [15], [20], [21], [23]

In addition, for a traceability system to be effective, a number of requirements must be met. First, all partners within the supply chain should be

identifiable, including small producers and hobby farmers, especially to trace and control livestock epidemics [12], [23]. In regards to *Halal* Supply Chain in Malaysia, studies of Omar and Jaafar [24] and Omar, et al. [25] have highlighted several affairs that should be known and highly concerned by customers. Such affairs include farm location, source of animal feed, as well as animal welfare and safety. Foodborne pathogens in milk might occurs due to the direct contact with contaminated sources in the dairy farm environment and to the excretion from the udder of an infected animal. Animal feed from unclean or impure source like rendered animal products, animal waste, antibiotics, metals, and fats, could result in higher levels of bacteria, antibiotic-resistant bacteria, prions, arsenic, and dioxin-like compounds in animals. Meanwhile, animal welfare and safety is related to slaughtering process in the abattoirs that need to be performed in a proper way according to the *Shariah* requirements such as the slaughter man must be a Muslim, a sharp knife is used to slaughter the animal and *tasmiyyah* (i.e. mentioning the name of Allah) is recited while performing slaughtering.

Also, there should be a unique product identification system [12], [20] usually aggregated to an identification system for batches of supplies (e.g. crops, livestock, ingredients, etc.) as soon as the processing level is reached. In the case of Malaysia *Halal* Supply Chain, Anir, et al. [17] and Mohd Bahrudin, et al. [14] promote the use of RFID to facilitate *halal* product traceability system. On the other hand, Mohamad, et al. [16] have designed a GPS-based system to trace, track and monitor *halal* products movement in order to reduce the possibility of cross contamination with non-*halal* or impurity substances that might occur during the transportation process.

Furthermore, an effective traceability system requires a credible and complete (in the sense of what has been agreed on) information transfer among all stakeholders in the supply chain. In the context of Malaysia *Halal* Supply Chain, Melatu Samsi, et al. [18] have emphasised on the role of government, NGOs, trade association, *halal* manufacturing firms, *halal* suppliers, employees of *halal* business, as well as *halal* product consumers to coordinate and collaborate in achieving *halal* status at every level of the supply chain. Further, Melatu Samsi, et al. [26] suggest Malaysia *Halal* Supply Chain stakeholders to adopt Knowledge Management as a commanding tool for an effective traceability system for Malaysia *halal* food industry in a subsequent study. In the same vein, Dabbene, et al. [27] propose another management approach to improve efficiency and performance of traceability system in food supply chain. Developing traceability-oriented management policies can be an important element in the more general control scheme of production and distribution. Dabbene, et al. [27] believe that by orienting and coordinating traceability system with other tools like HACCP, production planning and logistics may indeed lead to significant improvements on the performance of the whole supply chain. In sum, existing literatures support the notion that *Halal* Traceability System is one of the critical practices for preserving *halal* integrity in the whole supply chain.

Furthermore, the performance of a supply chain can be characterised by its ability to remain market-sensitive without losing the integration through the chain. In particular, market-sensitive represents delivery speed, new product introduction and customer responsiveness while integration addresses organisation's collaboration with partners and ability to deal with internal issues (i.e. demand and supply) [28]. However, there is a slight but substantial difference between conventional and *Halal* Supply Chain. Conventional supply chain is simply aimed to maximise profit, mainly cost-related and not inclusive. It is lacking of the measurement of the credence aspects of *halal* product, the Islamic value factor (i.e. *Shariah*-compliant) and the robustness requirements [29]. In contrast, *Halal* Supply Chain primary objective is to ensure *halal* integrity of *halal* product for end customers [14]. Therefore, a more appropriate definition should be coined to describe *Halal* Supply Chain performance. For the purpose of this study, *Halal* Supply Chain performance is defined as the ability of supply chain operations (e.g. activities, practices, procedures, etc.) to remain market-sensitive without compromising the *halal* integrity through the chain.

In other study by Fugate, et al. [30], the performance of supply chain can be measured by effectiveness, efficiency and differential. The effectiveness is the ratio between the actual outputs

and expected outputs. From logistics view, effectiveness is defined as the extent to which the logistics function's goals are accomplished. Besides effectiveness, *Halal* Supply Chain should also be efficient. Efficiency is the measurement of how well the resources expended are utilized [30]. Agreed by Tieman [31] efficiency can be measured by the supply chain management cost. As *halal* will require possible dedicated logistics infrastructure, so a suitable indicator could be the utilization of *halal* storage facilities and *halal* transport or containers. The utilisation of *halal* storage facilities is capacity spent on *halal* storage as percentage of the Halal capacity, while the latter refers to the capacity spent on *halal* transport or containers as percentage of total capacity [31].

Other than that, Tieman [31] added robustness as one of the measurement of performance in *Halal* Supply Chain. According to his study, *Halal* Supply Chain should be robust in order to better protect the Halal Products along the supply chain under various circumstance. Therefore, the robustness of *Halal* Supply Chain should have resulted in few *halal* rejects. *Halal* rejects are referring to the number of reject by company in the supply chain through damage or contamination. Besides that, a *Halal* Supply Chain should have sufficient access to dedicated *halal* warehouses and *halal* transport when required. *Halal* storage availability refers to the number of on time *halal* storage services as percentage of total required Halal storage services. Whereas, *halal* transport/containers availability is the number of on time *halal* transport/container services as percentage of the total required Halal transport/containers services [31].

In summary, *Halal* Supply Chain performance need to be effective (addressing process quality as well as minimize waste), efficient (high utilization of dedicated assets) and robust (little Halal rejects and high availability of Halal assets). An optimal *Halal* Supply Chain should have a strategic fit between corporate strategy, *Halal* Policy, supply chain objectives and the logistics parameters as well as an alignment between product characteristics and market requirement and the logistics parameter [32].

3. Methodology

The research framework is *Halal* Traceability System (TraceSys), as the determinant or predictor of *Halal* Supply Chain Performance (SCPerf). The whole study employs mixed-methods approach, through a combination of survey and case study strategies. As for this article focus will be on the survey method only. The instrument development (i.e. self-administered questionnaire) were based on literature survey. Systematically, the questionnaire consists of four major sections to fulfil the following purposes; i) Section A: to obtain respondents' background information, ii) Section B : to obtain respondents' perceptions on the extent of *Halal* Traceability System and iii) Section F: to obtain information on the *Halal* Supply Chain performance level of the respondents' respective organisations. This study focuses on the population of *halal* certified food and beverages (F&B) manufacturers as disclose in JAKIM Halal Portal. Through this portal, a directory of Halal certified ventures known as JAKIM's e-Halal directory is accessed and specified as the sampling frame for this study. G*power was used to calculate minimum required sample size for this study. The total sample size is 85 which indicated the minimum required sample size for this study is 85 organisations. However, due to the expectation of a low response rate (at around 12%) which is regarded common among Malaysian manufacturers [33], [34], [35] researchers decided to employ over sampling. The respondent organisations were first telephoned to double-check their qualifications as the respondents and confirm their official address. Then, self-administered questionnaire forms were distributed by postal mails as well as e-mails according to respondents' choice and convenience. The mail method was employed for this study because of its advantage in covering a wide geographical area with less time and cost [36]. Data collection using personally administered approach was conducted during three festivals that were held in Kedah, Penang and Kuala Lumpur. These events were selected to conduct the data collection process since the organisers clearly stated that, only *Halal* certified companies entitled to join these events. There were three events that gathered *Halal* manufacturers and *Halal* industry players at the same place. The events were;

i. Penang International *Halal* Expo (PIHEC). Organised by Penang state government

under its *Halal* facilitation agency in Penang, annually held early of the year (January or February) with approximately two hundred participants either local of international.

ii. Malaysian International *Halal* festival (MIHAS). Hosted and organised by Ministry of International Trade & Industry (MITI) and Malaysia External Trade Development Corporation (MATRADE) in Kuala Lumpur, annually held on April, with 400-500 participants every year either local or international *Halal* companies.

iii. *Halal* Festival (Halfest). An expo Hosted by HDC, with Majlis Amanah Rakyat (MARA) as co-organiser with special cooperation with JAKIM in Sungai Petani, Kedah aimed to stimulate local *Halal* industry player before they go abroad. Halfest is the largest *Halal* expo in Malaysia with a nearly 600 exhibitors every year where majority of them are local manufacturers.

Structural Equation Modelling (SEM) technique was used to analyse the data. SEM is recognised as a second-generation technique, which allows the simultaneous modelling of relationship among multiple variables [37]. SEM combines measurement and structural model in the same analysis. Thus SEM enables researchers to assess the set of factor analyses and multiple regressions simultaneously [37],[38],[39]. This study used PLS-SEM over CB-SEM when researchers seek several advantages and flexibilities such as ability to analyse; i) model with more complexity, ii) data that is not normally distributed, and iii) large property of consistency.

4. Analysis and Findings

Out of the 500 sets of questionnaire distributed, 280 respondents replied, giving a response rate of 56%. However, out of the 280 questionnaires received, only 254 are answered by the intended respondents. Out of the 254 questionnaire sets answered by the intended respondents, no data are detected as missing. All questions are completely answered by the respondents.

Table 2. Respondents' background

Respondents Background		Frequency	Percentage (%)
Position in the organisation	Owner/CEO/MD	90	37
	Manager/Executive	129	52
	Supervisor	27	11
Working Experience	Less than 5 years	39	16
	5 to 9 years	156	63
	10 years and more	51	21

Firstly, data normality is checked using WebPower [40], following recommendation of recent literatures [41], [42]. This web application provides both univariate and Mardia's multivariate skewness and kurtosis values and can be accessed at https://webpower.psychstat.org. Thus, Table 3. exhibits the results of data normality test.

Table 3. Data normality results

Data Distribution	Skewness		Kurtosis	
	Statistics	z-score	Statistics	z-score
Univariate	-0.798	-5.224	0.163	0.535
Multivariate	11.689	94.836	52.422	16.594

According to Kline [43] that data is considered to be normally distributed if it has the z-score values between -3 to +3 for Skewness and -7 to +7 for Kurtosis. Thus, the result in Table 4.2 indicates that z-scores for skewness and kurtosis test at univariate level are outside of normally distributed data range. Since the distribution of data is non-normal, non-parametric test will be used in the subsequent data analysis.

A non-parametric analysis of variance (ANOVA) called Kruskal-Wallis H test, is used to check the response bias that might existed due to the use of multiple approaches in distributing research instrument. The same statistical test has been performed in a previous study of the same context [44]. Kruskal-Wallis H test's result is presented in Table 4.

Table Error! No text of specified style in document..Kruskal-Wallis results

Survey Mode	n	Mean Rank	*p*-value
Postal	70	129.53	0.172
Personal	112	101.87	
E-mail	64	134.77	
Total	246		

Kruskal-Wallis H tests reveal that there is no statistically significant difference in all constructs between the different distribution approaches, at $p = 0.172 > 0.05$, with mean rank 129.53 for postal mail, 101.87 for personally administered, and 134.77 for e-mail. Therefore, this data is free from response bias.

Measurement model is an element of a path model that contains the indicators and their relationships with the constructs. It is also called the outer model in PLS-SEM [45]. In this study, measurement model analysis is performed using PLS-SEM algorithm function in SmartPLS 3.2.7 software [46] to assess reliability and validity of the constructs in the Islamic Supply Chain model. Measurement model analysis includes the assessment of; i) composite reliability (ρ_c) to indicate internal consistency, ii) average variance extracted (AVE) to specify convergent validity (see Table 5) and Hetereotrait-Monotrait (HTMT) ratio to justify discriminant validity (see Table 6).

Table 5. Results of convergent validity and composite reliability

Constructs	Items	Loadings	ρ_c	AVE
Halal Supply Chain Performance (SCPerf)	SCP01	0.748	0.942	0.699
	SCP02	0.778		
	SCP03	0.888		
	SCP04	0.890		
	SCP05	0.885		
	SCP06	0.851		
	SCP06	0.800		
Halal Traceability System (TraceSys)	TTS01	0.771	0.887	0.567
	TTS02	0.780		
	TTS03	0.805		
	TTS04	0.766		
	TTS05	0.679		
	TTS06	0.712		

The results in Table 5.0 shows that this construct has passed the internal consistency reliability and convergent validity tests with $\rho_c = 0.887$ and AVE = 0.568 [37], [47] Although outer loadings of items TTS05 is below the benchmarking value of 0.708, the value is still acceptable since this construct have achieved adequate convergent validity [48] .

Table 6. Results of discriminant validity (HTMT ratio)

Constructs	SCPerf	TraceSys
SCPerf		
TraceSys	0.824	

Table 6 shows the discriminant validity result between SCPerf and TraceSys based on HTMT ratio. HTMT is the mean of all correlations of indicators across constructs measuring different constructs relative to the mean of the average correlations of indicators measuring the same construct [49]. HTMT value greater than 0.85 indicate the problem of discriminant validity [43]. From the result, it is confirmed that SCPerf and TraceSys have no discriminant validity issue.

Further, structural model analysis is performed to determine the effect of *Halal* Traceability System towards *Halal* Supply Chain Performance (see Figure 1). Bootstrapping procedures with 5000 resamples [38], [45] in SmartPLS 3.2.7 software [46] has been employed for this purpose.

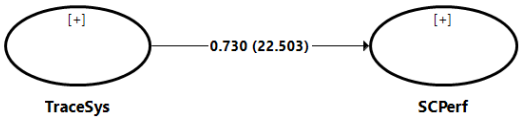

Figure 1. Structural Model
Note. Values on the arrow indicate path coefficient and t-value (inside bracket).

Table 7. Results of structural model analysis

β	*t-value*	*p-value*	f^2	R^2
0.730	22.503	0.001	1.196	0.543

Note. One-tailed test. *β = path coefficient, UL = upper limit, LL = lower limit*

The results in Table 7. conclude that TraceSys positively influenced SCPerf at $\beta = 0.730$, $t = 22.503$, $p < 0.01$, $f^2 = 1.196$, explaining 54.3% ($R^2 = 0.543$) of the variance in SCPerf. These results support the hypothesised relationship of this study.

R^2 value interprets the proportion of endogenous construct that is explained by exogenous construct with values of 0.75, 0.50, and 0.25 are regarded as substantial, moderate, and weak respectively [45].

Based on Table 7, it seems Halal Supply Chain Performance (SCPerf) have moderate level of variance explained (R^2 = 0.543) and is well-predicted by Halal Supply Chain practice that is Halal Traceability System.

In addition, the effect sizes (f^2) is computed to evaluate whether TraceSys has a substantive impact on the SCPerf. As recommend by Hair, et al. [38] Jacob Cohen's guideline is used to determine the magnitudes of the effect size. The magnitudes are 0.02, 0.15, and 0.35, representing small, medium, and large effects respectively [50]. Table 7 depicts that the effect of TraceSys on SCPerf is large (f^2 = 1.196).

5. Conclusion

Since majority of existing literatures are conceptual studies, there is no previous studies to directly support the hypothesis. Based on the empirical studies, *Halal* Traceability System were thoroughly review to justify its importance in preserving *halal* integrity and its effect to determine *Halal* Supply Chain performance. Thus the hypothesis is in line with views from studies such as Anir, et al. [17], Zailani, et al. [11], Melatu Samsi, et al. [18], Mohd Bahrudin, et al. [14], Shafii and Wan Mohamed Nor [51], Ab Talib, et al. [13], Abd Rahman, et al. [21]. This study provides strong empirical evidence that a high level of *Halal* Supply Chain performance can be achieved through the effective implementation of *Halal* Traceability System.

Acknowledgement

This study was supported by the Transdisciplinary Research Grant Scheme (TRGS) under the Ministry Of High Education, Malaysia (UUM/SO Code: 13169).

References

[1] K. Burgess, P. J. Singh, and R. Koroglu, "Supply chain management: A structured literature review and implications for future research," *International Journal of Operations & Production Management,* vol. 26, pp. 703-729, 2006.

[2] H. Folkerts and H. Koehorst, "Challenges in international food supply chains: Vertical co-ordination in the European agribusiness and food industries," *British Food Journal,* vol. 100, pp. 385-388, 1998.

[3] V. P. K. Sundram, A. R. Ibrahim, and V. Chandran Govindaraju, "Supply chain management practices in the electronics industry in Malaysia: Consequences for supply chain performance," *Benchmarking: An International Journal,* vol. 18, pp. 834-855, 2011.

[4] S. Z. Syed Marzuki, C. M. Hall, and P. W. Ballantine, "Restaurant manager and halal certification in Malaysia," *Journal of Foodservice Business Research,* vol. 15, pp. 195-214, 2012.

[5] I. Sungkar and D. Hashim, "The global halal food market and updates on global halal standards," in *Presenting atThe World BankFirst EAP Regional Agribusiness Trade and Investment Conference "Agro-enterprise Without Borders"* Singapore, 2009, pp. 30-31.

[6] W. M. Wan Omar, "Developing a model for Halal Food Supply Chain implementation," Doctor of Philosophy, School of Business IT and Logistics, RMIT University, Melbourne, Australia, 2017.

[7] JAKIM, "Guidelines for Halal Assurance Management System of Malaysia halal certification," in *Terms and definitions*, ed. Putrajaya, Malaysia: Jabatan Kemajuan Islam Malaysia (JAKIM), 2011.

[8] D. Jack, T. Pardoe, and C. Ritchie, "Scottish Quality Cereals and Coastal Grains-combinable crop assurance in action," *Supply Chain Management: An International Journal,* vol. 3, pp. 134-138, 1998.

[9] T. Wilson and W. Clarke, "Food safety and traceability in the agricultural supply chain: using the Internet to deliver traceability," *Supply Chain Management: An International Journal,* vol. 3, pp. 127-133, 1998.

[10] D. Timon and S. O'Reilly, "An evaluation of traceability systems along the Irish beef chain," *Long-term prospects for the beef industry, INRA, Ivry-sur-Seine,* pp. 219-225, 1998.

[11] S. Zailani, Z. Arrifin, N. Abd Wahid, R. Othman, and Y. Fernando, "Halal traceability and halal tracking systems in strengthening halal food supply chain for food industry in Malaysia (A review)," *Journal of food Technology,* vol. 8, pp. 74-81, 2010.

[12] M. P. Meuwissen, A. G. Velthuis, H. Hogeveen, and R. B. Huirne, "Traceability and certification in meat supply chains," *Journal of Agribusiness,* vol. 21, pp. 167-182, 2003.

[13] M. S. Ab Talib, S. S. Md Sawari, A. B. Abdul Hamid, and A. C. Thoo, "Emerging halal food market: An Institutional Theory of halal certificate implementation," *Management Research Review,* vol. 39, pp. 987-997, 2016.

[14] S. S. Mohd Bahrudin, M. I. Illyas, and M. I. Desa, "Tracking and tracing technology for halal product integrity over the supply chain," in *Electrical Engineering and Informatics (ICEEI), 2011 International Conference on*, Bandung, Indonesia, 2011, pp. 1-7.

[15] X. Gellynck and W. Verbeke, "Consumer perception of traceability in the meat chain," *Agrarwirtschaft,* vol. 50, pp. 368-373, 2001.

[16] M. A. Mohamad, S. Mansor, N. Ahmad, W. A. Wan Adnan, and I. Muhammad Wali, "The reliability of halal product transportation using GPS tracking system," *Journal of Theoretical & Applied Information Technology,* vol. 90, 2016.

[17] N. A. Anir, M. N. Mohd Hairul Nizam, and M. Azmi, "The users perceptions and opportunities in Malaysia in introducing RFID system for Halal food tracking," *WSEAS Transactions on information science and applications,* vol. 5, pp. 843-852, 2008.

[18] S. Z. Melatu Samsi, R. Tasnim, and O. Ibrahim, "Stakeholders' role for an efficient traceability system in halal industry supply chain," in *Annual International Conference on Enterprise Resource Planning and Supply Chain Management (ERP-SCM 2011)*, 2011, pp. 14-15.

[19] D. Poniman, S. Purchase, and J. Sneddon, "Traceability systems in the Western Australia halal food supply chain," *Asia Pacific Journal of Marketing and Logistics,* vol. 27, pp. 324-348, 2015.

[20] J. McKean, "The importance of traceability for public health and consumer protection," *Revue scientifique et technique (International Office of Epizootics),* vol. 20, pp. 363-371, 2001.

[21] A. Abd Rahman, H. B. Singhry, M. H. Hanafiah, and M. Abdul, "Influence of perceived benefits and traceability system on the readiness for Halal Assurance System implementation among food manufacturers," *Food Control,* vol. 73, pp. 1318-1326, 2017.

[22] R. G. Pettitt, "Traceability in the food animal industry and supermarket chains," *Revue scientifique et technique (International Office of Epizootics),* vol. 20, pp. 584-597, 2001.

[23] W. Disney, J. Green, K. Forsythe, J. Wiemers, and S. Weber, "Benefit-cost analysis of animal identification for disease prevention and control," *Revue scientifique et technique (International Office of Epizootics),* vol. 20, pp. 385-405, 2001.

[24] E. N. Omar and H. S. Jaafar, "Halal supply chain in the food industry - A conceptual model," in *2011 IEEE Symposium on Business, Engineering and Industrial Applications (ISBEIA)*, Langkawi, Malaysia, 2011, pp. 384-389.

[25] E. N. Omar, H. S. Jaafar, and M. R. Osman, "Assessing halalan-toyyiban food supply chain in the poultry industry," in *International Halal Conference 2012 (INHAC)*, Kuala Lumpur, Malaysia, 2012, pp. 000-000.

[26] S. Z. Melatu Samsi, O. Ibrahim, and R. Tasnim, "Review on knowledge management as a tool for effective traceability system in halal food industry supply chain," *Journal of Research And Innovation In Information Systems,* vol. 1, pp. 1.78-85, 2012.

[27] F. Dabbene, P. Gay, and C. Tortia, "Traceability issues in food supply chain management: A review," *Biosystems engineering,* vol. 120, pp. 65-80, 2014.

[28] A. Agarwal and R. Shankar, "Analyzing alternatives for improvement in supply chain performance," *Work study,* vol. 51, pp. 32-37, 2002.

[29] M. Tieman, J. G. van der Vorst, and M. Che Ghazali, "Principles in halal supply chain management," *Journal of Islamic Marketing,* vol. 3, pp. 217-243, 2012.

[30] B. S. Fugate, J. T. Mentzer, and T. P. Stank, "Logistics performance: Efficiency, effectiveness, and differentiation," *Journal of business logistics,* vol. 31, pp. 43-62, 2010.

[31] M. Tieman, "The application of Halal in supply chain management: In-depth interviews," *Journal of Islamic Marketing,* vol. 2, pp. 186-195, 2011.

[32] Z. Abdul Majid, N. H. Kamarulzaman, and R. Abdul Rashid, "Developing halal food supply chain integrity model in logistics industry: A conceptual review," in *Malaysia International Halal Research & Education Conferences (MIHREC 2014): Innovation for a Sustainable Halal Industry*, Serdang, Malaysia, 2014, pp. 114-122.

[33] Y. C. Wong, K. Y. Wong, and A. Ali, "A Study on Lean Manufacturing implementation in the Malaysian electrical and electronics industry," *European Journal of Scientific Research,* vol. Vol.38, pp. 521-535, 2009.

[34] R. Jusoh, D. N. Ibrahim, and Y. Zainuddin, "The performance consequence of multiple performance measures usage: Evidence from the Malaysian manufacturers," *International Journal of Productivity and Performance Management,* vol. 57, pp. 119+-136, 2008.

[35] R. Mohamed Ismail, "Mediation impact of manufacturing strategies on external environmental factors and manufacturing performance," Doctor of Philosophy, Othman Yeop Abdullah Graduate School of Business, Universiti Utara Malaysia, Kedah, Malaysia, 2014.

[36] U. Sekaran, *Research methods for business: A skill building approach*. New York: John Wiley & Sons, 2003.
[37] D. Gefen, D. Straub, and M.-C. Boudreau, "Structural equation modeling and regression: Guidelines for research practice," *Communications of the association for information systems,* vol. 4, p. 7, 2000.
[38] J. F. Hair, G. T. M. Hult, C. M. Ringle, and M. Sarstedt, *A primer on partial least squares structural equation modeling (PLS-SEM)*, 1st ed. Thousand Oaks, CA: SAGE Publications Inc, 2014.
[39] T. Ramayah, J. Cheah, F. Chuah, H. Ting, and M. A. Memon, *Partial Least Squares Structural Equation Modelling(PLS-SEM) using SmartPLS 3.0: An updated practical guide to statistical analysis*, 2nd ed. Kuala Lumpur, Malaysia: Pearson Malaysia Sdn. Bhd., 2018.
[40] Z. Zhang and K.-H. Yuan. (2018, January 8th). *Practical Statistical Power Analysis Using Webpower and R (Eds)*. Available: https://webpower.psychstat.org
[41] M. K. Cain, Z. Zhang, and K.-H. Yuan, "Univariate and multivariate skewness and kurtosis for measuring nonnormality: Prevalence, influence and estimation," *Behavior research methods,* vol. 49, pp. 1716-1735, 2017.
[42] T. Ramayah, J. Yeap, N. H. Ahmad, H. A. Halim, and S. A. Rahman, "Testing a confirmatory model of facebook usage in smartpls using consistent PLS," *International Journal of Business and Innovation,* vol. 3, pp. 1-14, 2017.
[43] R. B. Kline, *Principles and practice of structural equation modeling*: Guilford publications, 2011.
[44] A. H. Ngah, "Barriers and enablers to the adoption of Halal Transportation and Halal Warehousing services among Halal Manufacturers in Malaysia," Doctor of Philosophy (Technology Management), Faculty of Industrial Management, Universiti Malaysia Pahang (UMP), Pahang, Malaysia, 2016.
[45] J. F. Hair, G. T. M. Hult, C. M. Ringle, and M. Sarstedt, *A primer on partial least squares structural equation modeling (PLS-SEM)*, 2nd ed. Thousand Oaks, CA: SAGE Publications Inc, 2017.
[46] C. M. Ringle, S. Wende, and J.-M. Becker. (2015, Dec 1st). *SmartPLS 3*. Available: http://www.smartpls.com
[47] C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing research,* vol. 18, pp. 39-50, Feb 1981 1981.
[48] B. M. Byrne, *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Abingdon, UK: Routledge, 2016.
[49] J. Henseler, C. M. Ringle, and M. Sarstedt, "A new criterion for assessing discriminant validity in variance-based structural equation modeling," *Journal of the Academy of Marketing Science,* vol. 43, pp. 115-135, 2015.
[50] J. Cohen, *Statistical power analysis for the behavioral sciences* Hillsdale, New Jersey: Lawrence Earlbaum Associates, 1988.
[51] Z. Shafii and W. S. K. Wan Mohamed Nor, "Halal traceability framework for halal food production," *World Appl Sci J,* vol. 17, pp. 1-5, 2012.